Groupe INTRA

GIE : EDF - CEA - AREVA

Robots for indoor intervention

EROS - EOLE

General Description

Groupe INTRA has two types of indoor robots : **EROS** (**E**ngine **R**obot for **O**bservation and **S**urveillance) and **EOLE** (**E**ngine robot for **O**bservation and **L**ocalisation in the **E**nvironment).

Designed with caterpillars (EROS with two bodies and EOLE with a central body and two flippers) and remotely controlled, they can go up or down stairs or other obstacles routinely found in nuclear sites such as steps, ditches, insulated pipes...

They are equipped with an electrical manipulating arm fitted with grippers to perform simple mechanical tasks.

They are energy autonomous but, to ensure safe and reliable work in buildings impermeable to radio signals, are remotely controlled via a coaxial cable gradually unwound during progress through the premises.

Description - Missions

Missions

Both type of robots are remotely operated machines for indoor reconnaissance and light intervention when the radiological environment becomes hazardous to man. Designed to progress in industrial premises, they can climb obstacles, open doors and go up and down stairs. Their onboard lighting system allows operations in the dark.

During the reconnaissance phase, they gather and feedback information

- Videos of pumps, valves, electrical panels and readings,
- status of gauges, dials, screens, lamps and portholes...
- Temperature measurements, sound checks, dose rate...

During the intervention phase, they can perform simple operations within their design limits :

- Open and close unlocked doors with or without closing mechanism,
- Open and close electrically operated valves (push-button operation) or manually operated valves,
- Manœuvre electrical switches, contacts...,
- Pick up debris or collect samples,
- Monitor the radiological environment with suitable probes (radiameter, ...),
- Operate custom made tools (grinder, drill...),
- Assist other remotely controlled machines by providing additional lighting, vision or manipulation capability.

The presence, next to the team of robots' pilots, of a point of contact with good knowledge of the premises and their operation, is a significant contributor to missions' success.

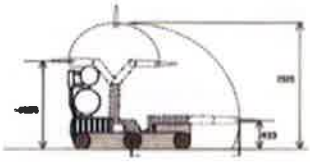
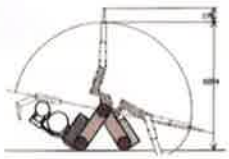
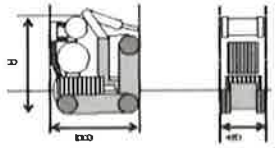
Indoor robots simulator : in operation since 2015, he provides a training environment of high fidelity with respect to Groupe INTRA's mock-up facility while sparing the indoor robots from damage and expanding their lifetime. The control station is fully identical to the one in operation and the trainer can simulate any type of glitches or breakdowns in real time and evaluate pilot's reactions..

View of simulator steering and control panels.

Robots for indoor intervention

EROS - EOLE

Characteristics

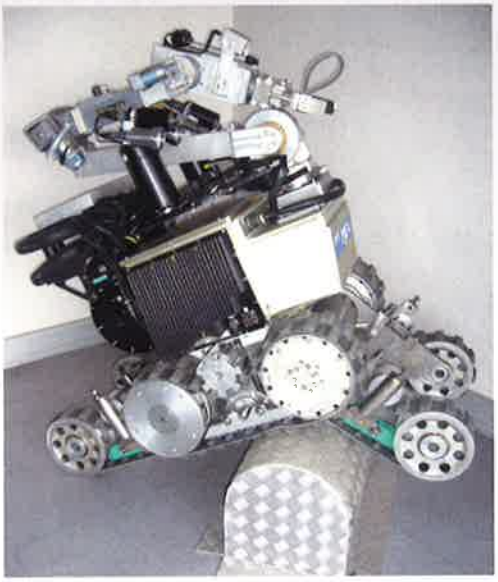

Control Stations

There are two types of control stations available depending the nature and location of the mission :

- An autonomous station made of a main electronics rack and three LCD fold-in screens. This easy to transport unit can be positioned inside a building as closely as possible to the area where the robots will progress.

- A specially equipped light utility vehicle when access inside the building is not possible and the robots must be operated from the outside..

Note : Groupe INTRA's two control station vehicles are multipurpose and can be used either for indoor or outdoor robots (ERASE type) in their 3rd generation (digital transmission) version. They cannot be used in contaminated areas.




External Interface

Real time videos from the robots can be sent to the Crisis/Emergency Management Centre for monitoring the mission progress via Groupe INTRA's Command Centre and its satellite link.
Detailed characteristics of indoor robots are shown in the table below :

EOLE

			EROS	EOLE
Dimensions	Number of Machines		2	3
	Length	(m)	0.92/1.50	1.00/1.60
	Width	(m)	0.45	0.72
	Height	(m)	1.02	1.13
	Weight	(kg)	330	376
Platform	Energy		Lithium-Ion Batteries	Lithium-Ion Batteries
	Run Time (acc. to task)	(h)	4 to 7	6 to 8
	Max Speed	m/sec	0.3	0.4
	Max Distance	(m)	< 350	< 350
	Number of Cameras		3	3
Handling Arm	Type		Romain 50	REMOTEC
	No. Degrees of Slack	(°)	7	6
	Horizontal Distance	(m)	1.25	1.70
	Vertical Distance	(m)	2.22	2.85
	Max Usable Load	(N)	50	160
Conditions of Use	Maximum Slope	(°)	< 42	< 45
	Obstacle Height	(m)	0.4	0.4
	Ditch Width	(m)	0.6	0.6
	Maximum Dose	(Gγ)	10000	10000
	Maximal Dose Rate	(Gγ/h)	70	70
Misc.	Wheel Mounting		no	yes

EOLE is based on indoor reconnaissance robot ERII (base REMOTEC ANDROS V body) modified to Groupe INTRA specifications.
EROS is the end product of developments made on CEA's CENTAURE robots.

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Robots for outdoor intervention

ERASE

General Description

ERASE (**E**xterior **R**econnaissance, **A**ssistance & **S**urveillance **E**ngine), based on tracked industrial snow-groomers to travel over difficult terrain, is a robot for outdoor day or night operations equipped with all features necessary for remote control (video cameras, lighting, GPS, radio transmitter, etc).

They are also fitted with a gammacamera dedicated to radioactivity measurement and punctual source localisation. This equipment can be completed with sensors or specific accessories suited to the type of operation.

The machines are furnished with a remotely controlled hydraulic robotic arm for handling heavy loads.

They are fully energy autonomous (a diesel motor driving an hydraulic system and a power generator) and are controlled by radio.

Description - Missions

Missions

ERASE is used outside buildings whenever the radiological conditions become hazardous to man.
It can be controlled to distances up to 2 miles (3km) or more, depending on terrain's topography, allowing pilots to operate from within safe zones.

ERASE can :

- Monitor gamma radiation levels on the ground and close to buildings,
- Search for and locate punctual radioactive sources,
- Conduct tele-visual reconnaissance operations,
- Pick up debris and samples for analysis,
- Set up safety signalisation for dangerous zones,
- Carry out worksite surveillance and assist other machines in operation.

ERASE may also be used as a towing vehicule for the «EMOI» trailer (EMOI is a relay system for indoor robots), taking an indoor robot close to a building, then acting as a transmission relay between the robot and the control station.

ERASE and EMOI trailer

Robots for outdoor intervention

ERASE

Characteristics

Control Station

The control station consists of a specially outfitted, energy-autonomous vehicle, containing all equipment necessary for remote control operations (radio-relay, calculator, screens, control workstation...) plus a light trailer for the antenna support mast. It may not be used within a contaminated zone.

Outdoor equipment suite: antennas mast trailer, control station and ERASE

Hydraulic arm

External Interface

In case of accident, the Crisis/Emergency Management Centre can receive videos from the operation in progress via Groupe INTRA's Command Centre and a satellite link.

Detailed specifications of outdoor robots machines are presented in the following table :

			ERASE
Dimensions	Number of Vehicles		2
	Length	(m)	4.80
	Width	(m)	2.75
	Height	(m)	3.62
	Weight	(kg)	6180
Platform			Kassbohrer Flexmobil w/ rubber cat tracks
	Mechanical Base		
	Energy		Diesel Motor Deutz 150 hp, air-cooled
	Run Time (acc. to mission)	(h)	10 hrs
	Max Speed	m/sec	4.2 (10 mi/hr)
	Max Distance Range	(km)	3
	Number of Cameras		5
Handling Arm	Type		Hydraulic
	No. degrees of Slack	(°)	5
	Horizontal Distance	(m)	2.85
	Vertical Distance	(m)	
	Payload	(N)	2900
Conditions of Use	Maximum Slope	(°)	< 30
	Obstacle Height	(m)	
	Ditch Width	(m)	
	Temperature Range	°C	-20 < à < +45
	Humidity		80% at +30 °C
	Maximum Dose	(Gγ)	1000
	Maximal Dose Rate	(Gγ/h)	1

Outdoor Robotic Intervention

Unmanned Aerial Vehicles (UAV)

Description - Missions

General Description

Groupe INTRA has outdoor aerial drones (UAVs) in electric and thermal versions with contra-rotating twin propellers. This technology allows for stationary flight and a much more compact and wind-resistant machine than those of the classical helicopter type.

The latest developments in electronics and embarked computer-assisted flying aids make lighter work for the ground-control pilot, who can thus concentrate on using specific measurement or reconnaissance equipment.

With a maximum speed of 90 km/hour (55 mi/hour), a maximum flight altitude of 3000 metres (~ 10,000 ft), up to two hours of run time (gas-powered version), a remote control range of up to six miles and greater reliability, these UAVs may now be used in crisis/emergency situations.

Flight control is simplified thanks to onboard electronics which interprets the flight orders programmed by the operator.
With the UAV automatic pilot, the operator can concentrate on the gyro-stabilized camera (day/night vision, infrared sensor, or both) to observe the targeted zone.

The power and stability of the 26x optical zoom camera immediately and efficiently point out potential dangers from a distance of up to 6 miles (10 km).

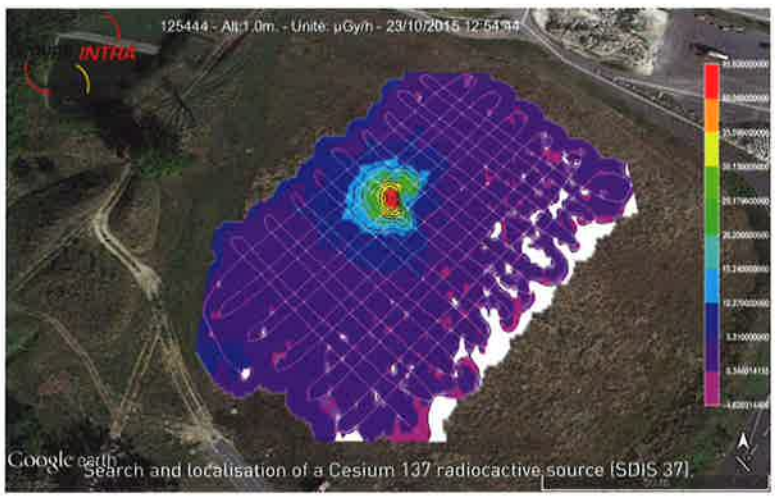
Missions

UAVs operate outside buildings with the following missions :

- Monitoring radiation levels,
- Visual reconnaissance,
- Accompanying and monitoring machines on ground missions,
- Locating heat sources with the infra-red camera,
- Retrieving or laying measurement sensors

Electric UAV with battery, ball caméra and radiological detector.

Cartodrone is a software for gamma detectors' data processing. At the end of a mission, data are digitally processed (Kriging) to elaborate a dose rate isovalues map with or without altitude correction.The software can exports results in formats compatible with Geographical Information Systems.



Search and localisation of a Cesium 137 radiocactive source (SDIS 37).

Outdoor robotic intervention

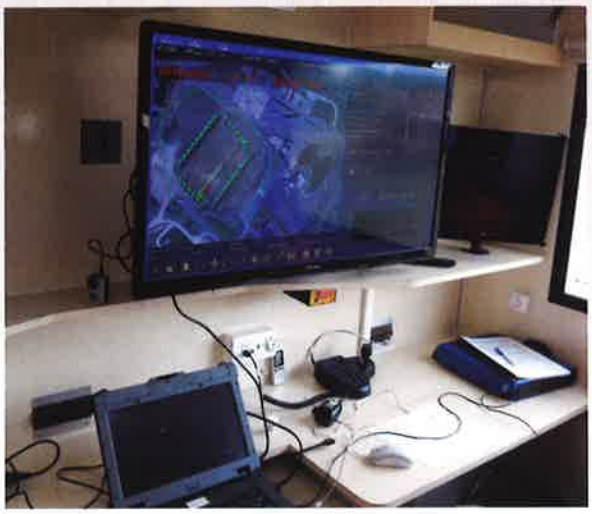
Unmanned Aerial Vehicles (UAV)

Characteristics

Control Station

The equipment necessary to control the UAVs (Personal Computer, «cockpit» software, transmitter and screen) have been integrated inside a light utility vehicle equipped with a power generator and a mast supporting a telescopic antenna. The control station enables first person view type of flight as well as transportation of two pilots and all supporting equipment towards the damaged site.

Control station with deployed antenna.



Inside view of the control station with screen and ground control station.

Equipement

There are a variety of missions for the UAVs, as long as payload limits are complied with.

The following equipment is used for specific missions :

- A high-resolution gyro-stabilized camera with integrated zoom that can operate both in the visible and infrared spectra to conduct highly-detailed visual reconnaissance missions,
- A light-weight high-resolution camera in the visible spectrum, without zoom, to assist in controlling the machines while taking measurements,
- Sensors/detectors for monitoring radioactivity.

UAV equipped with radiological detector

Manufacturer's specifications

Model	IT180-5 TH	IT180-3 EL
Motor Type	Gas-powered engine	Electric motor
Rotor Diameter (m)	1,8	
Weight (kg)	14	
Payload (kg)	5	3
Maximal Speed (km/h)	90	
Maximal Altitude (m)	3000	
Run Time (minutes)	60 - 120	30
Control Modes	Manual / Automatic / Terrain Following Radar (TFR)	
Frequencies	869MHz / 1.3 GHz / 2.4 GHz	
Automatic Functions	Take-off, Flight, Landing	

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Indoor and outdoor intervention equipment

3G Control Station

Description – Missions

General Description

The 3G (3rd generation) control station consists in a specially-outfitted vehicle and a trailer supporting an antenna for transmission.

This new control station is entirely self-powered and uses digital signal transmission technology.

Racks of electronics and computers necessary for data transmission and robotic vehicles remote control have been installed in custom-made panels. The remaining space has been fitted with control workstations, screens to display videos from the robots, equipment functions and parameters dashboard and, for outdoor machines, the operations zone map with vehicle progress trajectory. The station is air-conditioned and includes a radio communications system.

The 3G control station enables EROS and EOLE indoor robots control in First Person View after computer and controllers reconfiguration.

It cannot be used in an area suspected of contamination or radiation risks. Its usage in the theatre of operations is limited to outside zones of radioactive release (real or potential) or, otherwise, with provisions for an eventual transfer should a change in weather conditions occurs.

3G control station for indoor and outdoor robots

Inside view of the control station: screens and control workstations

Missions

The 3G control station usage is for controlling outdoor or indoor robots in First Person View mode. It is designed to operate with a pilot and a co-pilot. The pilot concentrates on guiding the robot while the co-pilot performs general surveillance, monitors the robot technical parameters and relays data back to the support base.

Indoor and outdoor intervention equipment

3G Control Station

Characteristics

Onboard electronics allow for real-time communication with the remotely controlled robots.
It includes various components, notably :

- A UHF radio transmitter for indoor robots remote control.
- A VHF radio receiver for digital videos and outdoor machines telemetry
- A radio receiver for analog back-up videos
- A coaxial modem for indoor robots data and videos
- A video recorder and a selector to patch videos from different sources (outdoor vehicles, indoor robots, EMOI trailer, auxiliary cameras, etc.),
- A Personal Computer to set up equipment parameters and to display the Man-Machine Interface controls.

Control workstations are connected to the computer via a synchronous communication card. One workstation is dedicated to the robot locomotion and the robotic arm control. The other is for adjusting video cameras parameters. Hence, both functions can be shared by the pilot and the co-pilot if necessary. The synchronous communication card and the workstations run on custom-made softwares written in C-language.

The user interface is based on Panorama supervision software. It gives pilots the possibility of viewing the status of the vehicle, of setting the transmission parameters and of selecting the videos. On a specific video screen, the co-pilot follows the position of the outdoor robot on a map, thanks to the GPS fitted to the robot.

With this system, up to four videos can be viewed simultaneously with a lag time of less than 100 milliseconds. These videos may be forwarded by fibre optics to a support base or to another control station.
Indoor robots transmission range is 350 metres directly, or about 2 miles (3km) with fibre optics. Outdoor vehicles transmission range is approximately 3 miles (5 km) depending on the terrain's topography.

The 3G Control Station is normally located in a risk-free radiological zone for personnel safety.

In order to ensure protection against potential contamination risks following eventual changes in weather conditions, the 3G Control Station is equipped with atmospheric contamination detectors to alert the personnel if contamination thresholds are reached, triggering special safety procedures : domming personal protective equipment and/or moving the vehicle away from the hazard zone.

Close-up of the antenna on its support mast


Detail of workstation

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Civil Engineering Vehicles

EPELL – EBULL – EPPB

Description - Missions

General Description

Groupe INTRA has two civil engineering vehicles (EPELL : an excavator and EBULL : a bulldozer) operated from within a shielded control cabin (EPPB). They are based on industrial vehicles and are equipped with the devices needed for remote-controlled operations (cameras, lighting) as well as transmission equipment (audio, video and data control). They can be operated directly from the driver's cabin or by remote-control from a radiation-shielded control station, and can perform missions night and day. EPELL and EBULL can be operated from distances of about 300 m from the EPPB vehicle.

The EPPB control station consists in a motorized base carrying a shielded cabin plus the auxiliary equipment needed to keep it running. This cabin can house two operators simultaneously controlling the EPELL and EBULL vehicles as well as EPPB. Vehicles control can either be performed by eyesight through the safety-shielded portholes or via the video systems.

Operators inside the EPPB cabin are protected from :

- Ionizing radiation thanks to steel-lead shielding with an attenuation factor of 100x,
- Contamination, thanks to dynamic nuclear ventilation, with ultra-high-efficiency particulate filters and air conditioning.

Radiological surveillance detectors are installed in the control station and the operators have individual emergency protection gear on board, to ensure protection from contaminants in case of emergency exit.

Due to its specifications for operators' protection, EPPB can also be used for visual reconnaissance on allegedly hazardous sites.

EPELL EPPB EBULL

Missions

The civil engineering vehicles named EBULL and EPELL are able to operate outside buildings after reconnaissance missions have been performed by UAVs or outdoor robots and conduct operations in radioactive and contaminated areas.

The EPELL and EBULL vehicles are designed to perform the following jobs :

- Stripping topsoil,
- Building hillocks,
- Re-shaping ground contours,
- Clearing roadways,
- Digging trenches.

Civil Engineering Vehicles

EPELL – EBULL – EPPB

Characteristics

Shielded control station with support systems : nuclear ventilation system and power generator

Inside view of EPPB shielded cabin

Civil engineering vehicles specifications are as follows :

		EPELL	EBULL	EPPB
Length	(m)	4.50	6.70	10.60
Width	(m)	2.40	3.20	2.75
Height	(m)	4.10	4.10	4.10
Weight	(kg)	22,000	20,000	48,000
Manufacturer		Caterpillar	Caterpillar	FAUN
Integrator		Bergerat Monnoyeur		
Type		320L	D6HxR series 2	ATF 70-4
Motor		Diesel 3116 DTx 130 cv	Cat Diesel 3306 DTI – 175 cv	Mercedes Turbo Diesel – 381 cv
Run time (h)		30	30	20
Max speed		5 km/h	10 km/h	80 km/h
Capacity		Bucket 1,2 m^3	Blade 3.25m, 1-tooth ripper	
Visuals		5 cameras	5 cameras	7 portholes 1 camera

Radio-relayed Radiological Detection

Gamma Tracers

Description - Missions

General Description

This system for measuring radiation is a platform for remote radiological surveillance, transmitting by radio periodic ambient dose rate measurements. It consists of a group of self-powered Gamma radiation detectors, a radio receiver and data-processing software. The system may be deployed in a radius of a couple of miles around the damaged site.

To ensure clear reception, the receiver must be placed at an optimal point considering the accident kinetics, the weather forecast with the dominant wind direction and the damaged zone topographic layout.

The system can establish a self-powered and independent measurement network to complete or replace existing permanent networks that can be damaged in case of a serious accident.

Data received will then be relayed by satellite to Groupe INTRA's web site, accessible to involved Crisis/Emergency Management organisations (IRSN, operators).

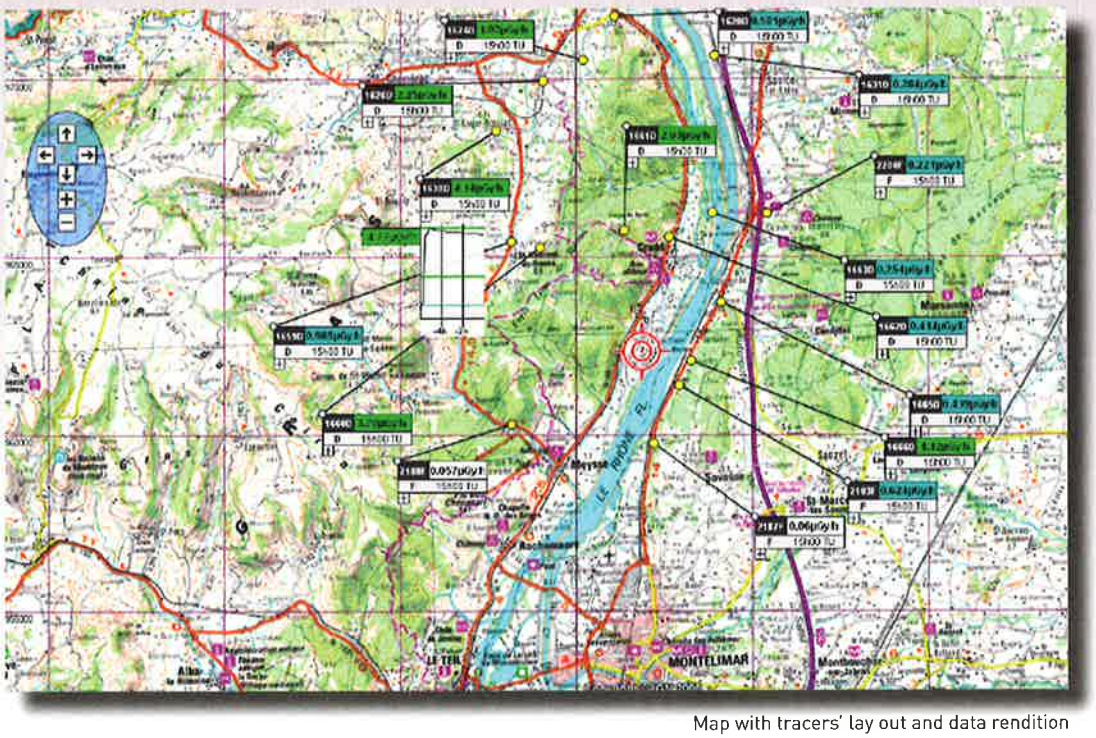
Missions

Depending on the accident kinetics, tracers can be placed as a preventive measure - before radiation release - to obtain continuous feedback during the release phase, or can be set up to monitor a specific location, or else to monitor a specific area's radiological evolution.
The tracer probes installation occurs when radiological conditions allow human personnel to do so or, in the contratry, by outdoor robots or even by UAVs.

Radio-relayed Radiological Detection

GAMMA TRACERS

Characteristics



Map with tracers' lay out and data rendition

Interface

Data processing consists in tracer probes' dose rates real time acquisition and positioning on a geographical map with respect to coordinates. Readings are transmitted to the nuclear operator and to the Nuclear Radioprotection and Safety Institute (IRSN) which embed them into their general radiological surveillance plan.

This map, displaying last values transmitted and historic data, is available on **Groupe INTRA**'s web site via a secured access.

Tracer conditioned for transport

Available data

- Real time gamma dose rate,
- Real time map display of tracers' readings,
- Historic data for any tracer.

Characteristics	
Gamma-Ray Tracer Probes	Genitron/Saphymo
Frequency Range	400 and 500 MHz
Transmitting Power	10mW
Measurement Range	10 nGy/h to 10 mGy/h
Value measured	Air Kerma rate\ 2 GM sensors
Transmission Range (without obstacle)	25 km
Sampling Period	2 min. to 2 hours
Monitoring Software	DataEXPERT

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Airborne Gamma Spectrometry System

HELINUC

Description - Missions

General Description

HELINUC installation kit for EC 145 consists of a cradle fitted with GPS instrumentation, radio-sensors and antennas fixed on the helicopter skates. The nacelles with Sodium Iodide (NaI) detectors are positioned on both sides of the EC 145 lower body with goosenecks. Two Germanium detectors are installed in front of the helicopter with specific supports tailored for the EC 145 footstools.

A screen has been added to assist the pilot and electronics racks and Personal Computer installed in the rear bay for CEA operators.

Ground scanning is performed by following a pre-established flight pattern with the following parameters: length of a pass, distance between passes, altitude, speed and measurement integration time.

During flight, the on-board equipment records simultaneously Gamma spectrum data and aircraft spatial coordinates while personnel is monitoring data acquisition.

At the end of the mission, records are processed to superimpose radiological data of the scanned zone on a topographic survey map.

Results are expressed in Bq/m² for maps representing each radionuclide activity or in Gy/h for dose rate.

HELINUC measurement system installed on Civil Security EC 145 helicopter

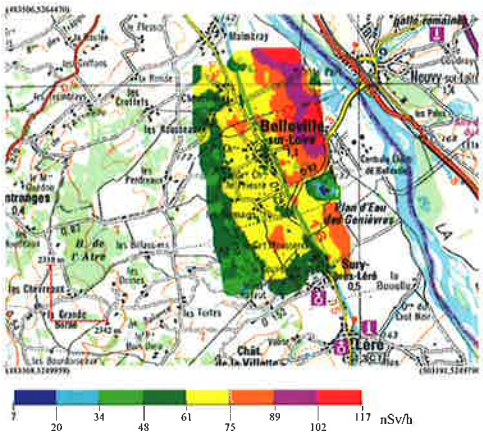
Symetrical assembly of detectors in the craddle installed under the helicopter

Mission

This helicopter embarked apparatus allows for quick cartography of gamma-ray emitting radio-isotopes on large contaminated areas by :

- Creating a map of Gamma radioactivity over large areas of land,
- Detecting and identifying radionuclides,
- Evaluating surface contamination or ground-level dose rate,
- Detecting, pinpointing and identifying punctual sources.

Exercice Belleville (simulation)



Depending the area, background noise is approximately of 100 ηSv/h

Airborne Gamma Spectrometry System

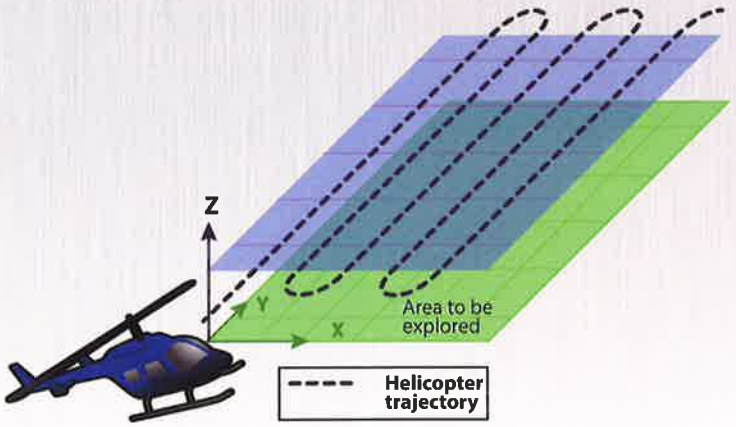
HELINUC

Characteristics

Operational Capabilities

System capability allows for analysis of surface areas of some 20 square miles per day with a detection sensitivity ranging from natural background radioactivity levels to those of a major nuclear accident. HELINUC system can also be used for quick search and localisation of punctual radioactive sources.
For on board personnel safety, HELINUC system will not be deployed in case of confirmed aerial contamination or during radioactive gas release.

The operational capability of HELINUC and its manning team is permanently guaranteed by CEA (Atomic Energy and Alternative Energies Commission) through drills and exercises, international benchmarks or environmental survey campaigns around civil or military nuclear or industrial sites in France or abroad.



HELINUC flight trajectory

Germanium GeHP detector ; NaI detector and embarked camera

Detailed Characteristics

The complete system is composed of
- Two NaI detectors (16 to 34 litres) operating at ambient temperature,
- Two liquid nitrogen cooled Germanium detectors,
- An electronic unit controlling all the functions necessary for operation (power supply, signal processing, GPS data acquisition, flight trajectory creation and display and data record and storage for post-processing).

The combination of high volume NaI detectors with the excellent spectral resolution of Germanium detectors allows HELINUC to discriminate natural radionuclides (Potassium 40, Thorium 232 ou Uranium 238) from artificial ones (Américium 241, Iode 131, Césium 137, Plutonium 239, Cobalt 60...).

General flight parameters are as follows :

Parameters (flight and values)	Nominal Value
Helicopter speed (km/h)	70
Flight Altitude (m)	40
Distance between two passes (m)	80
Spectra Acquisition Frequency (s)	1
Analysing Capacity (km²/day)	50 mnimum
System Assembly Time (h)	< 2
HELINUC personnel required	3, including 1 or 2 on board
Post-Processing Time (min.)	< 30

Radionuclides detection limits for a 16l NaI detector in optimal conditions are as follows :

Radionuclides	Detection Limits
Americium 241 (^{241}Am)	15 – 40 kBq/m²
Uranium metal (U)	40 – 100 kBq/m²
Iodine 131 (^{131}I)	2 – 5 kBq/m²
Cesium 137 (^{137}Cs)	1 – 4 kBq/m²
Cobalt 60 (^{60}Co)	0,5 – 3 kBq/m²
Potassium 40 (^{40}K)	30 – 80 Bq/kg
Uranium 238 (^{238}U)	15 – 40 Bq/kg
Thorium 232 (^{232}Th)	2 – 10 Bq/kg

Versatile indoor/outdoor trailer

EMOI

Description - Missions

Mission

EMOI is deployed with ERASE for outdoor missions and with EROS/EOLE for indoor interventions. It therefore can :

- Carry two indoor robots up to 3km from the control station,
- Act as a back up channel for control and communication signals between the robot and its control station,
- Monitor robots thanks to its panoramic ball camera.

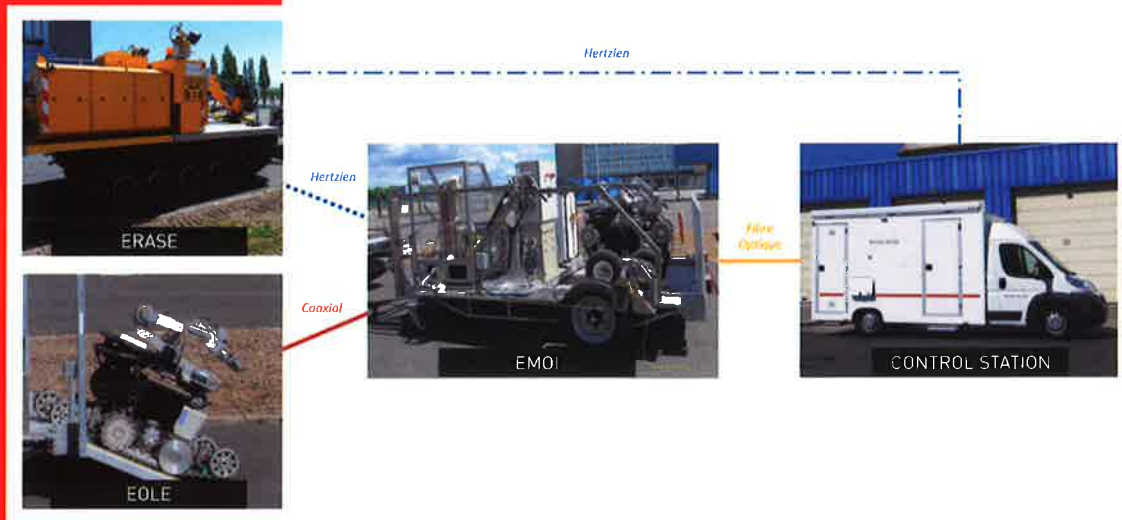
Fibre optics connect EMOI trailer to the control station.
ERASE control signals transit through EMOI via a short distance radio link with modems.

General Description

Groupe INTRA has developed an equipment which can be used with both indoor and outdoor robots, the **EMOI** trailer.

EMOI is towed by an outdoor robot ERASE and can carry two indoor robots over a few kilometers. Communication between the robots and the control station is then performed with fibre optics controlled by a double system: winding/unwinding reel and fibre support.

This trailer is equipped with a power generator providing full autonomy for 8 hours. An articulated arch fitted with communication antennas and a panoramic ball camera can be deployed at 4 metres high and the trailer tailgate unfolded remotely to allow for indoor robots exit.



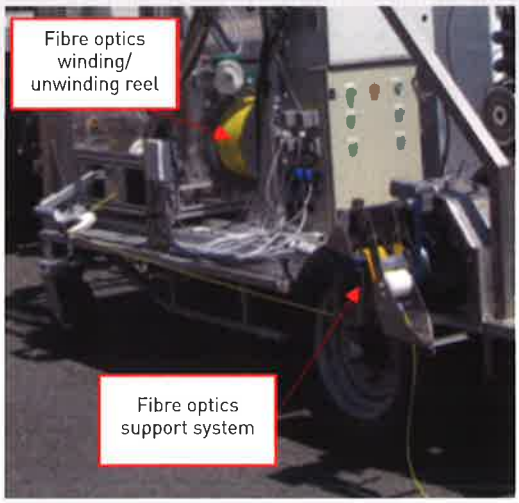
Versatile indoor/outdoor trailer

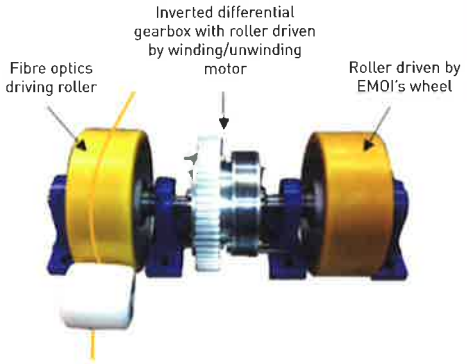
EMOI

Characteristics

Fibre optics management

EMOI is equipped with a reel which keeps the fibre optics under a constant tension to allow secure winding and unwinding operations. Groupe INTRA has developed a support system using an inverted differential gearbox to ensure that the fibre will be laid on the ground along with the trailer progress and stay free of strain to prevent damage if tied on something or during rewinding when coming back to base. Operated from the control station, a small motor adapts the fibre winding or unwinding speed with respect to the guiding roller located on the trailer's wheel.





Exploded view of fibre optics support system

Control station

EMOI trailer is operated from a 3G control station (which can also operate ERASE and EROS/EOLE robots) through two hard-wired automatons. The power generator, the articulated arch, the tailgate and the fibre optics management systems are also operated from the control station.
The different steps of a mission with EMOI are the following :

- Start up of the power supply and the winding/unwinding system,
- ERASE tows the trailer to the mission location (up to 3 km away from starting point),
- The articulated arch fitted with antennas and the panoramic ball camera is deployed,
- ERASE unhitchs from the trailer and is positioned approximately 100m away from it either on stand-by or to perform another mission (double communication link is then kept available),
- Tailgate is unfolded to allow for indoor robots exit (they can progress up to 350m away from the trailer).

All control signals for the above come from the same control station.

Characteristics

Detailed characteristics of EMOI trailer are shown in the table below :

		EMOI
Dimensions	Length (m)	5,3
	Width (m)	2,4
	Height (m)	Folded arch: 2 Deployed arch: 4
	Weight (kg)	2300
Platform	Mechanical body	1 axle and 2 freewheels
	Energy	Gas powered generator
	Run Time (h)	8
	Max Speed (m/s)	4,2 (15km/h) ERASE Speed limit
	Operational Range (km)	3
Miscellaneous	Payload	2 indoor robots
	Vision	5 cameras
	Accreditation	According to regulations (not suitable for transport)

Groupe INTRA

GIE - EDF - CEA - AREVA

Data and communication transmission

PCRI, satellite broadcast and GIS

General Description

Groupe INTRA missions take place on damaged sites. The first stage consists in discussions with the site/company emergency crisis centre («the client») to gain full understanding of the situation and then decide which equipment should be deployed.

The second stage is about seting up a process for gathering all types of data and information (measurements, pictures, videos, field reports, ...).

This variety of information is centralised in the Operations Team Leader's Control Station (PCRI), analysed under the team leader supervision and then broadcasted to the client and the Radioprotection and Nuclear Safety Institute (IRSN) to feed crisis management analysis and decision making.

This is achieved through the PCRI, satelitte communication, use of internet and a Geographical Information System (GIS).

Description - Missions

PCRI

PCRI, Groupe INTRA's Operations Team Leader's Control Station, is located in a light utility vehicle and receives all the data coming from the equipment deployed on the damaged site. These data can be transmitted by fibre optics, coaxial cable or radio.

The Operations Team Leader is the interface between the crisis/emergency management centre and the team in the field. Together with an expert from Groupe INTRA who provides technical support, he checks data quality before broadcast to the client and analyses requests to direct and control the interventions.

PCRI is based on a van body upon which a cell, divided in two sections (workstation and equipment transport), has been fitted. The vehicule is fully energy autonomous. It includes a gas powered generator, a GSM link, radio communication with other teams working on the field, video selection and display features, a WIFI entry point and a satellite antenna.

The vehicule is not designed to withstand CBRN risks due to a 3.5 tonnes gauge limitation but includes a radiological beacon system to alert in real time the team members from any environmental evolution that would warrant implementation of safety measures (donning personal protective equipment, vehicule relocation and emergency evacuation).

Satellite links and internet connection

Groupe INTRA has two systems to broadcast data via satellite which also enable internet connection and phone line.

The first system is permanently installed in the PCRI and the satellite antenna coupled with an automatic search and aiming system.
The second system, normally used with the aerial drones, is portable with a manual aiming system. It is made of two modems, one for routine usage during tests and exercises without bandwidth guarantee and the other for emergency situations with a dedicated bandwidth.

Data and communication transmission

PCRI, satellite broadcast and GIS

Characteristics

Geographical Information System

Groupe INTRA has set up a GIS (Geographical Information System) platform to :

- Ease and reduce missions preparation time,
- Centralise actions within the same software,
- Simplify data collection and visualisation,
- Ensure perenniality and maintainability of the solution.

And therefore cover all needs for useful geographical data during the missions' different phases (preparation, execution, feedback).

The platform has been designed with ESRI products (ArcGIS) which are widely used worlwide.

It consists of :

- A geographical database optimised for all other softwares,
- A desktop GIS software to manage data and prepare missions maps,
- Offline GIS applications for equipment and Operations Team Leader's Control stations,
- Online services and web application for crisis/emergency management organisations with direct access by login and password provided by the Operations Team Leader.

Snapshots of the web site