Engage. Explore. Empower.

Connecting Visionaries in Radiation Safety, Science and Industry

MIRION Connect 24

Annual Users' Conference

July 29 - August 2 | Omni Dallas Hotel, Dallas, TX

MIRION TECHNOLOGIES

Mirion Unmanned Detection Systems

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Mirion Connect | Annual Users' Conference 2024

Dallas, Texas

MIRION Connect 24
Annual Users' Conference

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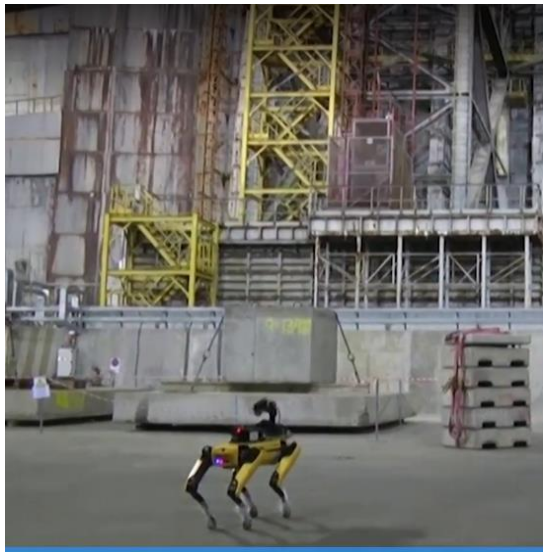
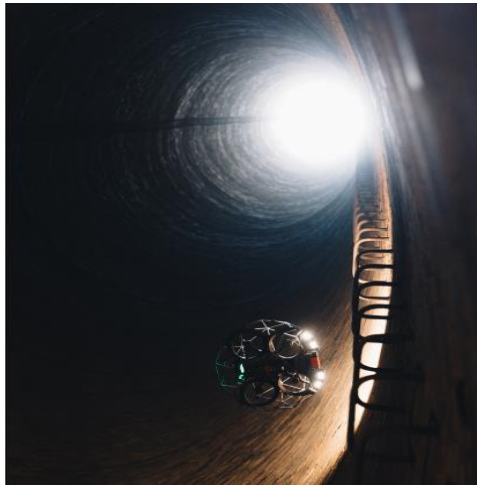
Agenda

- Overview
- Elios 3 Indoor Drone - Flyability
- Quadruped Robot – aka SPOT
- Play Time!
  - Walk the dog
  - Find the source
- Open discussion and questions - Anytime

Unmanned Detection Systems





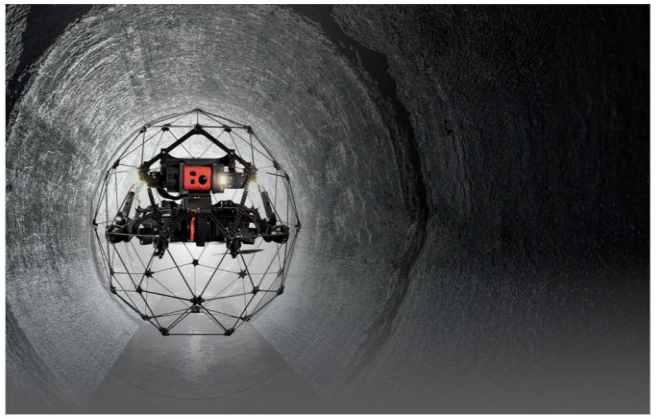


Photo Credits:

- Flyability at EDF
- Uni of Bristol at Chernobal
- Flyability at VW Wolfsburg
- NPX at Bruce Power
- Flyability at Chernobal
- Gamma Reality at Surry

Part I: Overview

Overview

- Identified the need for unmanned detection systems in the market
- Useful in Decontamination and Decommissioning, Security and 1st response, Power plant operations, etc.
- Focus on personnel safety – ALARA
- Need for Manual and Autonomous operations

Part II: Elios 3 Indoor Drone

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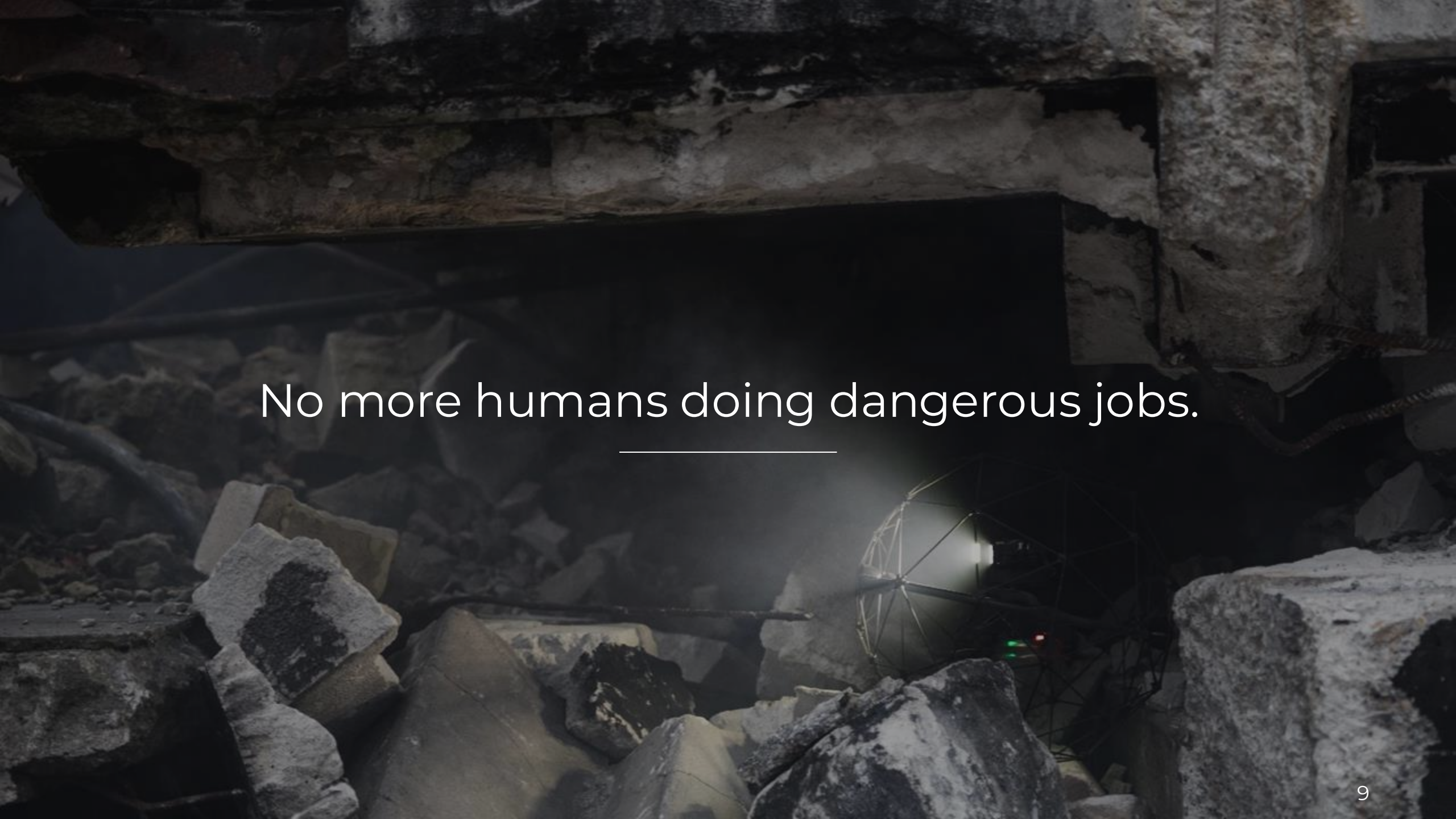
FLYABILITY

FLYABILITY

SAFE DRONES
FOR INACCESSIBLE PLACES

Elios 3 RAD



No more humans doing dangerous jobs.

Send robots instead of humans to gather visual data in dangerous, hard-to-reach places

2014

Established in 2014, Flyability has pioneered and continues to lead the innovation in the commercial indoor drone space. The company is dedicated to intense R&D and is the driving force behind the progressive adoption of drone-based technology, as an alternative to traditional visual inspections methods.

From a pioneer of drone-enabled inspection to a global industrial leader.

Elios 1

The 1st collision-tolerant indoor drone.

Unleashes the potential of UAVs to inspect inaccessible places from a safe distance.

Elios 2

The most intuitive and reliable indoor drone.

Enables flawless inspections of industrial assets right from the first flight using cutting edge data capture capabilities

Elios 3

The 1st inspection, mapping & surveying indoor drone

Opens doors to automation and verticalization through an unmatched combination of intelligence, stability, and versatility.

THE FUTURE

Fully autonomous inspections with a **range of payloads** addressing industry specific needs.

2014 2015 2016 2017 2018 2019 2020 2021 2022

MARKET BREAKTHROUGH | INDUSTRIALIZATION | COMMODITIZATION & SPECIALIZATION

Take the guesswork out of maintenance operations in a safe, fast, and economical Way

IMPROVE SAFETY

Avoid confined spaces entry, radiation exposure and work at height during inspections

REDUCE DOWNTIMES

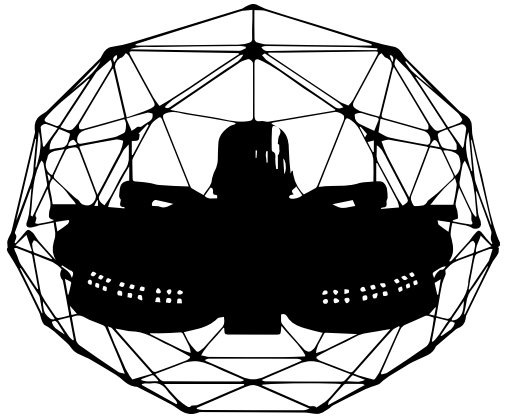
Turn days of asset downtime into hours.

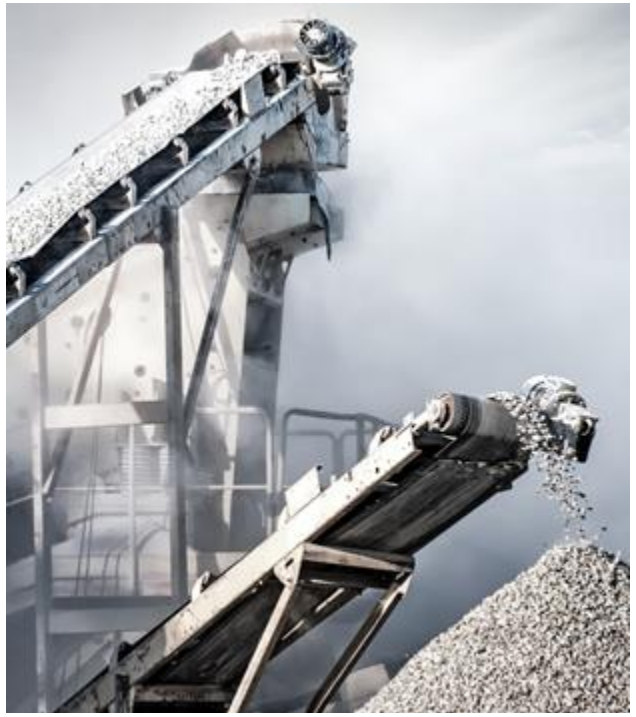
LOWER COST

Save your financial resources for where they're really necessary.

100,000+ flights

2000+ drones



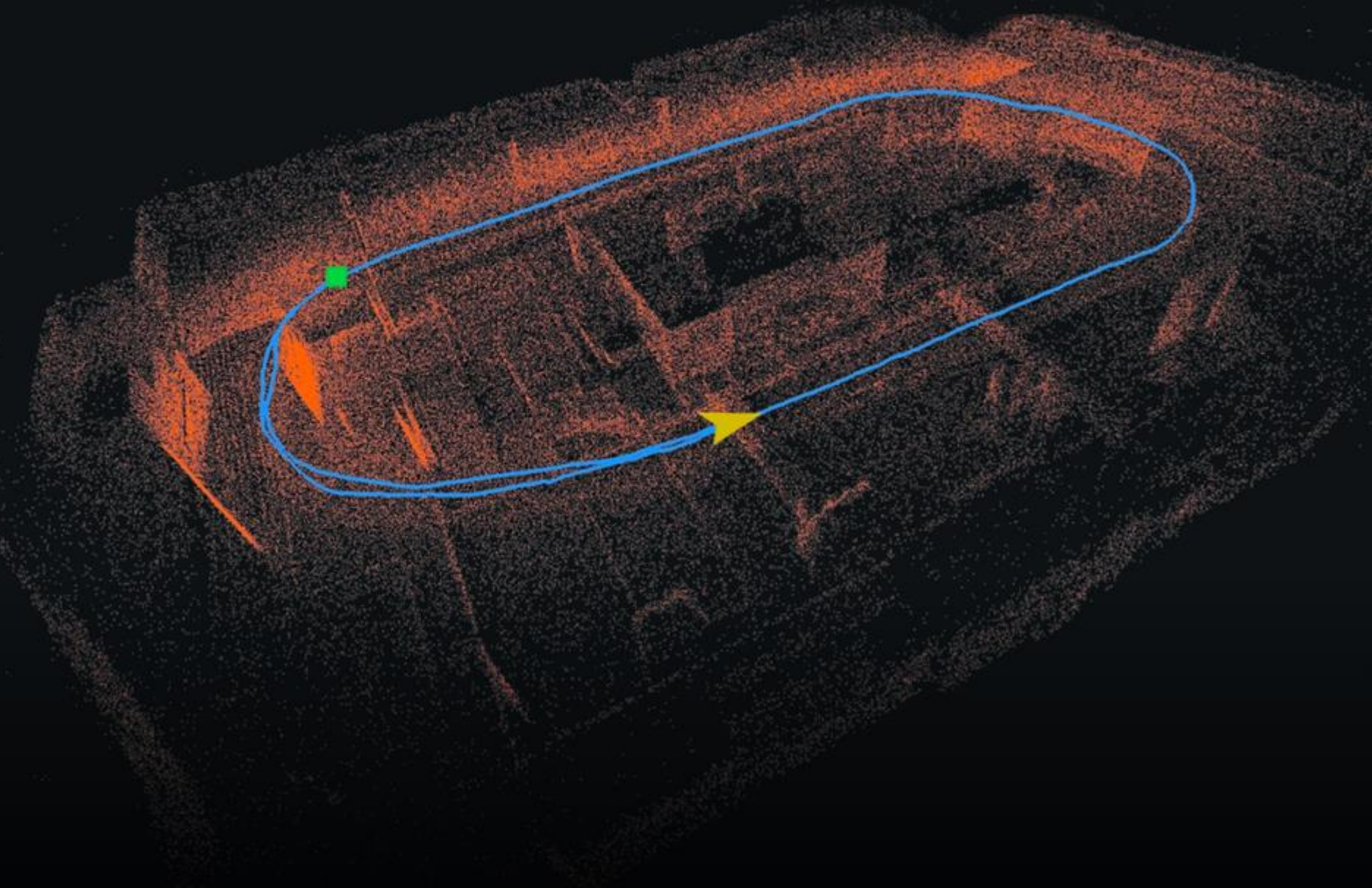


Across the most challenging industries

Chemicals, Cement, Power Generation, Infrastructure & Utilities, Mining, Oil & Gas....

Powered by FlyAware™.

FlyAware™ is the unique combination of computer vision, LiDAR technology, and a powerful NVidia graphic engine. Acting as an indoor GPS, it builds real-time 3D maps enabling the drone to sense its surroundings instantaneously.



FLYABILITY

MIRION TECHNOLOGIES

ELIOS 3 RAD PAYLOAD

Remote radiation detection and localization powered by Mirion Technologies.

Perform fast & accurate radiation surveying of indoor spaces without human exposure

Elios 3 RAD Users

A safe and healthy work environment for your staff is our number one priority

A solution praised by the nuclear industry.

Used in over 80% US nuclear reactors

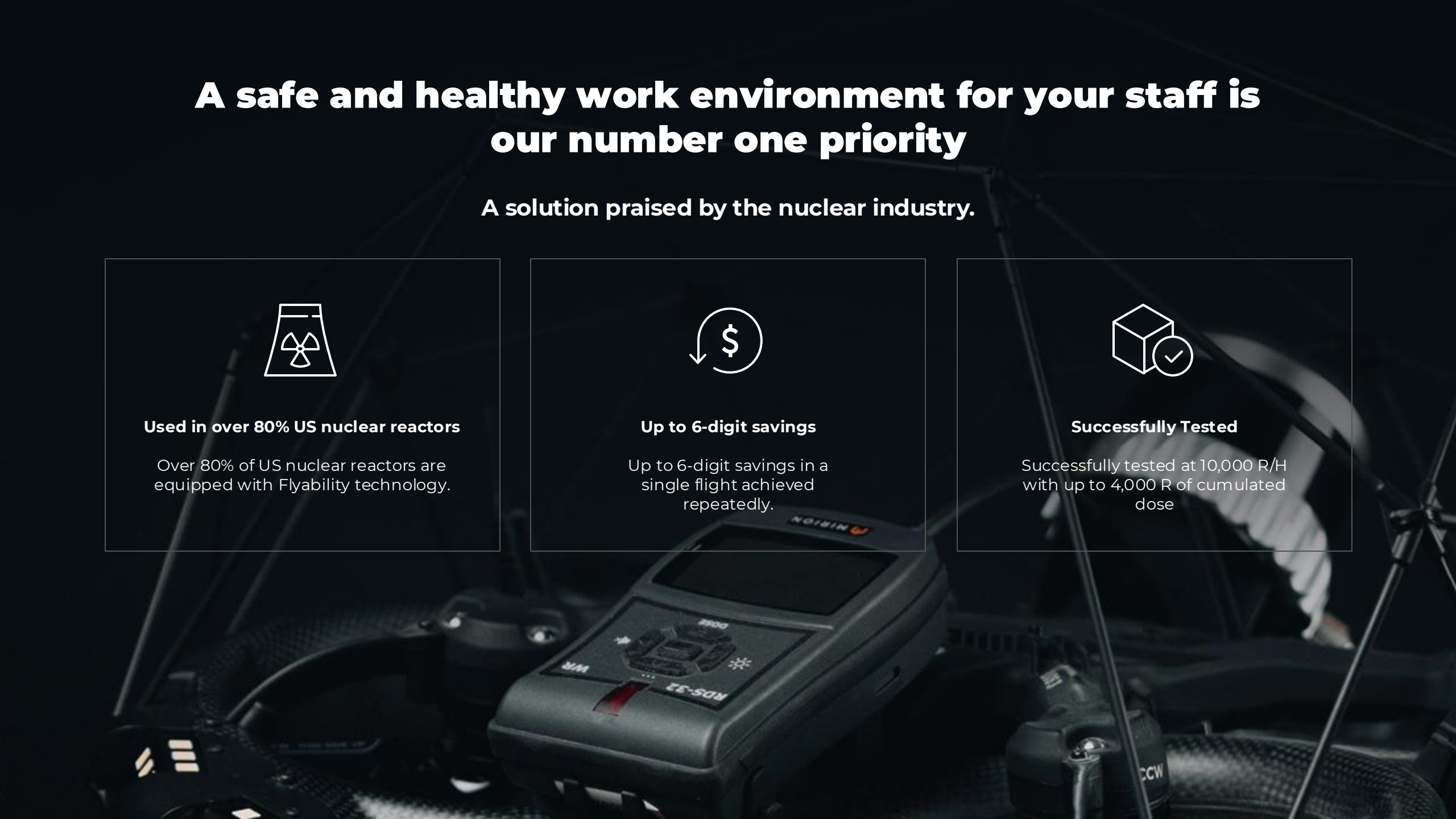
Over 80% of US nuclear reactors are equipped with Flyability technology.

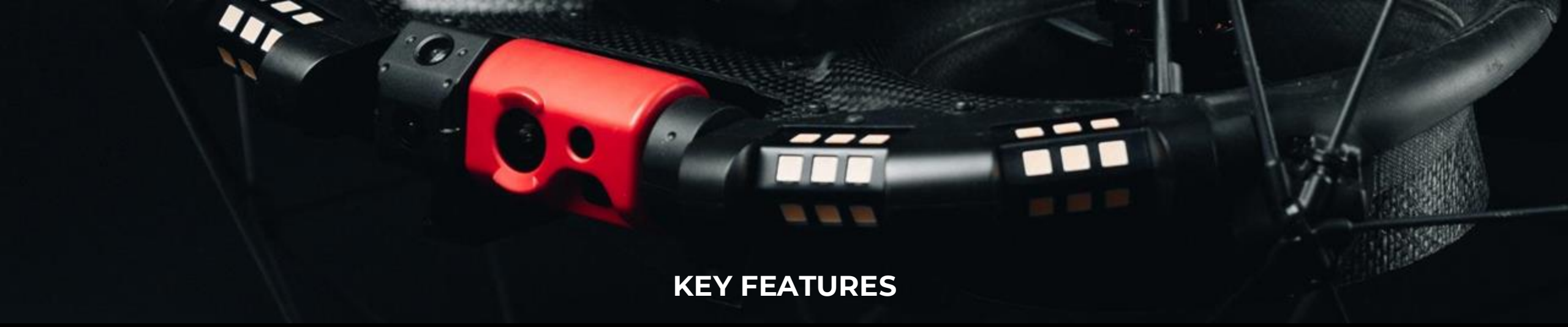
Up to 6-digit savings

Up to 6-digit savings in a single flight achieved repeatedly.

Successfully Tested

Successfully tested at 10,000 R/H with up to 4,000 R of cumulated dose





KEY FEATURES

Much more than a flying dosimeter, Elios 3 and the RAD payload form a powerful radiation surveying tool.

Comprehensive In-Flight Radiation Reading

Post-Flight Radiation Reading, Localization, and Reporting

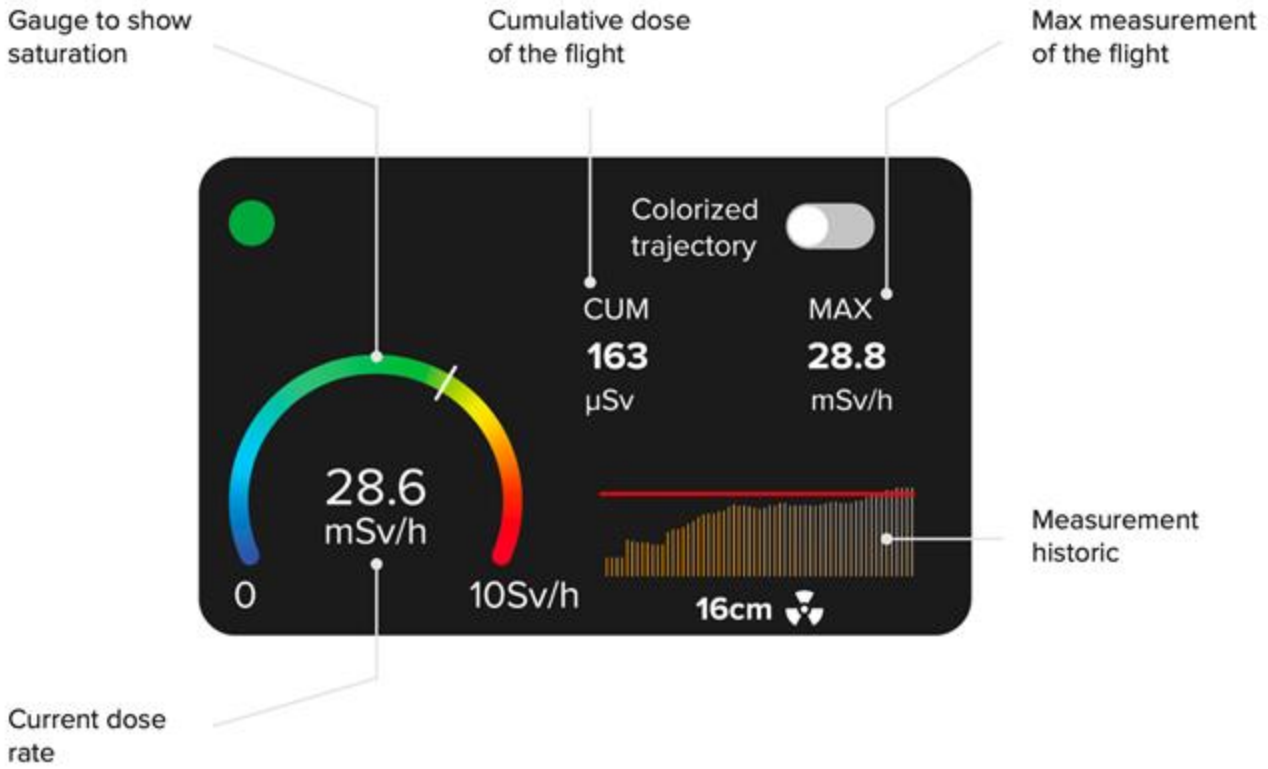
Powered by Mirion Technologies

Detachable and swappable sensor

Comprehensive in-flight radiation reading

Instant reading. No exposure.

Get an instant reading of current and cumulative dose rate along with max recorded value and measurement history to understand measurement trends and help you find high radiation sources.

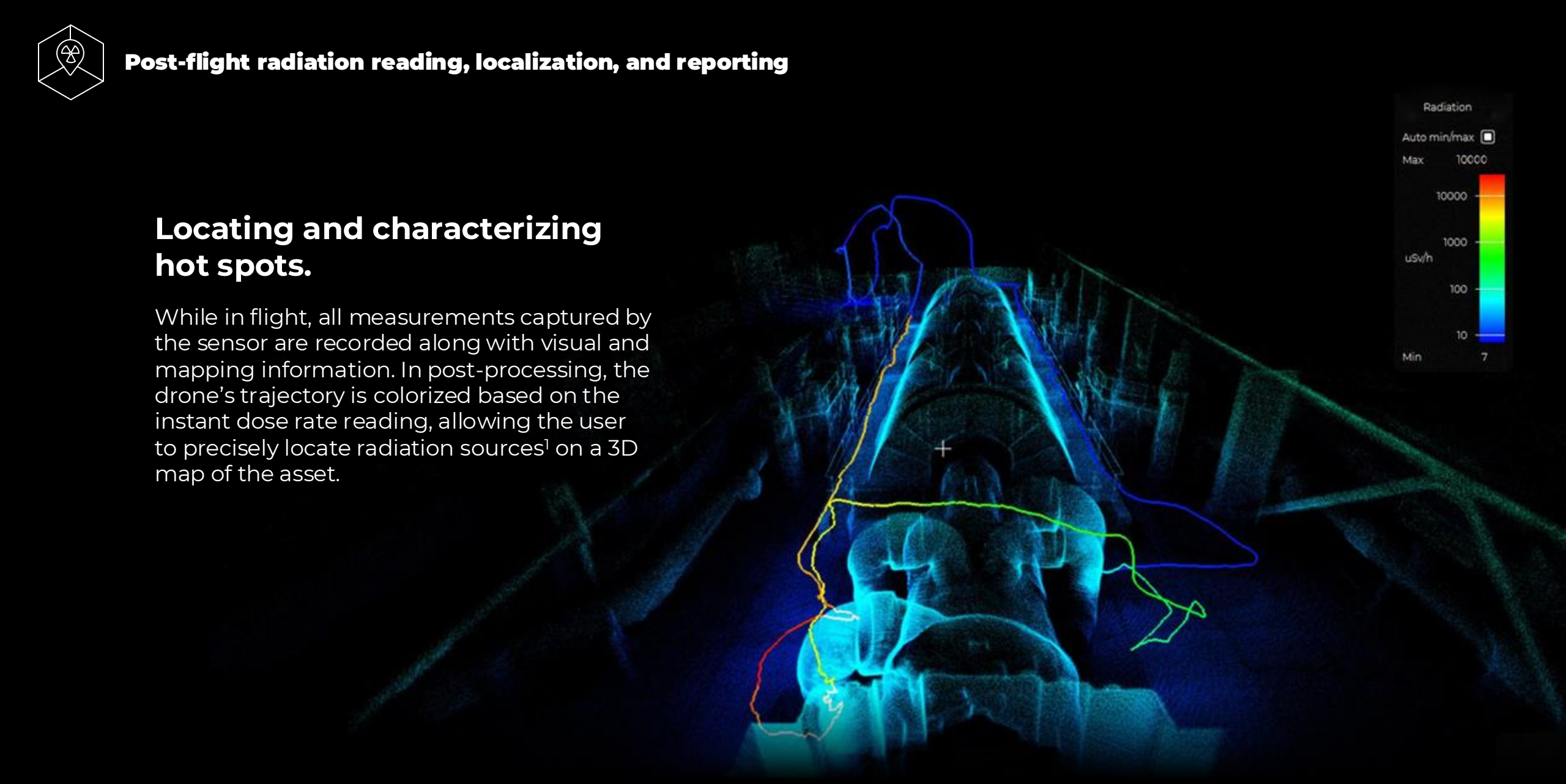


Comprehensive in-flight radiation reading

Post-flight radiation reading, localization, and reporting

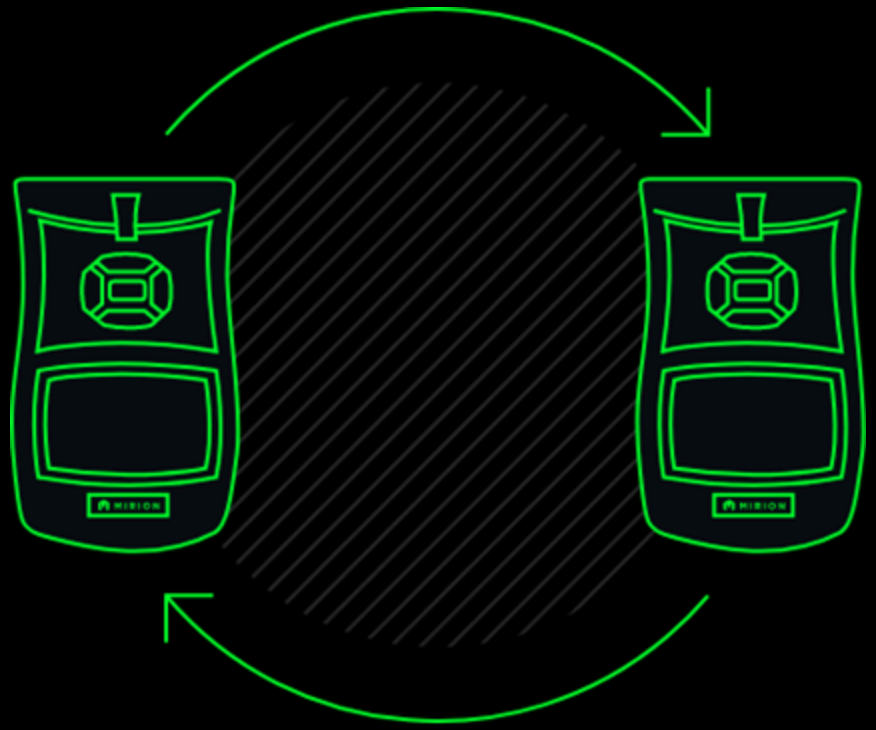
Locating and characterizing hot spots.

While in flight, all measurements captured by the sensor are recorded along with visual and mapping information. In post-processing, the drone's trajectory is colorized based on the instant dose rate reading, allowing the user to precisely locate radiation sources[1] on a 3D map of the asset.



1. The colorization of the drone's trajectory is indicative and subject to over/under estimation because of the drone speed and convergence time of the sensor. For an accurate measurement, the drone must remain at a given location until the full convergence of the sensor. This procedure should be repeated for each point of interest.

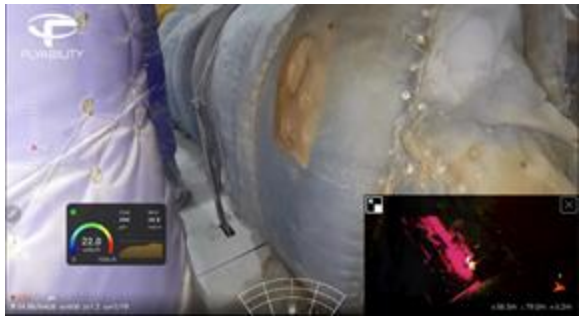
Detachable and swappable sensor



Compatible with your existing sensors.

Comply with sensors' maintenance and calibration requirements without stopping your operations. Elios 3 is compatible with every RDS-32 WR sensor you have[1], so you can swap them as needed.

1. RDS-32 WR sensors used in conjunction with an Elios 3 should be properly configured according to the recommendations made by Flyability and local legal regulations. Not following this recommendation can impact the quality and reliability of the data captured.



Source: Footage captured by Flyability. For privacy reasons, the footage shown in the video doesn't show the entire site.

Turbine deck inspection

Quickly deploy the Elios 3 RAD from a convenient area to identify, locate, and monitor radiological conditions of an asset.

IN A NUTSHELL:

Speed: Deploy a drone on demand without the need for complex safety procedures.

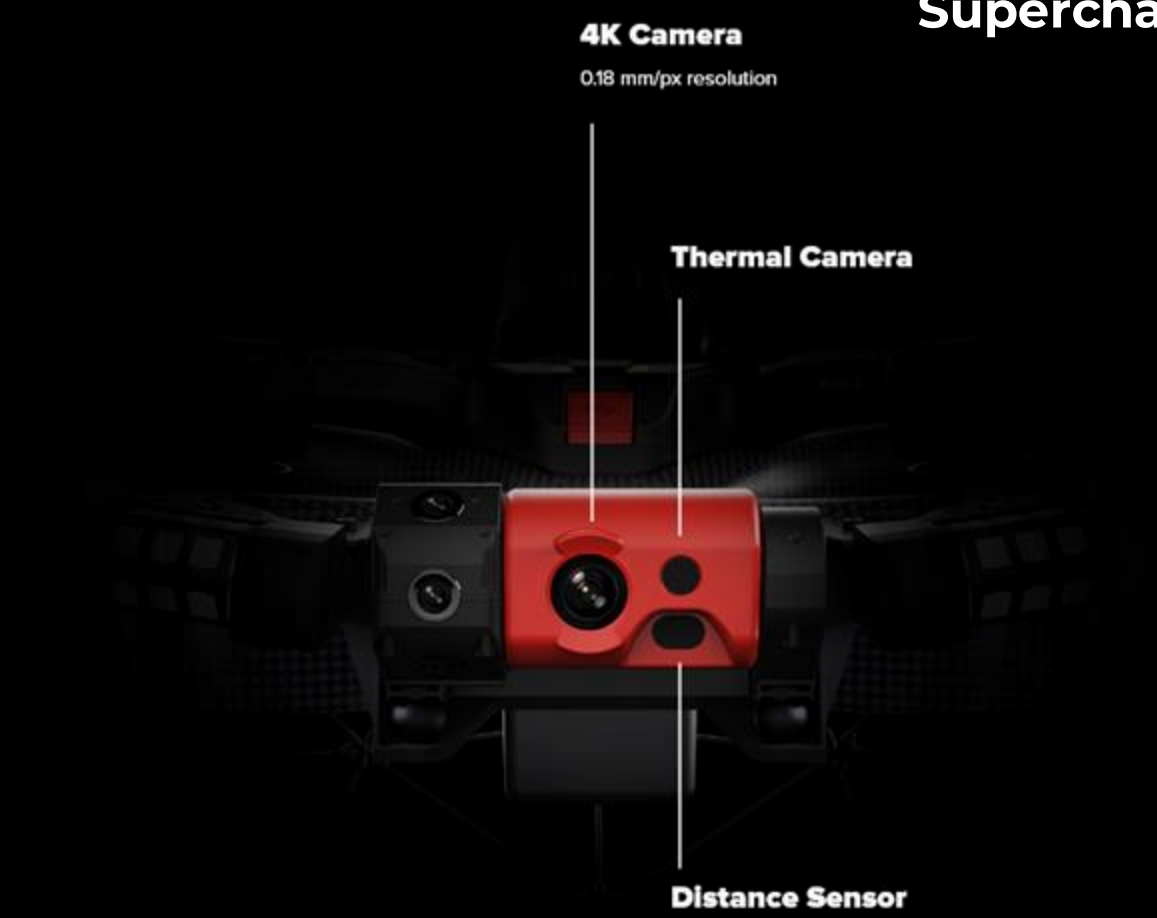
Access: Get 100% data coverage even in no-go zones

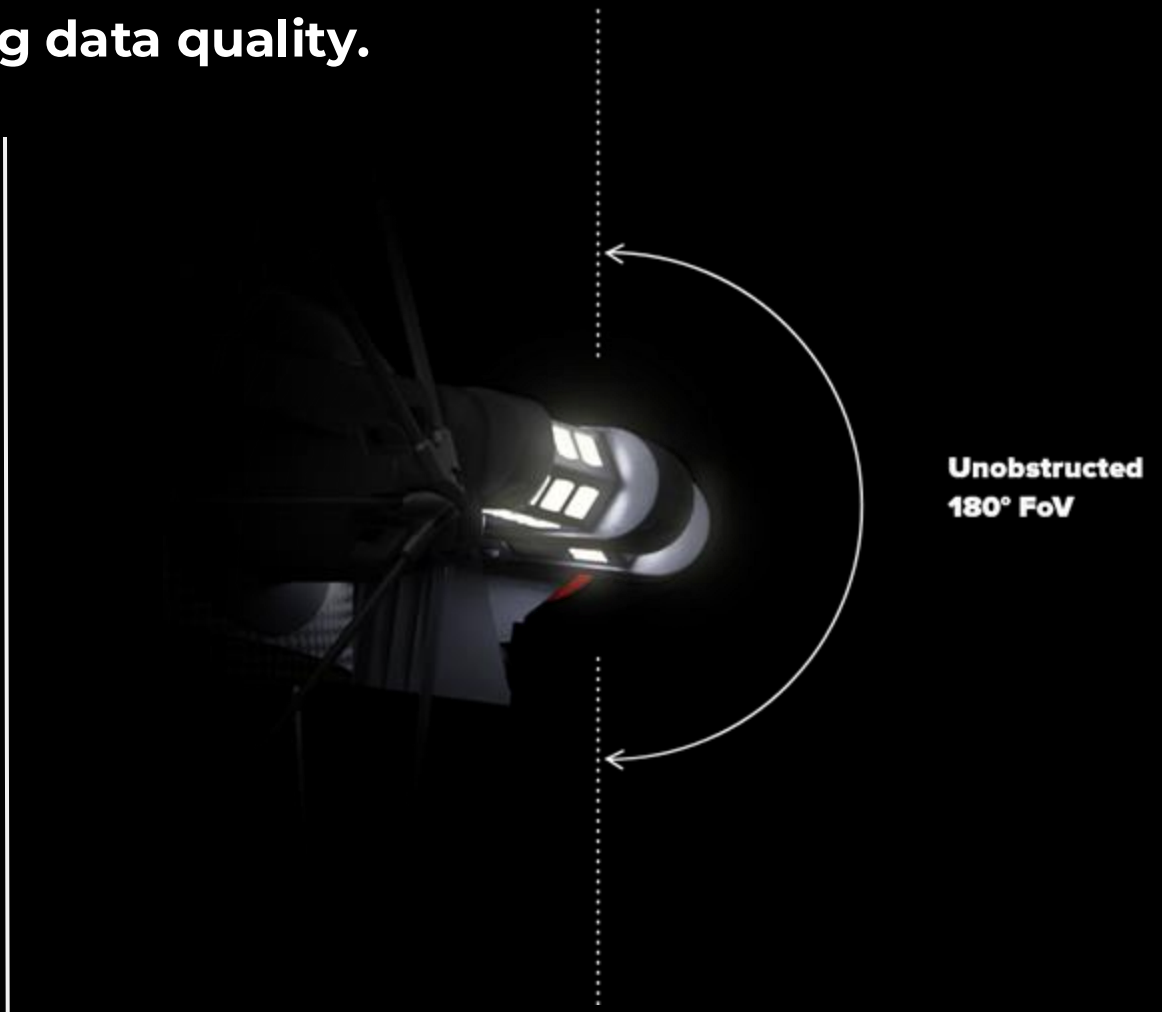
Safety: No workers exposed to hazards.

Case study

CLOSE-UP INSPECTION DEDICATED PAYLOAD

Supercharging data quality.





Dust-Proof 16k Lumen Lighting

Looking for pitting, cracks, or build-ups becomes as natural as doing it manually with a flashlight

Questions?

Part III: Spot Quadruped Robot

Fully autonomous or manually operated quadruped UGV platform

SPOT robot

- Developed by Boston Dynamics
- Extremely easy to operate without the safety and training issues of drones/UAVs
- Fully autonomous operation, with automatic routine routes and automatic charging options
- Can autonomously traverse stairs
- Can open doors, manipulate valves, drag objects with optional arm

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SPOT specifications

- General specifications:
  - Net weight: 33kg (72 lbs)
  - Average runtime: 90 mins
  - Operating temp: -20 to 45 °C (-4 to 113 ° F)
  - Ingress protection: IP54
- Terrain sensing:
  - Horizontal FOV: 360°
  - Range: 4 m (13.1 ft)
  - Communications: WiFi / Mesh / Cellular
- Locomotion:
  - Max speed: 1.6 m/s (3.6 mph)
  - Max slope: ±30°
  - Max step height: 30 cm (11.8 in)
- Payload:
  - Max weight: 14 kg (31 lb)

- Safety and compliance:
  - Designed according to ISO 12100 for risk assessment and reduction methodology and IEC 60204-1 for electrical safety
  - EMC: FCC Part 15A
  - Radio equipment: Incorporates a FCC Part 68 Certified radio system
- Security:
  - All connections encrypted and authenticated using industry standard techniques (TLS 1.2+) and modern cipher suites (e.g. AES-256)

The “Mirion Backpack” payload

Universal payload architecture

Mirion’s universal payload architecture
Topology

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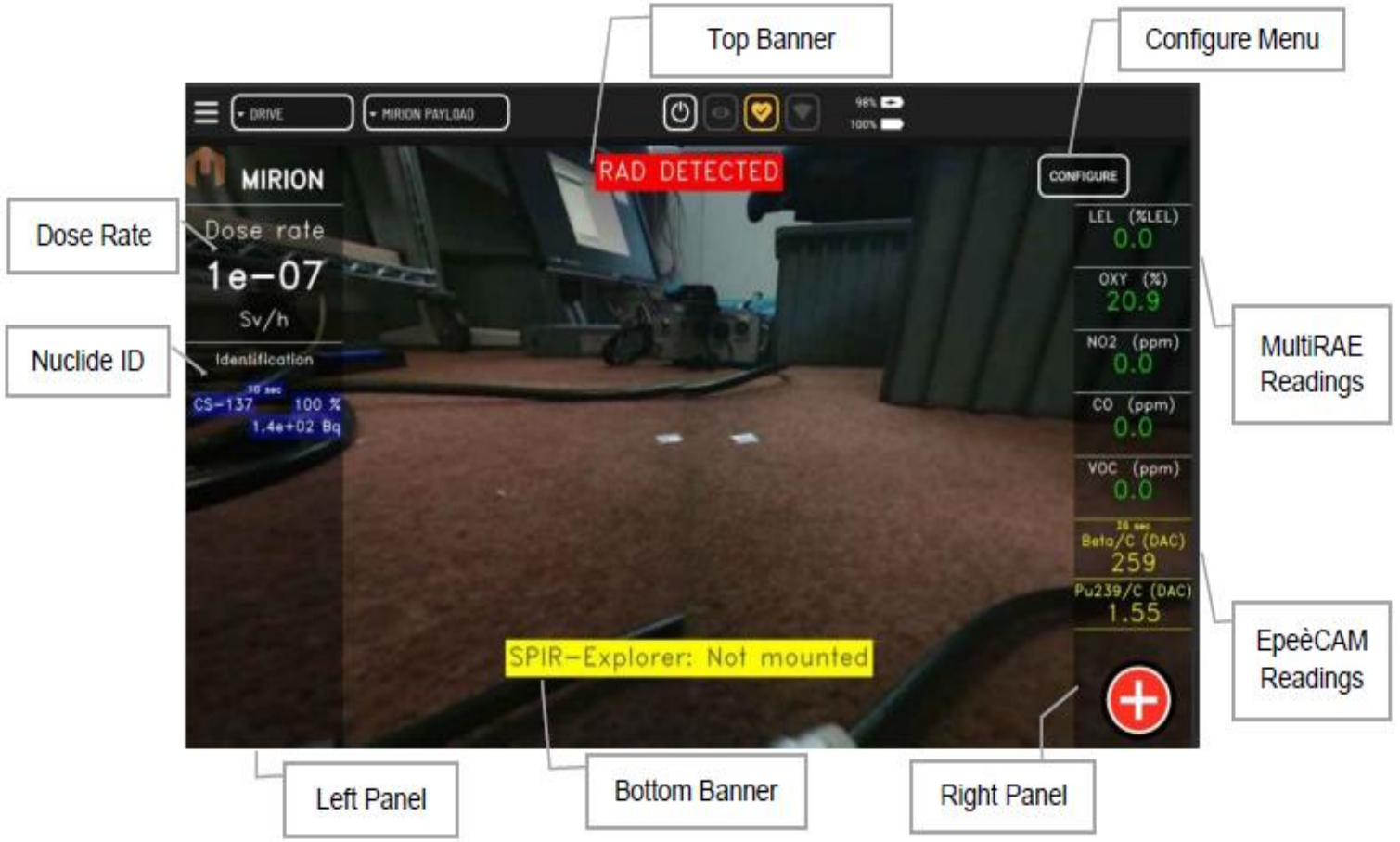
Mirion's universal payload architecture
The "Mirion Backpack" concept for SPOT

- **Internals:**
  - Industrialized, low-power embedded computer with a suite of acquisition protocols, processing algorithms, and data storage options
  - Gigabit and power connection to payload port on back of SPOT robot via flexible ribbon cable, allowing placement of the Backpack anywhere on the top rails of the robot, allowing for more payload options
  - Power supplies (24VDC/12VDC/5VDC regulated voltage from robot battery)
- **Left-side:**
  - RGB LED indication panel, showing status of all subsystems
  - On/off pushbutton
  - HDMI
- **Front/Rear:**
  - Ethernet connector (directly connected to embedded computer)
  - 9-pin, low-voltage communications connector
    - 5V output
    - USB 2.0
    - 3.3V TTL serial
    - 5V TTL serial
  - 7-pin power connector (5VDC, 12VDC, and 24VDC output)
  - SMA connector for GPS antenna
  - USB 3.0 input (backwards compatible with USB 2.0)
  - Secondary 9-pin, low-voltage communications connector

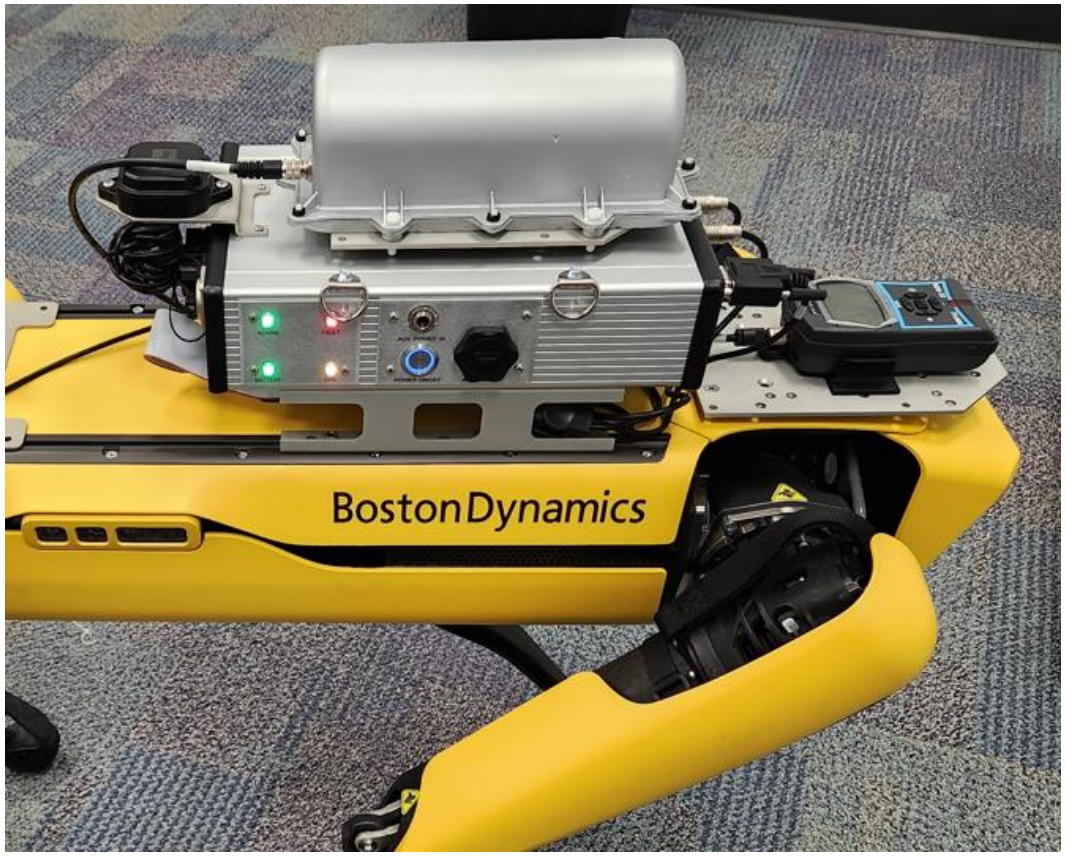
Mirion's universal payload architecture
Robot integration

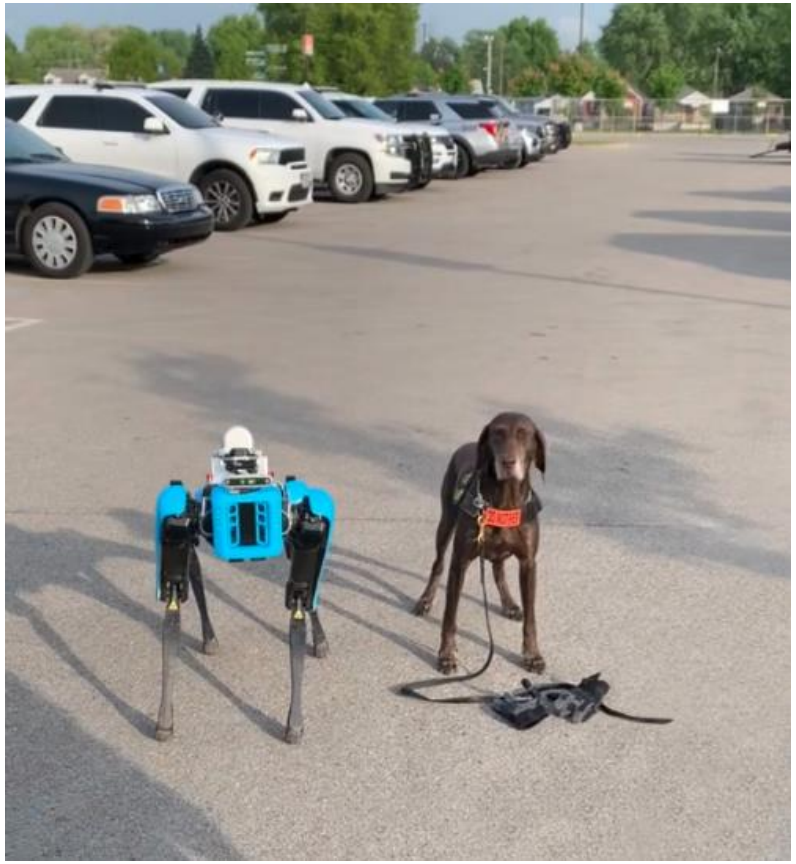
- Shares power and communications with robot
  - No additional wireless radios or batteries required
- Provides user-friendly interface directly on the robot controller
  - System status
  - Dosimetry
  - Rapid NID processing
  - Other sensor data
- External RGB indicators continuously report system status at a glance
- External connections for additional payload support
  - E.g.:
    - SPIR-Explorer or other spectroscopic detector
    - RDS-32 dosimetry
    - Chemical sensors
    - Thermal camera
- Optionally, data can be transmit to SPIR-View or othe data servers for visualization and monitoring



Rapid radionuclide identification payload options

Mirion SPIR-Explorer payload
All-in-one payload with rapid NID with dosimetry





SPIR-Explorer (NaI or $LaBr_3$ detector) for spectroscopy (rapid NID)
with low & high range GM tubes for dosimetry, HD video, depth imaging, dead-reckoning GPS, and wireless reach back

Mirion SPIR-Explorer detector

- Choice of scintillator (NaI or $LaBr_3$)
  - 1024 channels, automatic stabilization
- Low and high range detection with two internal GM tubes (up to 1000 R/h)
- Onboard processing
  - Stabilization and linearization algorithms
  - Self tests
  - Data management
  - Data output
- Lightweight: 1.5 lbs

Miniature HPGe

Dosimetry / health physics payload options

Mirion RDS-32 payload
Dosimetry w/ support for alpha/beta & neutron probes

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Mirion RDS-32 meter

- H*(10) dose equivalent rate
  - Range: 10 rem/h, or 1000 rem/h (WR version with Si)
- Support for external alpha, beta, gamma, and neutron probes
- Battery life: ~1.5 months with NiMH batteries

- Complies with IEC 60846 standards, designed to meet ANSI 42.17A / 42.17C standards (normal / extreme conditions)
- IP-67 immersion rating

Display with Gamma Probe

Display with Alpha/Beta Probe

Specialized payload options

Lidar Camera

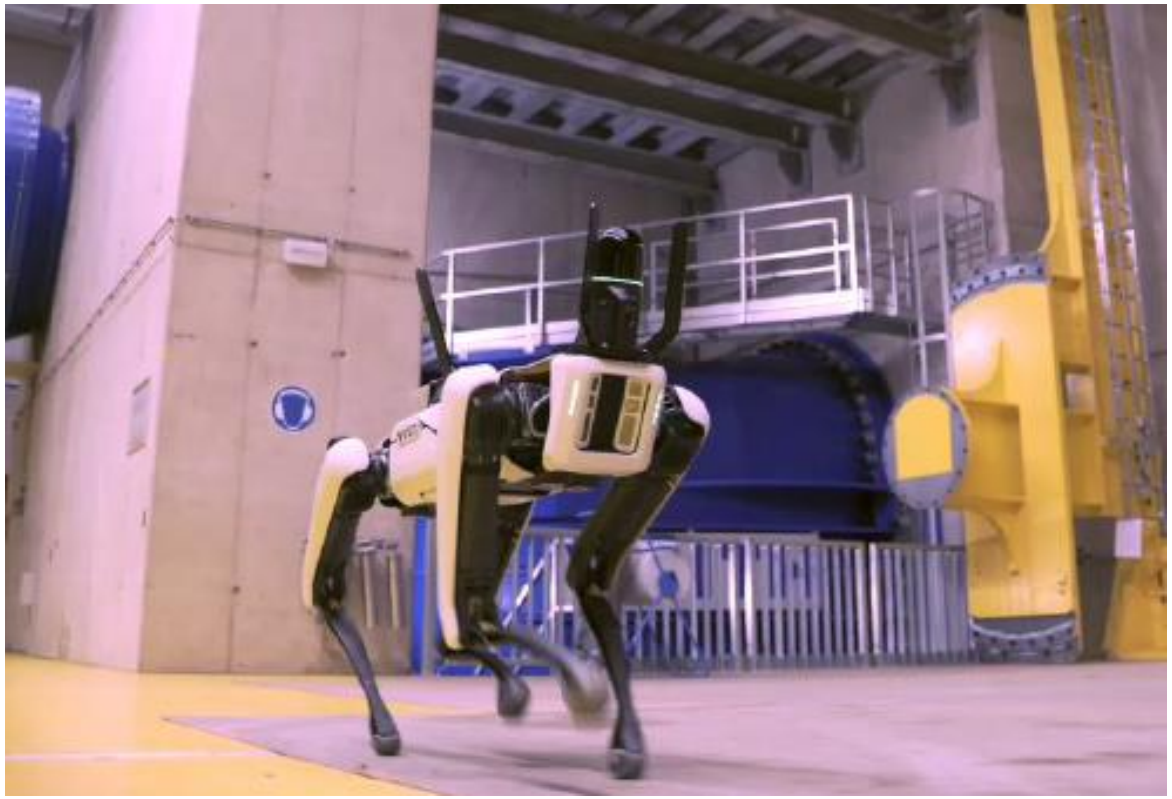
Chemical Sensor

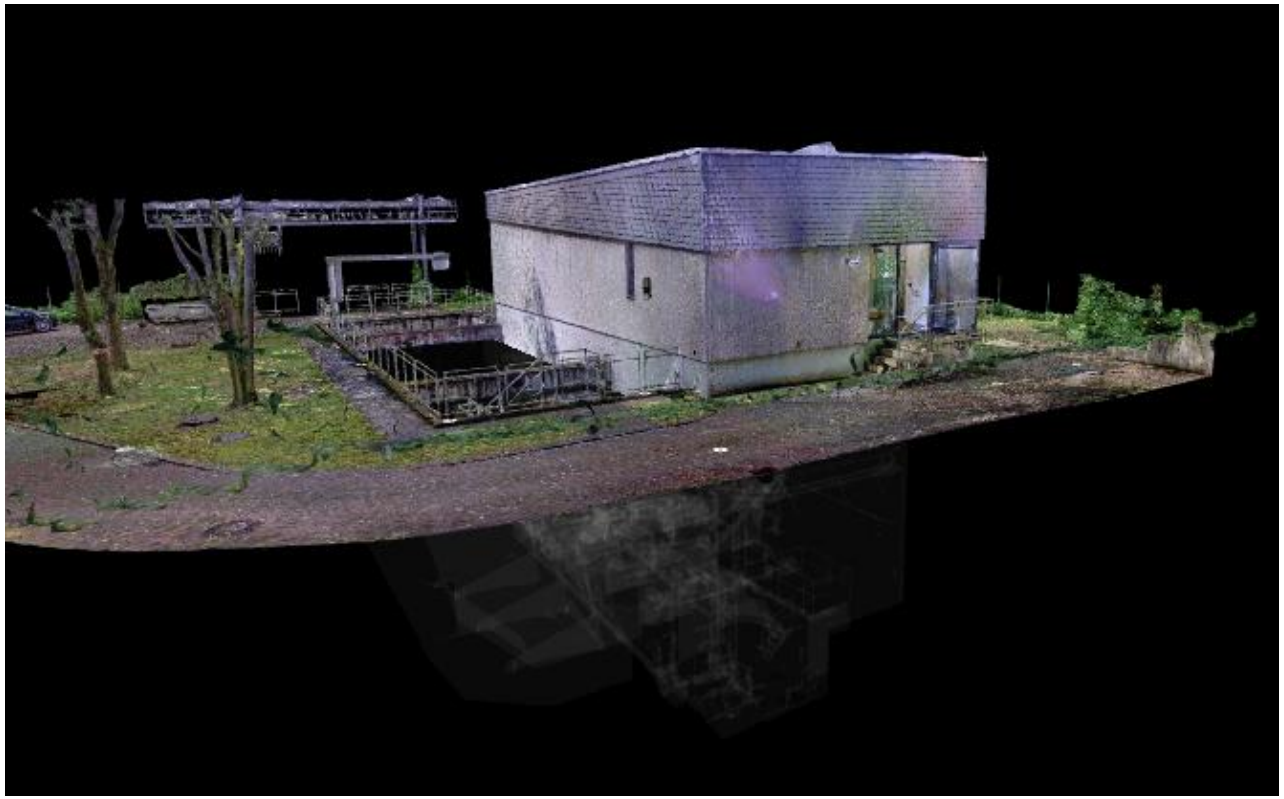
Alpha/Beta CAM

Mesh Radio

3D scanning & mapping payloads

LIDAR mapping
Digital reconstruction of facilities





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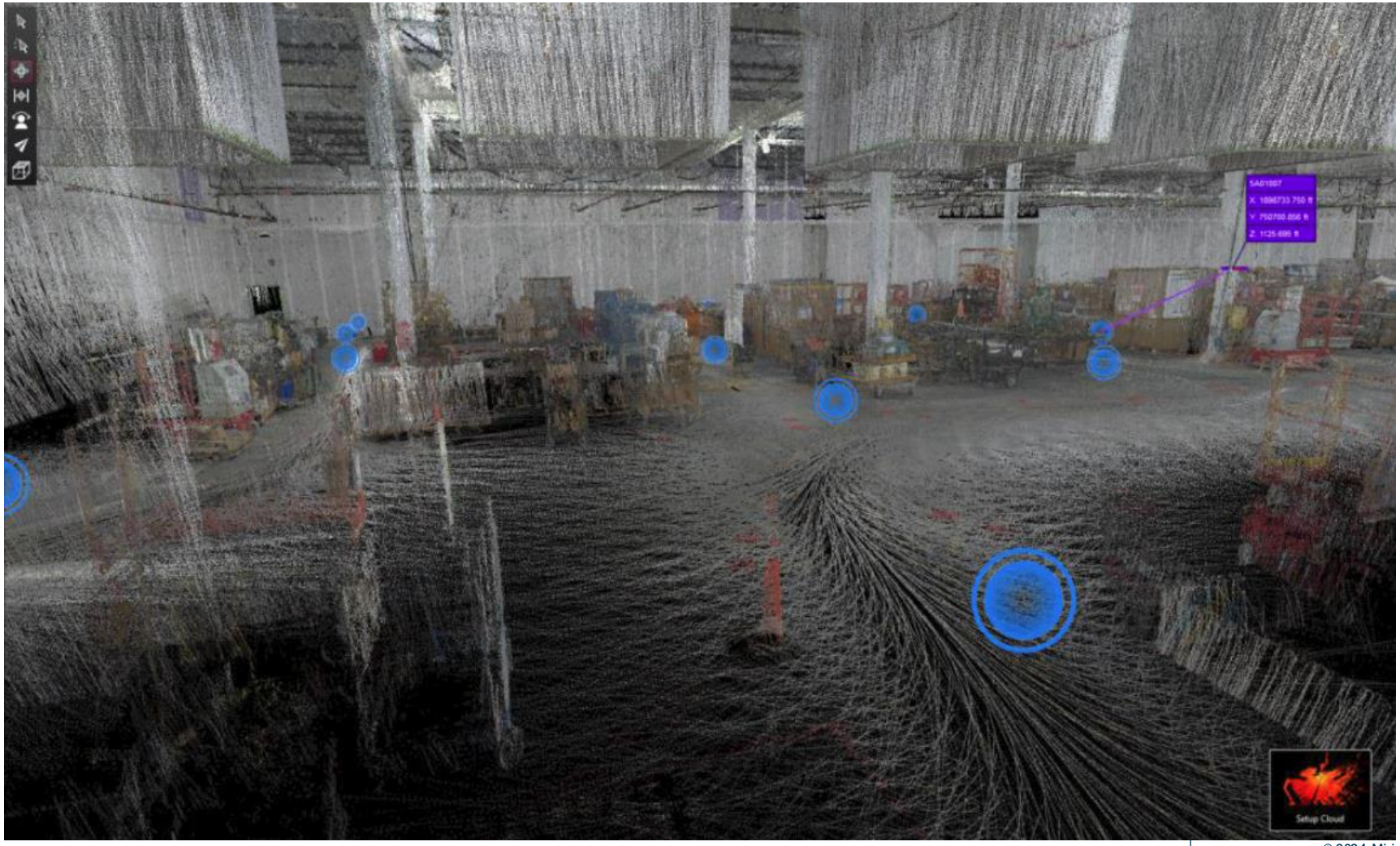
LIDAR mapping

Digital reconstruction of facilities with offline route planning



Integration with SPIR-View software

Data collection and aggregation software

SPIR-View software (coming soon)

- Background determination and monitor major radiological events
- Mapping allows for location of detector (vehicle) and live time radiological information
- Isotope Identification
- Mission Recording ability to include post mission playback
- Expandable to monitor multiple detectors (SpirVIEW Server)

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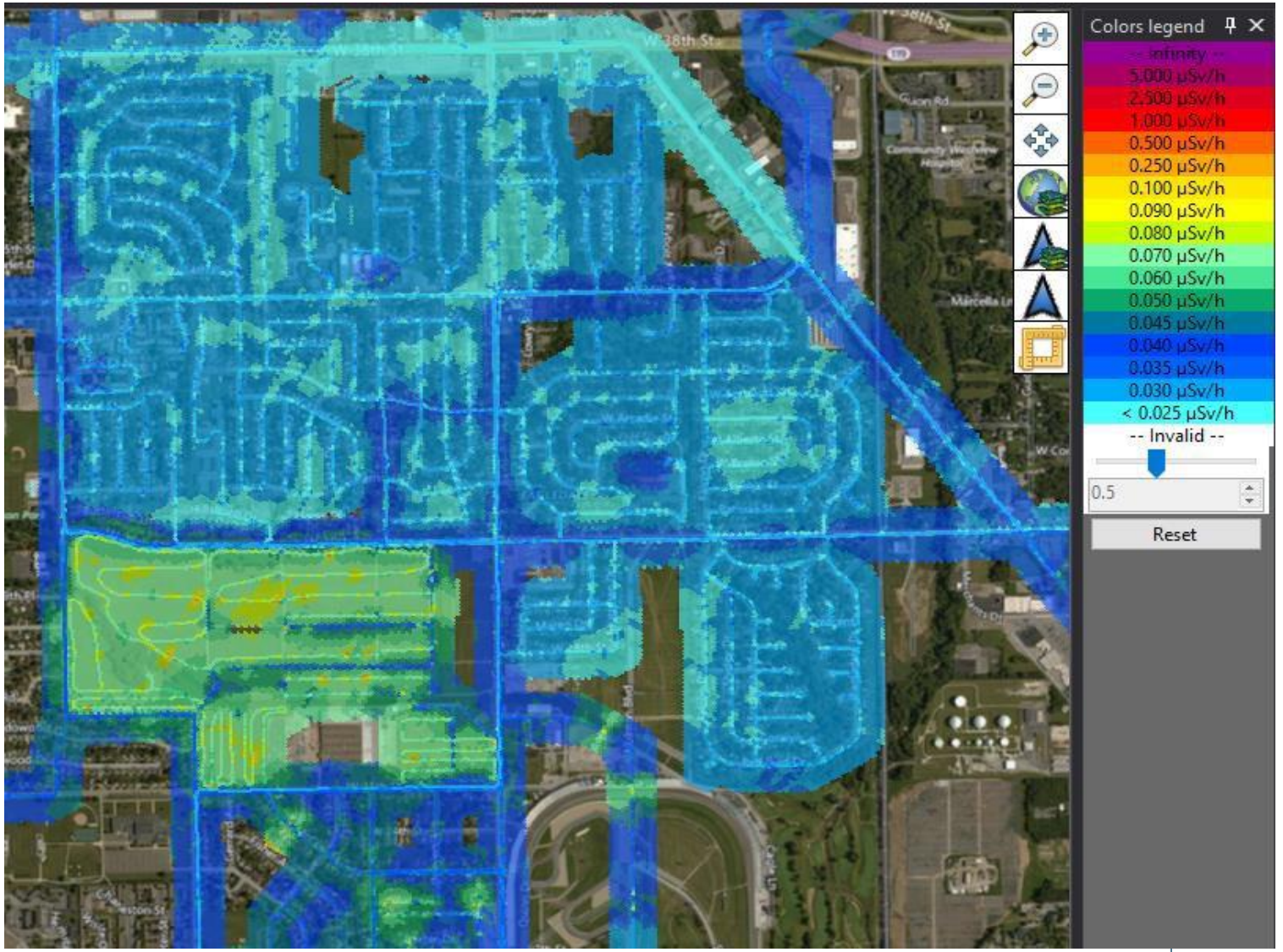
SPIR-View software



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Part IV: Play Time!!!

Thank you