

Foldable Oranef UAV for High Radiation Zones inspection in Nuclear Plants

2 June 2022

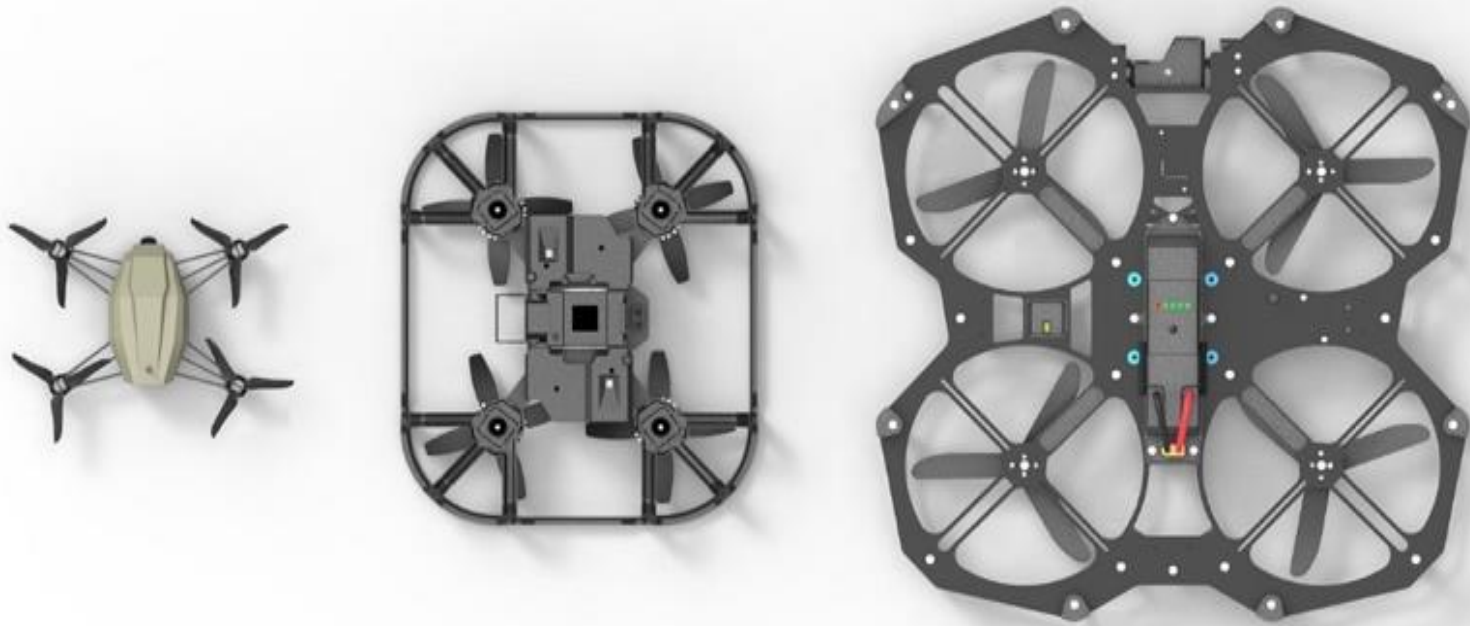


- funded in 2014
- “deeptech” technology solutions provider
- designs and produces an innovative portfolio of indoor and outdoor UAVs for :
 - Defence & Security (ISR)
 - Nuclear plants, Oil & Gas, ...
 - New markets : Precision Agriculture, Perimeter Security, Parcel Transport Service
- towards Drone-As-A-Service (Aeraccess Service)
 - Acquisition of Air Marine company (April 2022)

100% control of value chain

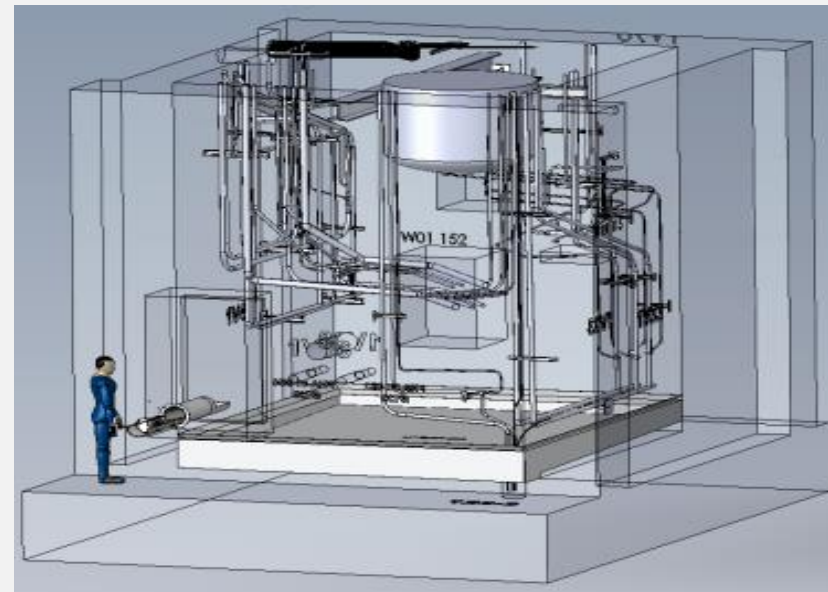


100% in-house design



Limits of existing solutions

- no human presence is allowed in High Radiation Zones (HRZ)
- no complete inspection of such zones can be done
- current robotic solutions:
 - limited range of action
 - significant shutdown period
 - heavy developments
- difficult and costly solutions to implement
- risk of radiation exposure to the operators

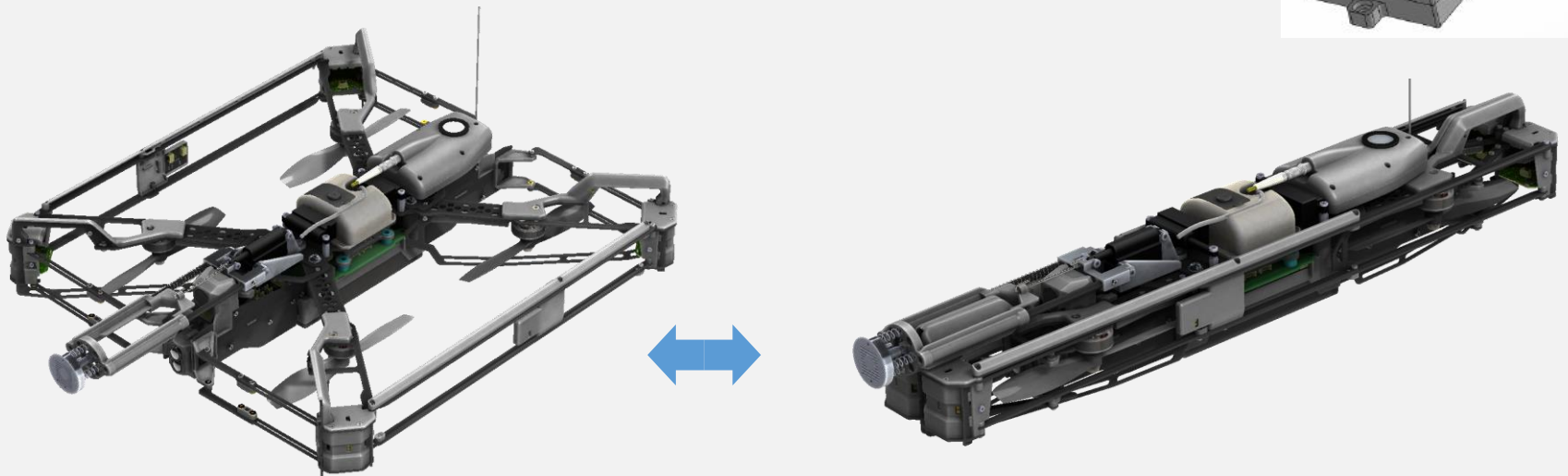


Drone solutions for HRZ inspections must address multiple specific constraints:

- no standard outdoor GPS or positioning solutions
- no contact allowed with any part of the HRZ
- interferences issues for the UAV compass due to metallic and inbox environment
- embedded measurement means on the drone
- necessity to introduce in and extract from the HRZ through a 100 mm diameter and >1m length tube

A unique architecture:

- developed and evolving since 2018
- foldable frame for its introduction through a 100 mm diameter sheath
- remote deployment of its 4 arms from the Control Station
- 4K camera for vision and peripheral sensors on 3-axis for anti-collision & stabilisation
- carry payloads such as ultrasonic (NDT) or dosimetric sensors



Oranef V1



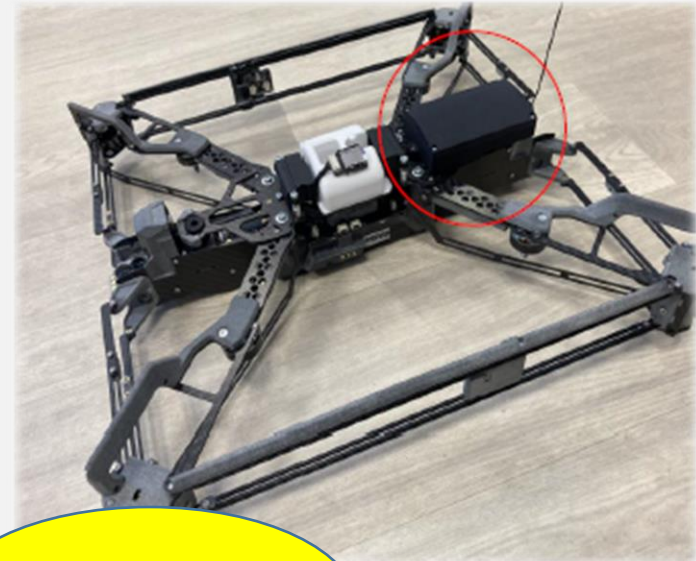
Visual 360°
inspection

Missions

Radiological
mapping

Thickness
measurements

Oranef V2

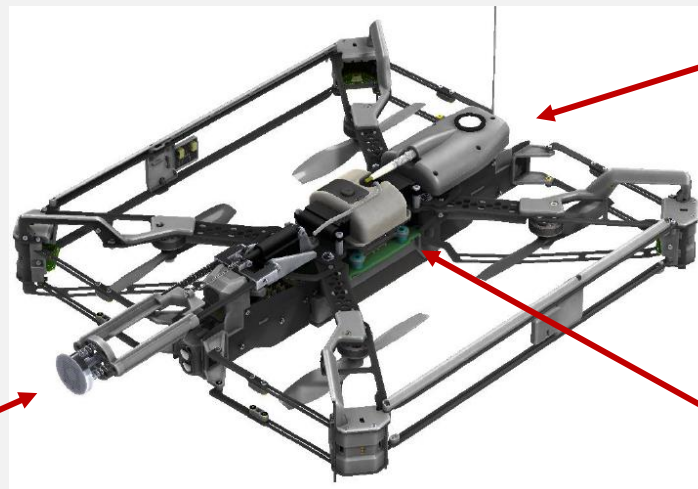


Embedded solution of thicknesses measurements with ultrasounds

- Wifi communication module (Mistras)
- Ultrasonic probe (active diameter 6.35 mm, frequency 5 MHz) (OLYMPUS probe C543)
- Specific arm for efficient probing



**Water
coupling**

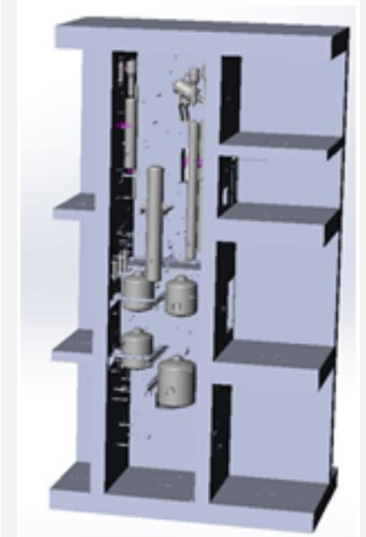
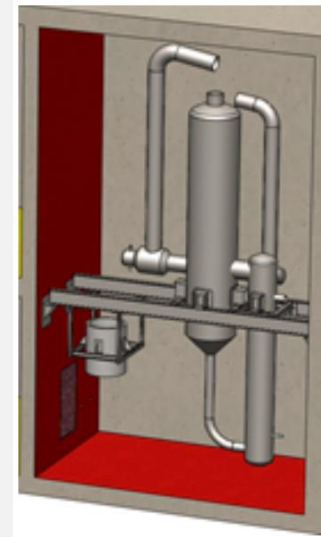
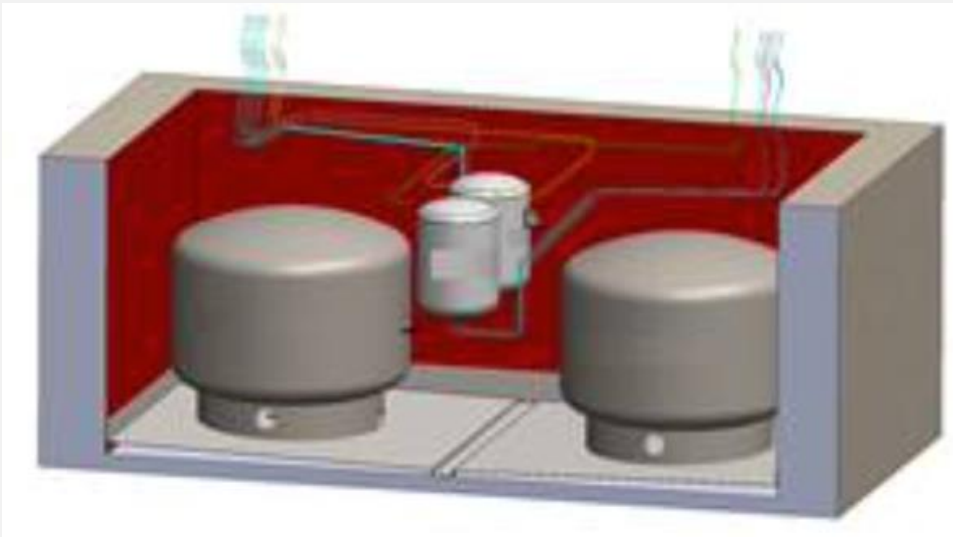


**Probing arm with
ultrasonic probe**

**Embedded Mistras
transmission module**

**Water reservoir
with pump**

- Complexity of HRZ cells
- Geometry of entry conduct to the HRZ cells
- Volume and weight of the sensors on the Oranef
- Positioning precision (obstacles avoidance & measurements)





Acoustic Drift Compensation System

Required when:

- the operator lets go of the controls
- the UAV needs a very precise straight forward trajectory

Cross technology solution, that combines:

- Acoustic/Ultrasonic ranging
- UWB ranging
- LIDAR elevation

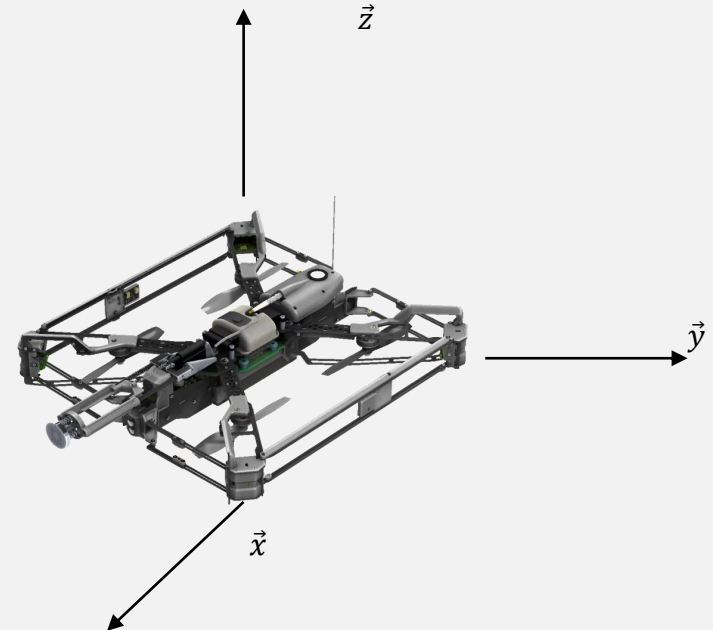
Adapted for configuration:

- LOS (Line Of Sight)
- NLOS (Non-Line Of Sight)

The precision of drift identification is $\approx 1 \text{ cm}$

Compensate until $\approx 7 - 10 \text{ cm}$ drift

Partnership with Stimshop and Orano



Spiider Project (15 months)



ROBOTICS FOR INSPECTION
AND MAINTENANCE

SLAM (“Simultaneous Localization and Mapping”) Navigation based on stereoscopic vision

- 3D mapping of HRZ cells (off-line)
- Fusion of 3D mapping with avec radiological measures (off-line)
- Control of the trajectory according to obstacles (real time)
- Decision support for precise positioning for the missions (real time)

Partnership with Probayes and Orano

UDD@Orano Project (36 months)

 bpi france



Thanks for your attention

