



The first autonomous surface robot for the oil and gas industry



ARGOS
PROJECT
THE FIRST AUTONOMOUS ROBOT FOR GAS AND OIL SITES

www.argos-challenge.com

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The ARGONAUTS team presents its robot to a member of the ARGOS Challenge jury during the third competition held in March 2017



Daniel PLATHEY

Research and Development Vice-President of Total E&P

"There is currently no surface robot designed to autonomously inspect or manage emergency situations on the Group's facilities. However, the potential benefits would be multiple in terms of operation safety and optimisation.

To address this gap, and because Total has always been driven by its pioneering spirit, our R&D department launched the first robotics challenge in the Oil and Gas industry at the end of 2013, known as the ARGOS (Autonomous Robot for Gas & Oil Sites) Challenge. This innovative challenge proved fruitful and Total currently leads the way in the development and use of autonomous surface robotics applied to our complex environments.

This open innovation project, designed to simultaneously test five robotic solutions, reflects our willingness to keep a few steps ahead by identifying technological breakthroughs, sometimes in areas far removed from our core businesses, and to explore their potential. We have called upon the most skilled in the sector and selected five international teams to develop the first generation of ATEX* and autonomous surface robots capable of operating on the Group's sites.

After three years of research, design and programming, we are striving forwards on this technological adventure with the ARGONAUTS robot, winner of the ARGOS Challenge. A pilot is now being prepared at one of our industrial sites.

Moving beyond this R&D success, the integration of robotics in our Oil and Gas activities constitutes a complete divergence from our traditional operating methods. New procedures are being drafted that will revolutionise our skills and our practices. Let's rewrite the rules for future facilities!"

*Certification required to be sufficiently robust to operate in a potentially explosive atmosphere

HIGHLIGHTS OF THE ARGOS CHALLENGE

DECEMBER 2013
Launch of the international call for projects



JUNE 2014
Selection of five teams from 31 applicants



Loïc Sabarly
French National Research Agency (ANR)

SEPTEMBER 2014
Official launch of the ARGOS Challenge



SEPTEMBER 2014
Technical meetings and tour of the competition site with the selected teams



APRIL 2015
Training week at the competition site in Lacq (South-West France)



JUNE 2015
1st competition
Promising results in autonomous navigation



Alain Goulois
President of the ARGOS Challenge jury

APRIL 2016
2nd competition
Confronting the robots with the reality of the environment



Kris Kydd
Total R&D Project Manager, ARGOS Challenge

MARCH 2017
3rd competition
Work on an industrial site in complete safety



MAY 2017
Award ceremony. ARGONAUTS (Austria/Germany) wins the ARGOS Challenge



A BOLD CHALLENGE FOR ROBOTICS EXPERTS

In 2014, five teams originating from Austria and Germany (ARGONAUTS), Spain and Portugal (FOXIRIS), France (VIKINGS), Japan (AIR-K) and Switzerland (LIO) are selected by Total from more than thirty robotics projects submitted from 15 different countries.

The teams are tasked with designing and building the first prototype of the ARGOS robot in just three years and are each assigned a global budget of up to € 600,000 to conduct their research and development work.

RIISING TO THE TECHNOLOGICAL CHALLENGES WITH OPEN INNOVATION

By launching the first challenge to be run as an international robotics competition, Total wanted to make robotics experts aware of the operational difficulties encountered in its hydrocarbon exploration and production activities. The aim is to pool the best skills in the sector, to promote partnerships and, ultimately, to boost research; a first in robotics in the Oil and Gas sector.

The ARGOS Challenge incorporates:

- 7** academic centers
universities, labs, research institutes
- 8** industrials
and start-ups
- 1** partner:
the French National Research Agency (ANR)



FPSO CLOV - Angola



Operator on the FPSO Pazflor - Angola



Gas treatment and production site - Qatar

THE AIM: A RELIABLE AND REACTIVE ROBOT TO OPTIMISE AND STRENGTHEN THE SAFETY OF OPERATIONS

Designed to operate in a potentially explosive atmosphere (ATEX standard), the ARGOS robot will make operations safer by reducing the exposure of personnel to potentially high-risk situations. Routine inspection tasks will be automated and performed by the robot, leaving the operator free to concentrate on complex tasks that robots are yet able to perform.

Hydrocarbon exploration and production activities are also subject to extreme and demanding conditions such as severe cold spells, arid climates, and isolated sites, offshore and onshore.

In this context, the robot will be able to manage operations everywhere, and to perform inspections, read and record measurements, detect anomalies and intervene in an emergency situation, where human presence is not possible.

The ultimate aim is for the robot to be used to optimise the way in which onshore and offshore facilities are operated, in addition to optimising the efficiency, costs and feasibility of future projects.

The anticipated benefits of this robotics solution are not restricted to Oil and Gas sites. They also extend to all industrial facilities worldwide, and could have positive outcomes for civil society.



FOXIRIS
Spain/Portugal

AIR-K
Japan

ARGONAUTS
Austria/Germany

LIO
Switzerland

VIKINGS
France

THREE COMPETITIONS TO CONFRONT THE ROBOTS WITH THE REALITY OF THE FIELD

From June 2015 to March 2017, the five prototypes are tested in Lacq (South West France), on a competition site representative of Total facilities and operating conditions.

The performance of the robots was assessed by a jury of four international experts and four Total employees, headed by Alain Goulois, R&D Vice-President at Total Exploration-Production until 2014.



Kris Kydd, Project Manager of the ARGOS Challenge, observes the AIR-K robot during its mission in the 3rd competition held in March 2017



Etienne Dombre, member of the jury, and Alain Goulois, jury Chairman, assessing the performance of the robots during the competitions



Site of competition at the SOBEGI safety training centre in Lacq

THE JURY USED THE FOLLOWING OPERATIONAL CRITERIA:

- Navigate and perform inspections autonomously in complete safety and deliver reliable information and analyses.
- Manage internal and external events correctly: anomalies at inspection point, internal malfunctions, emergency shut-downs, low battery, alarms, static or moving obstacles such as detecting the presence of an operator...
- Operate in a degraded situation (loss of wifi connection, unknown obstacle detection and navigation).
- Monitor the environment by analysing the sounds coming from pumps.
- Demonstrate the robot's reactivity: programming speed, rapid switch between autonomous mode and teleoperated mode.
- Develop a man-machine interface that is easy to use and intuitive.

INCREASINGLY COMPLEX TESTS

The robots tackled missions that reflected real life operational scenarios.

The main priority was to demonstrate the robots' ability to operate in potentially explosive atmospheres (ATEX standard).

The ARGONAUTS team surpassed the requirements of the ARGOS Challenge rules by presenting a fully ATEX-certified robot at the third competition.

ARGONAUTS

WINNER OF THE ARGOS CHALLENGE

In May 2017, the two partners - Austrian start-up Taurob GmbH and the research group SIM at Technical University Darmstadt in Germany - win the ARGOS Challenge.

Their complementary skills combined with a high level of expertise and a determination to succeed set them apart from the competition and resulted in the best performance.



THE FOUR CHALLENGER TEAMS

During this extremely intensive three-year challenge, the teams gave their all to prove whose robot was the most capable of operating in complete safety on the Total Group's industrial sites. Their research has opened new opportunities as well as a new generation of robots.



VIKINGS

France

IRSEEM, SOMINEX



LIO

Switzerland

ETH Zurich and Alstom Inspection Robotics



FOXIRIS

Spain & Portugal

GMV, IdMind, UPM-CAR



AIR-K

Japan

BestTechnology, Mobile Robot Research, FUJISOFT, Tohoku University, Shibaura Institute of Technology

Matthias BIEGL
Managing Director of Taurob GmbH



“ This bold challenge gave our team members the opportunity to demonstrate our expertise and dedication in developing technology for capable intelligent robots. We are especially thrilled to bring autonomous robotics technology to Oil and Gas facilities in cooperation with Total.”

Alain GOULOIS
President of the ARGOS Challenge jury



“ The ARGONAUTS robot was the most technologically sophisticated of all the robots in the competition. It has a very robust system and is highly advanced in terms of its engineering. Moreover, the robot has been designed in a modular and adaptable way, which will allow further enhancements in the future.”

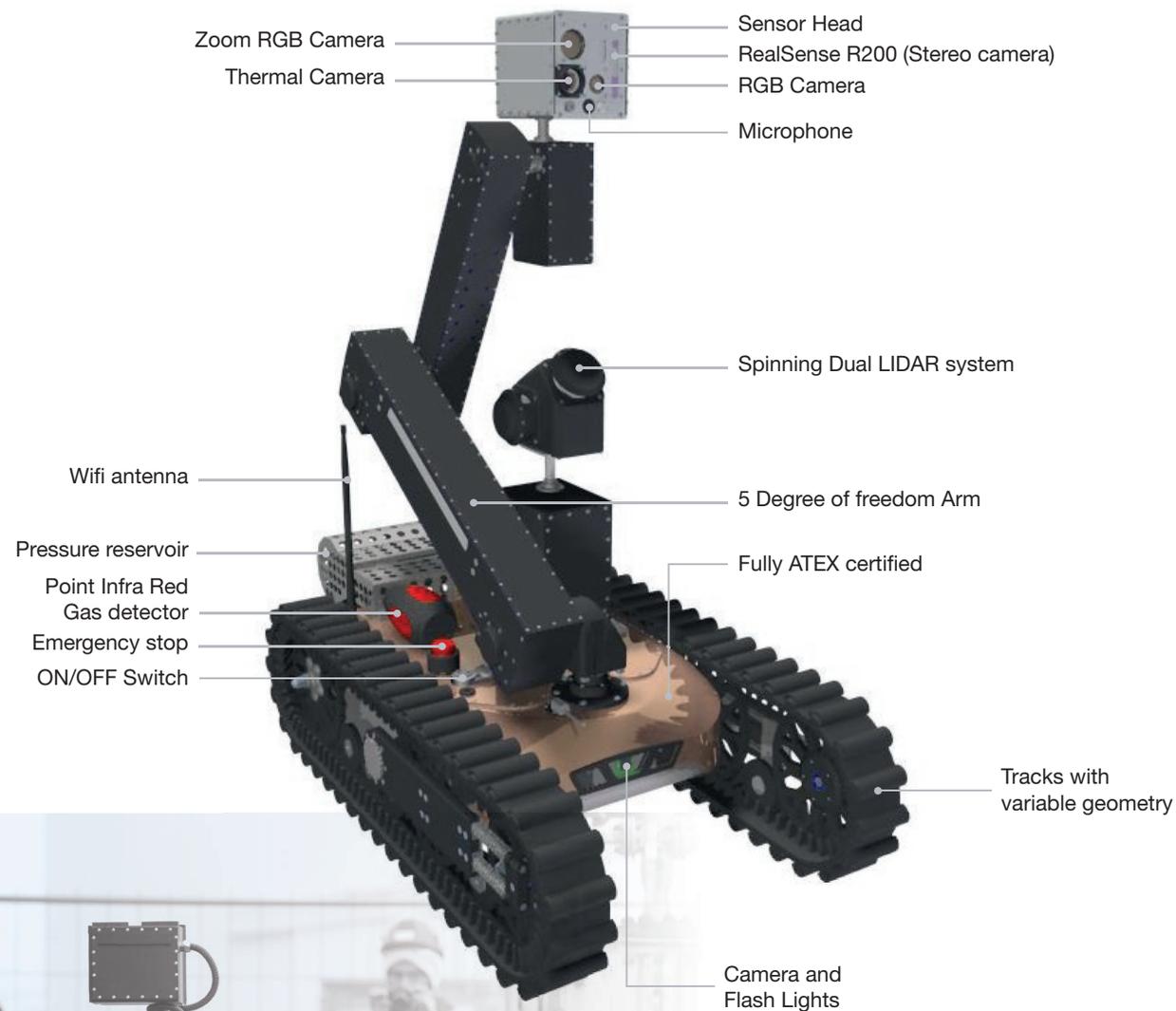
To find out more about the ARGONAUTS consortium:

Taurob: www.taurob.com

SIM, TU Darmstadt: www.sim.tu-darmstadt.de

ARGONAUTS

TECHNICAL SPECIFICATIONS OF THE ROBOT



Oskar VON STRYK

Technical University Darmstadt
Professor of Computer Science, Head of Simulation, Systems Optimisation and Robotics Group



“ Our robot enables to perform highly complex remote inspection missions in hazardous atmospheres either in fully autonomous or teleoperated mode or in combination of both. Hereby, the robot takes measurements by its vision and hearing sensors as requested and locomotes autonomously over the steps and stairs of a plant with multiple stories. Programming and adaption of a mission can be done efficiently through a highly intuitive and capable graphical operator interface. It also allows the remote operator to monitor the state of the robot and the measurements transparently at any time.”

FROM AN R&D SUCCESS

TO THE NEXT GENERATION OF OIL AND GAS FACILITIES

The ARGOS Challenge has demonstrated the potential of robotics to improve the safety of operations, to make these operations more effective and to provide backup for operators.

The encouraging results obtained during the competitions extend the scope of possibilities in terms of the operation of Oil and Gas facilities.

The robotics adventure continues with the ARGONAUTS team. The robot will be tested at a Total site in the UK with the aim to improve reliability and to gradually develop additional functionalities such as an articulated gripper arm.

The aim is to obtain a robotics solution on an industrial scale by 2022.

Simon HARE

Field Operations Manager, West of Shetland gas plant, Total Exploration & Production UK



“ One of the areas where I see the robots helping us, is by doing some tasks that human operators are not able to do such as detecting early failures in equipment by monitoring the sounds coming from pumps and motors. That means we can keep the plant running longer and more efficiently.”

Kris KYDD

R&D Project Manager, ARGOS Challenge Total Exploration & Production



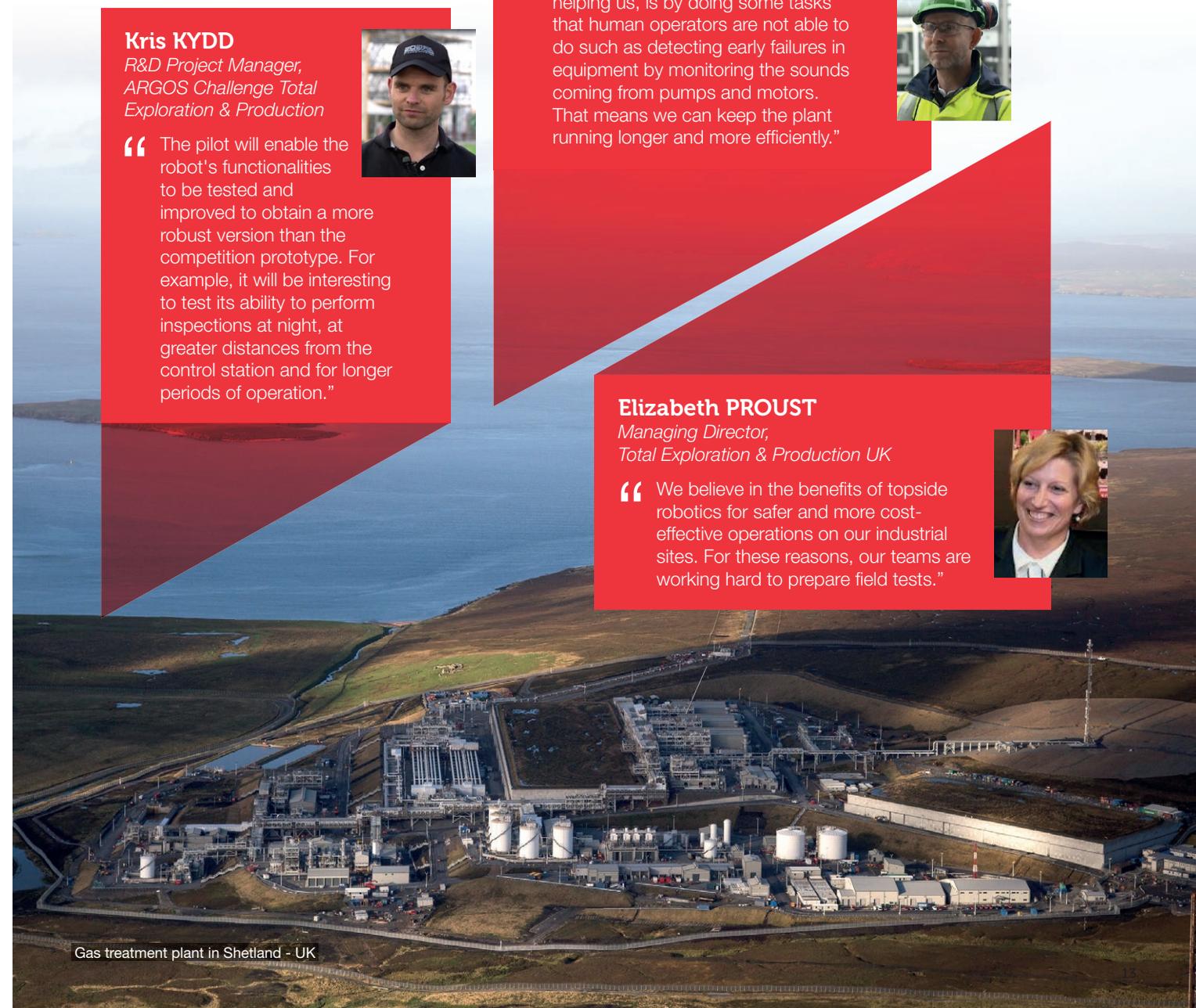
“ The pilot will enable the robot's functionalities to be tested and improved to obtain a more robust version than the competition prototype. For example, it will be interesting to test its ability to perform inspections at night, at greater distances from the control station and for longer periods of operation.”

Elizabeth PROUST

Managing Director, Total Exploration & Production UK



“ We believe in the benefits of topside robotics for safer and more cost-effective operations on our industrial sites. For these reasons, our teams are working hard to prepare field tests.”



Gas treatment plant in Shetland - UK

Group photo of the five teams and their robots, the jury, the organisers at Total, members of the ANR and teams from the SOBEGI safety training centre where the three competitions took place.



total.com



Total is a major energy player committed to supplying affordable energy to a growing population, addressing climate change and meeting new customer expectations.

Those commitments guide what we do. With operations in more than 130 countries, we are a global integrated energy producer and provider, a leading international oil and gas company, and a major player in low-carbon energies. We explore for, produce, transform, market and distribute energy in a variety of forms, to serve the end customer.

Our 98,000 employees are committed to better energy that is safer, cleaner, more efficient, more innovative and accessible to as many people as possible. As a responsible corporate citizen, we focus on ensuring that our operations worldwide consistently deliver economic, social and environmental benefits.

Our ambition is to become the responsible energy major.



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