

Maintenance & Inspection



Working in height is one of the top 3 reasons for fatal accidents

Industrial Drivers

- **Reliable inspection data**
 - Repeatable & re-producible
 - Feed asset management systems (measurement – position data)
- **Reduced outage time & costs**
 - Easy set up & fast operation
 - Minimize preparation & additional equipment (scaffolding)
- **Increased Safety**
 - Minimize working in height
 - Safe deployment & operation
- **Technology differentiator**



Case: Boiler / Combustion Chamber Inspection

Goal: Cleaning and Inspection of known “hot spots” in a short outage (6h)

- Visual (pre) inspection
- Cleaning of boiler tubes for inspection preparation
- Docking to the pipe wall having a NDT system or manipulator on board
- Adding supporting structures to a pipe wall



Burners, top down

Residual coal/slag

Coated tubes, heat shield

Tubes without coating

ALSTOM: 60'000 employees
2011: 18 fatal accidents / 6 due to working at height



Case: Pipe Inspection



Pipe Inspection

2008 Worldwide HPI maintenance spending by equipment and materials

%	Item	U.S.	O.U.S.	Worldwide
5	Piping	\$ 274.000.000	\$ 846.000.000	\$ 1.120.000.000
8	Vessels	\$ 383.600.000	\$ 1.184.400.000	\$ 1.568.000.000
6	Boilers	\$ 328.800.000	\$ 1.015.200.000	\$ 1.344.000.000
10	Heat exchanges	\$ 548.000.000	\$ 1.692.000.000	\$ 1.568.000

Source: HPI market data

.... we don't talk about peanuts!



The approach

- Flying robotics (drones)
 - Contact free inspection (visual, thermography)
 - Semi-autonomous operation
- Areal workers
 - Aerial robotic manipulation by the flying robots (cleaning, inspection, repair)
 - Semi-autonomous / autonomous operation
- Areal workers + mobile robotics:
 - Transporting & maintenance of mobile robots by aerial worker
 - Semi-autonomous / autonomous operation

