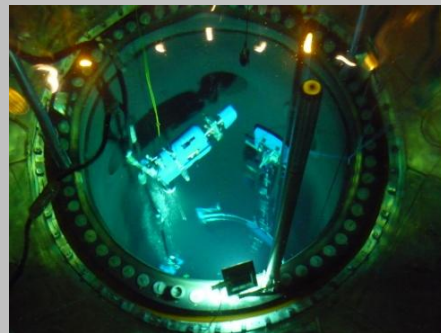


DEKRA Industrial

Torbjörn Sjö, Mats Wendel and Jorge Benitez, Business Area Nuclear
2011-10-26



 **DEKRA**
On the safe side.

DEKRA in General

One of the leading service provision companies in Europe

- Based in Stuttgart
- Operates in more than 50 countries
- Divided into 3 Business Units and 15 Service Lines
- Generates more than 1.7 billion Euros in sales
- Employs around 25,000 employees



Tecnatom Group Joint Capabilities for VVER and RBMK Market

- Tecnatom S.A is an engineering Spanish company owned by the Spanish main electrical utilities
- Tecnatom employs around 750 persons
- Tecnatom is a global leader company in delivering advanced engineering solutions that has been providing services to the nuclear industry since its creation in 1957
- The company's main activities centres on the rendering of inspection and component structural integrity services, the training of operations personnel by means of full-scope simulators and engineering in support of plant operation for the power generation market
- Tecnatom has two subsidiaries in France Metalscan and Multi2000 (M2M) companies for R&D in the area of NDT and a joint venture company in China (CITEC company) with CGNPC (China Guangdong Nuclear Power Company) for PSI and ISI services providing



Agents: Argentina, Brazil, Bulgaria, Rep. of Korea, China, Mexico, Russia, Taiwan, Ukraine.

DEKRA Resources for NDE

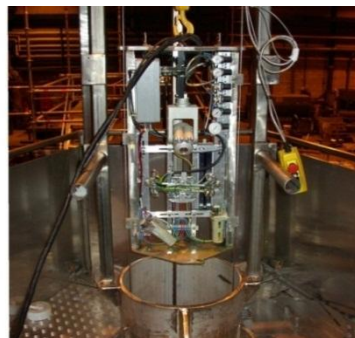
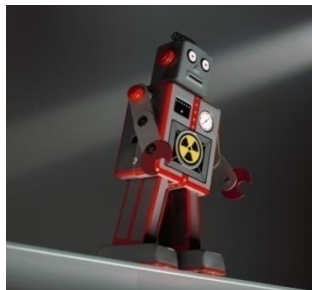
- DEKRA more than 615 persons with NDT certificates
- **Mechanized inspection:**
 - More than 80 persons with NDT certificates
 - More than 10 design engineers



Experience of our staff

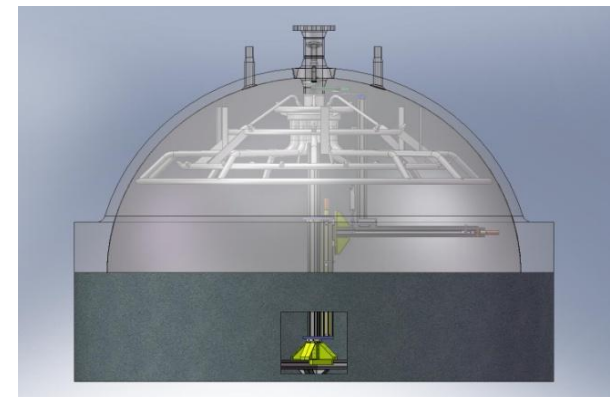
Development

- Design of manipulators
 - Vessel, Nozzle, BMI
 - Internals
 - Piping
 - Control systems
- NDE development
 - UT Sizing TOFDT
 - Phased array
 - ET
 - VT, AVT-replika
- Probes for special applications



Inspections

- BWR
- PWR
- VVER
- RBMK
- Conventional industry



Development of manipulators for PWR

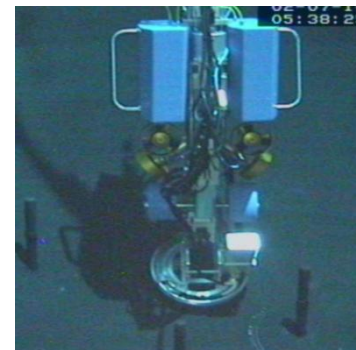
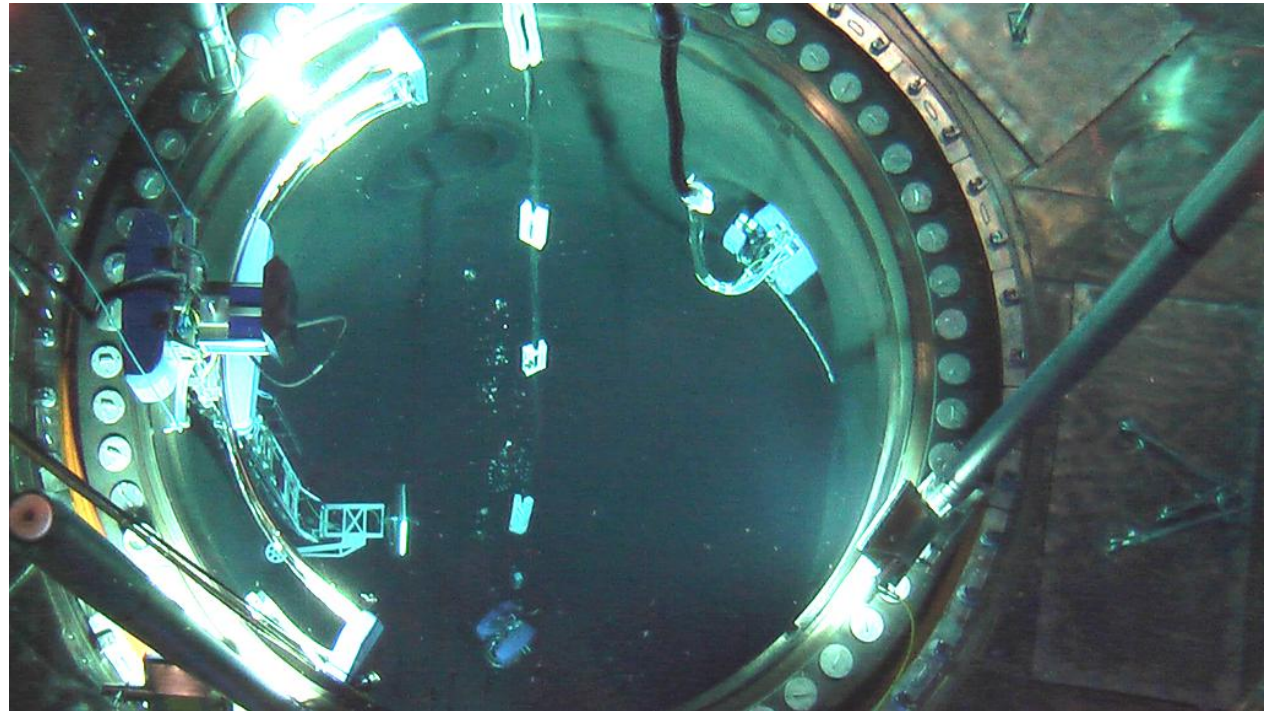
The task was to perform a qualified inspection of all vessel welds including nozzles, bottom nozzles and VT of the radial supports in Ringhals 2,3 and 4

Conclusion: a new concept is demanded in order to perform a full vessel exam in 5 days

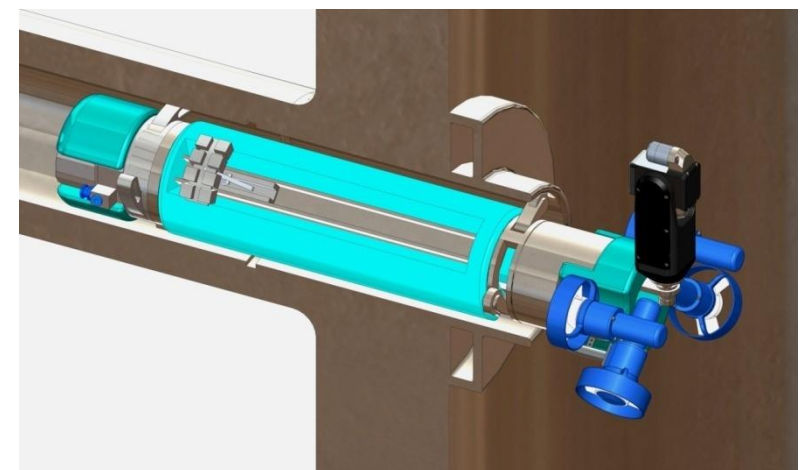
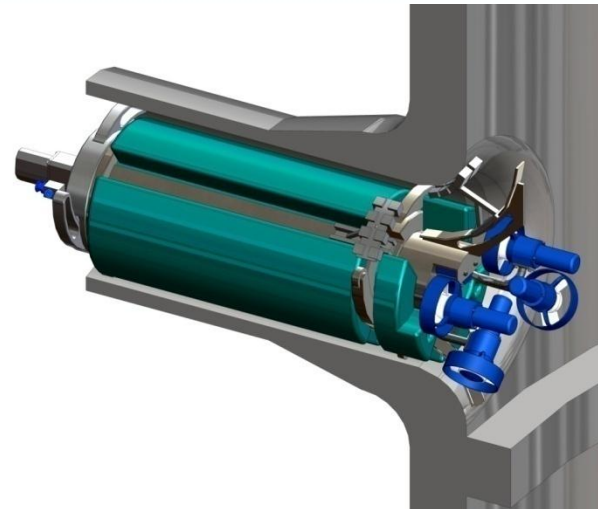
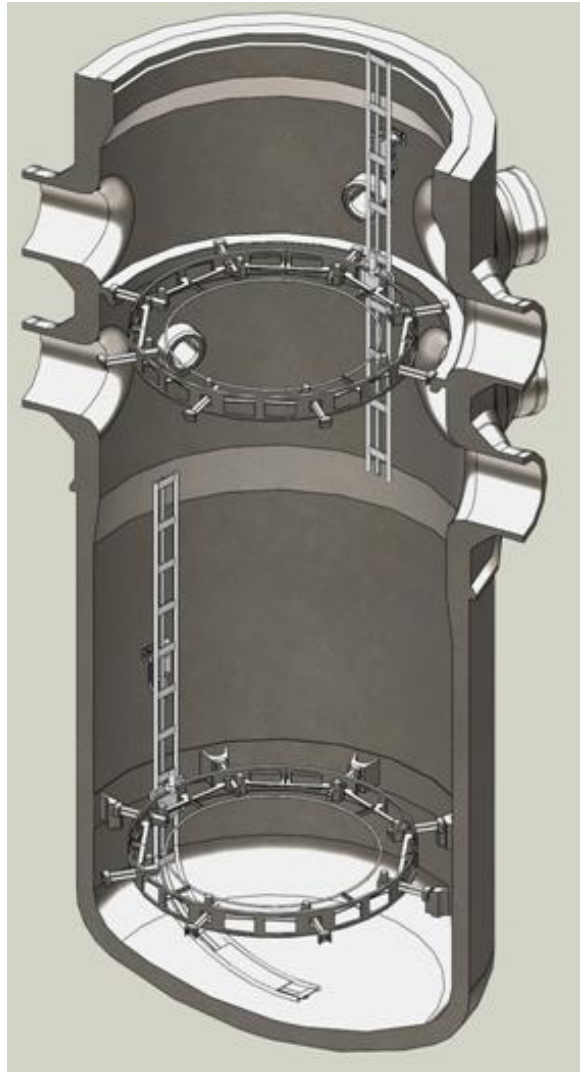
**The Customers voice:
“*A scope of this extent has never been performed before*”**

Inspection order for PWR Ringhals 2-4

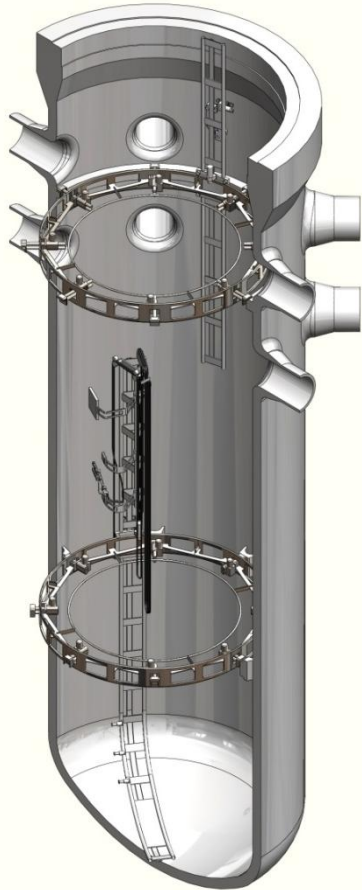
- **Parallel inspection!**
- **Inspection of the whole reactor in 5 days**
 - **Skidbladner:** Circumferential and longitudinal shell welds including the bottom dome
 - **Särimner:** Inlet and Outlet Nozzles, Nozzle to shell welds, inner radius and connection welds
 - **Gungner:** BMI Nozzle and J-groove
 - **Draupner:** Moulding VT tool for BMI J-groove weld



VVER Vessel manipulators for parallel inspection

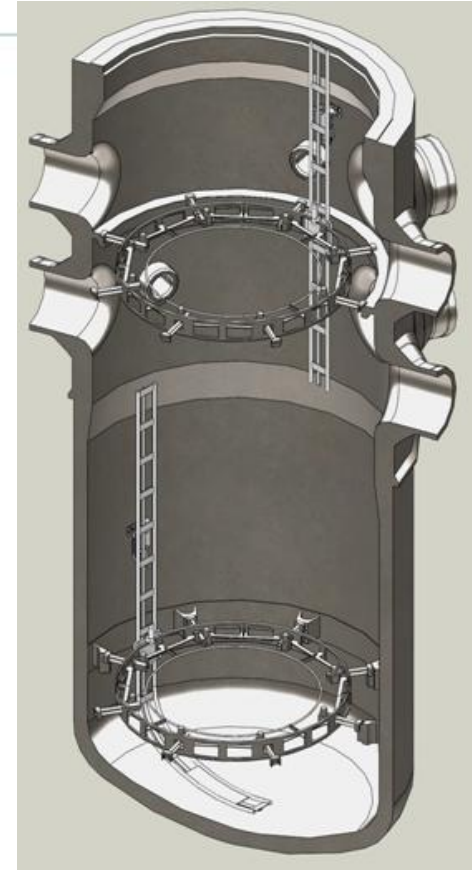


Manipulator for Inspection of RPV Welds and base material



Manipulator for inspection of VVER 440

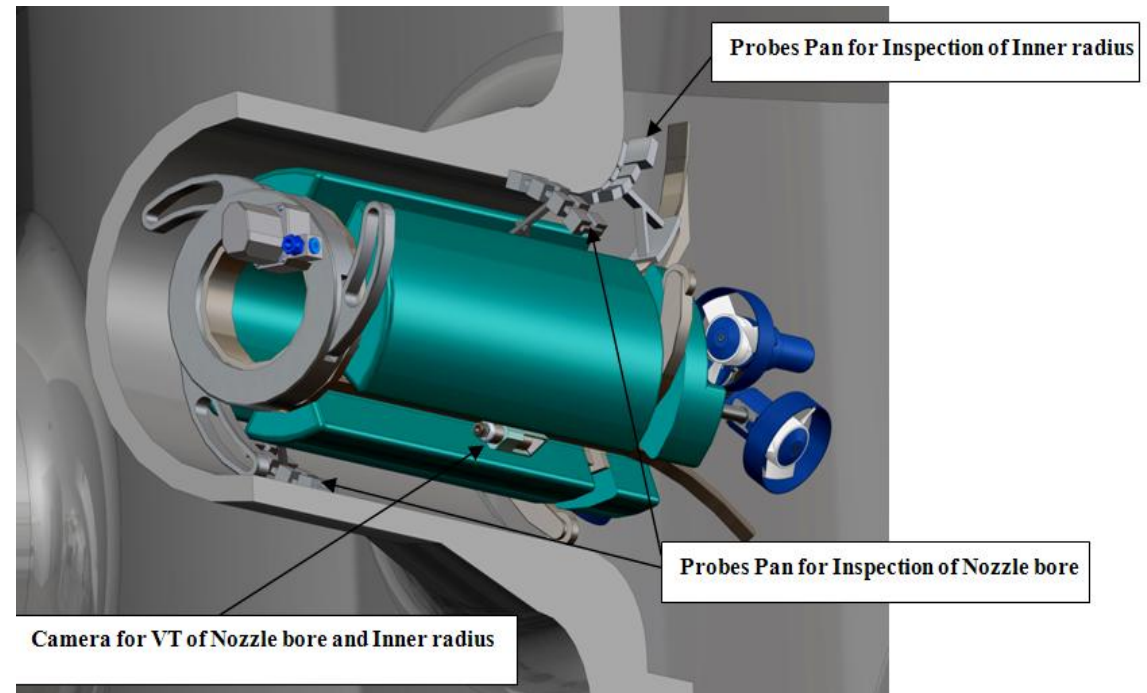
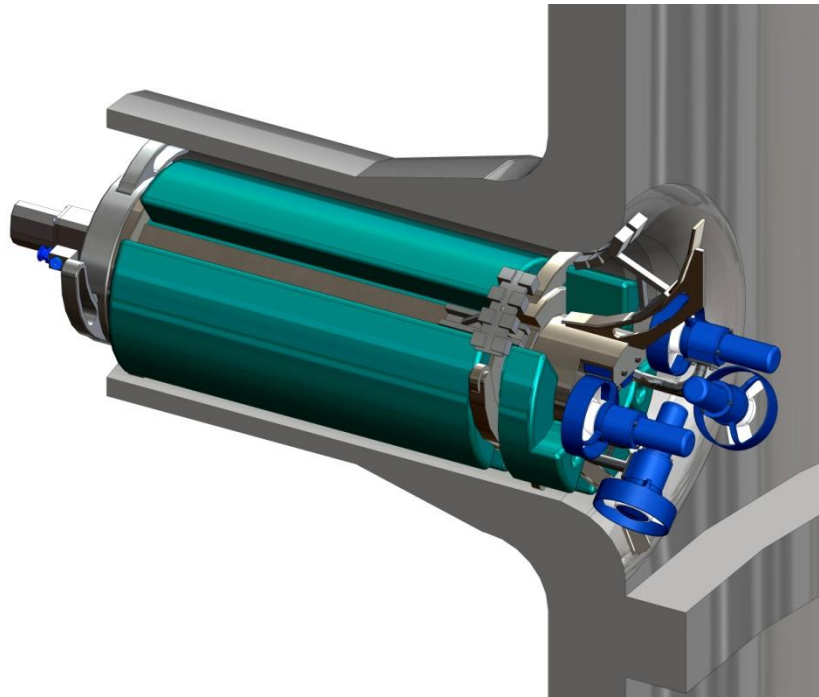
Circular rail mounted in the lower support for inspection of the lower part of RPV and the circular rail mounted in the water dividing ring for inspection of the upper region. (Note that the curved rail in the upper position is hidden in these pictures.)



Manipulator for inspection of VVER 1000

The figure shows the rail mounted in the two different positions and also the different vertical position of the mast compared with the position in a VVER1000. (Note that the curved rail in the upper position is hidden in these pictures.)

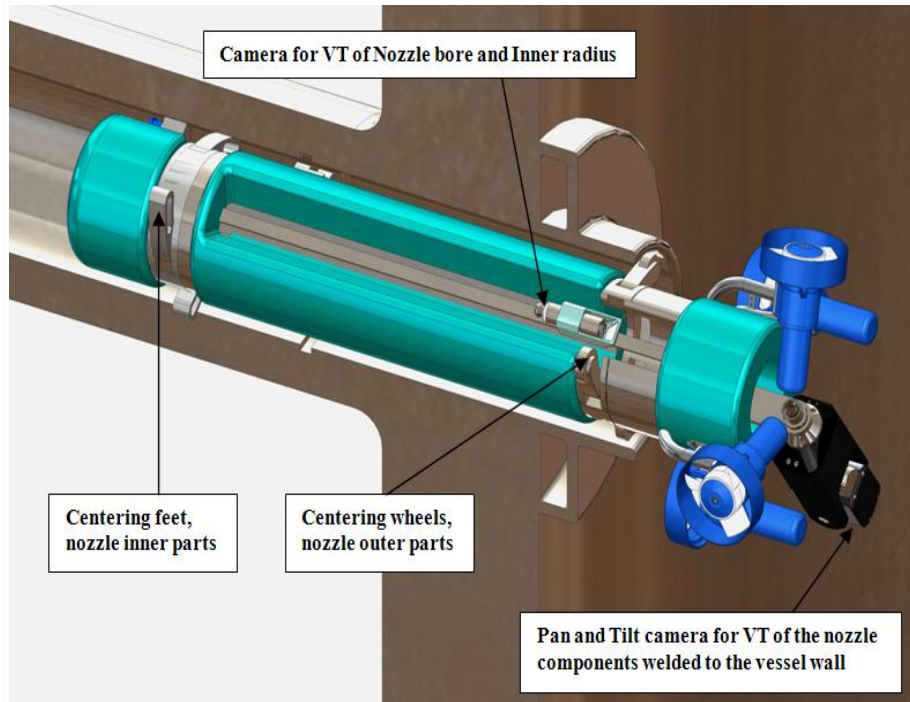
Manipulator for Inspection of Ø850/500 mm nozzles



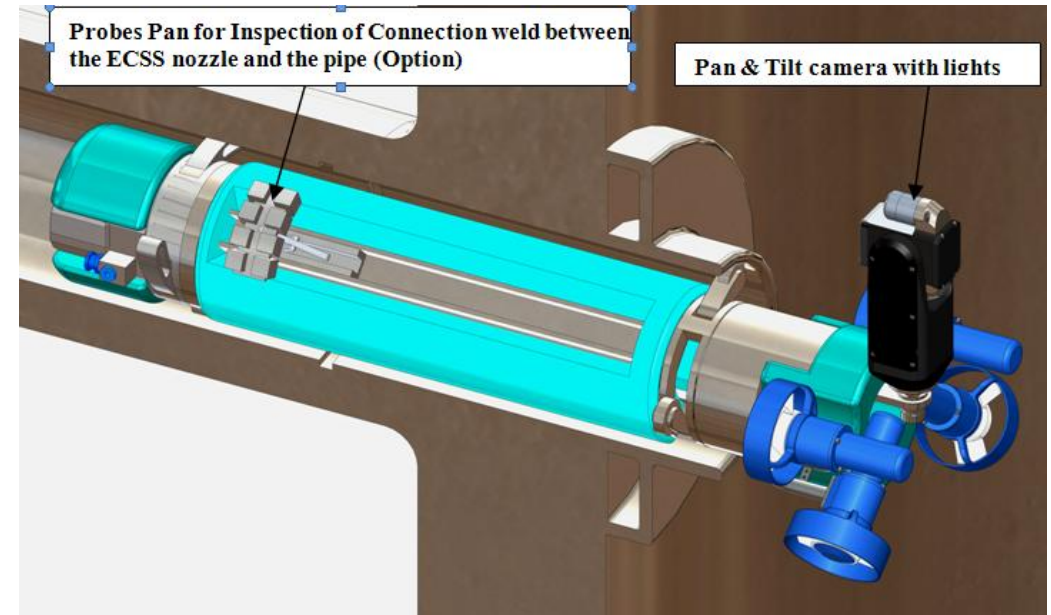
Manipulator for inspection of Ø850/500 mm nozzles, showing probe pans for the nozzle bore and inner radius. The figure also shows the ROV thrusters and floatation blocks with slots for centering arms. The cables are attached in the centre of the manipulator and designed to allow a rotation of more than 400°

Manipulator for inspection of Ø850/500 mm nozzles, showing an inspection camera in the in the floatation block slot and the probe-pan for inspection Inner Radius and probe-pan for inspection of Nozzle bore

Manipulator for Inspection ECCS nozzles



Manipulator for inspection of ECCS nozzles, showing the inspection camera in the floatation block slot and also the camera for inspection the nozzle components welded to the vessel wall. The figure also shows the ROV thrusters and floatation blocks with slots for centering arms. The cables are attached in the centre of the manipulator and designed to allow a rotation of more than 400°

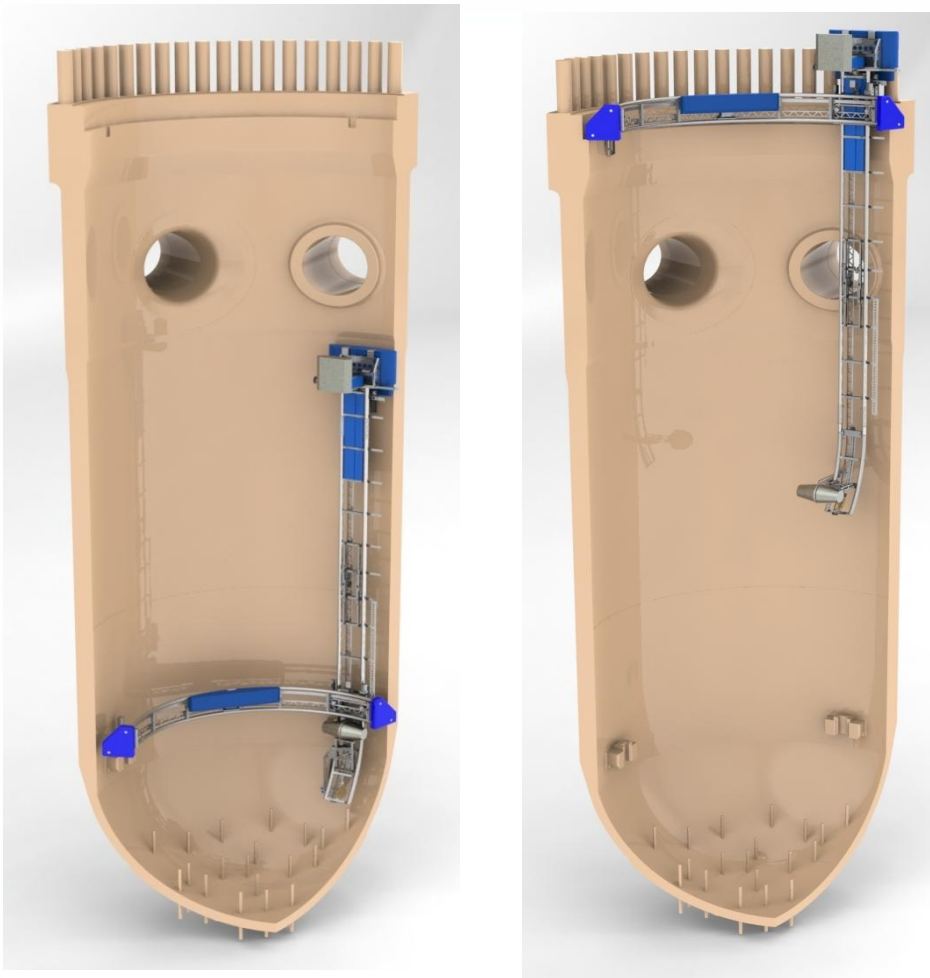


Manipulator for inspection of ECCS nozzles, showing the probe-pan for inspection of the connection weld between the ECCS nozzle and the pipe.

Note: this is an Option

Vessel manipulator ...

Skidbladner

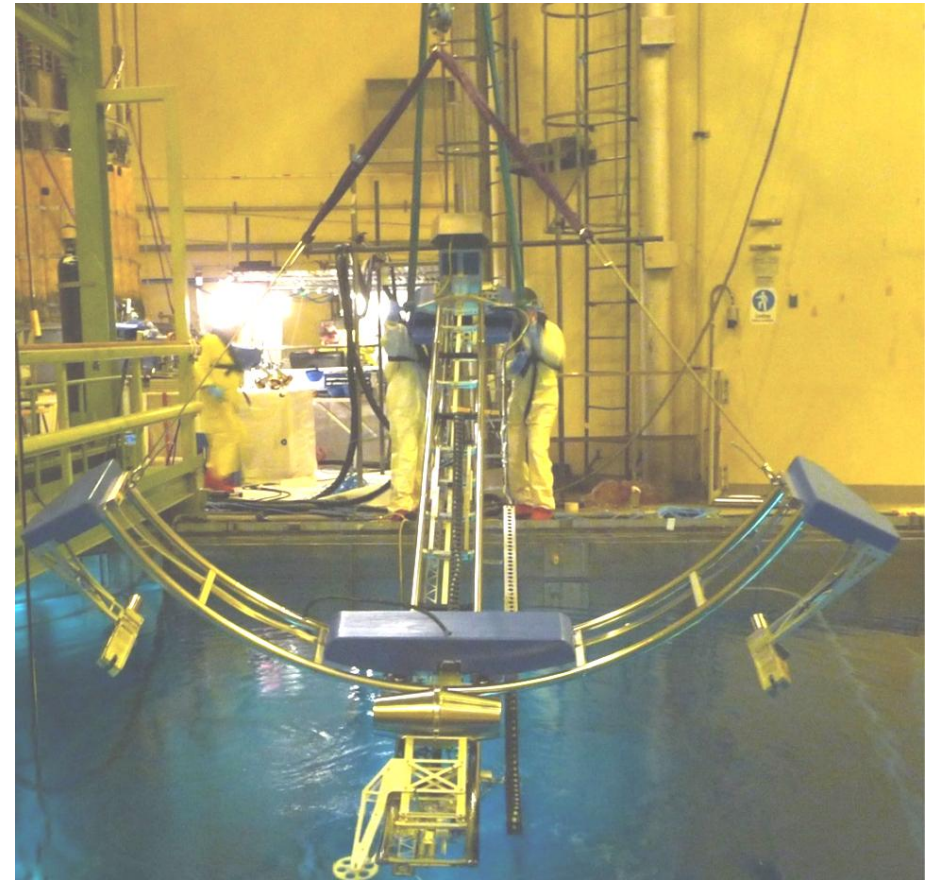


- Light weight and easy to handle
 - Neutrally buoyant
 - Allows for parallel activities
- Inspection of circumferential and longitudinal shell welds including the bottom dome
 - Upper region (four positions)
 - Lower region (four positions)

... Vessel manipulator

Skidbladner

- **Launching and fixation**
Manually by two operators, from refueling machine or auxiliary bridge
- **Fixed references**
The radial support guides give a repeatable and precise position in direct relation to the vessel, with no need for complicated positioning system
- **Facilitates parallel work**
For other manipulators or Inspection cameras etc.



Nozzle manipulator

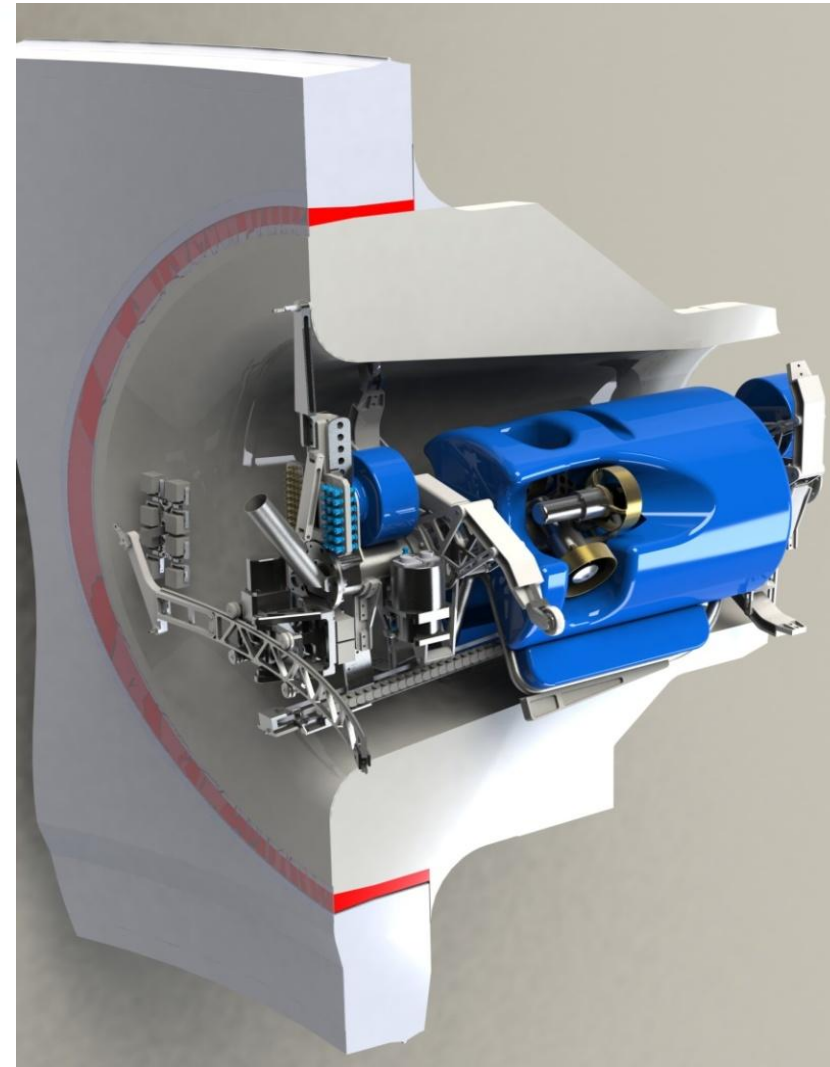
Särimner

- ROV- Scanner
... manoeuvring between nozzles

Manually launched into the water from the auxiliary bridge, with no need of polar crane.

The ROV functions and centering is remotely controlled with a wireless joystick

- Inspection of:
 - Nozzle to shell welds
 - Inner radius
 - Connection welds
 - Nozzle bore

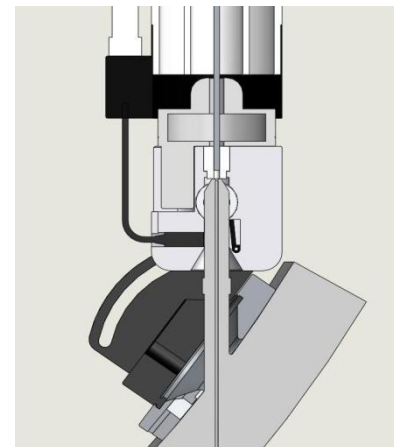


BMI (Bottom Mounted Instrumentation) Nozzle Manipulator

Gungner

- ROV-Scanner
... manoeuvring between nozzles
(Surveillance by an underwater camera)

- Inspection of:
 - Inner surface of nozzle
 - Connection weld
 - J- groove from ID
 - J- groove and HAZ from OD of Nozzle



Moulding VT Tool

Draupner

- A moulding tool based on the BMI Nozzle manipulator concept which will be remotely controlled with rods and a wire system
- The moulding tool makes a mould from the full circumferential of the BMI J-groove weld
- Detection target 2mm x 3µm

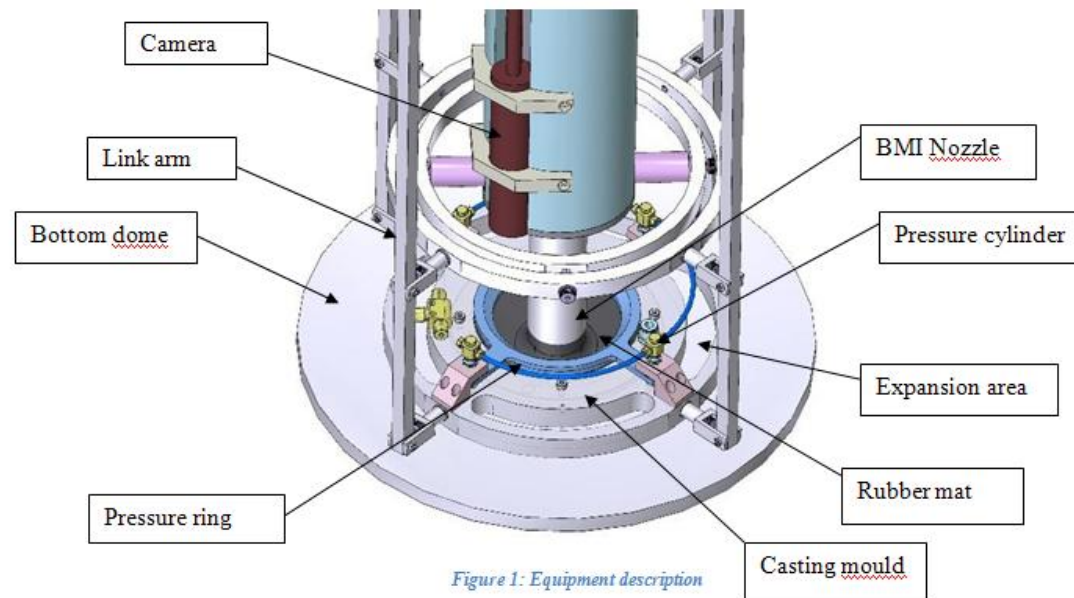
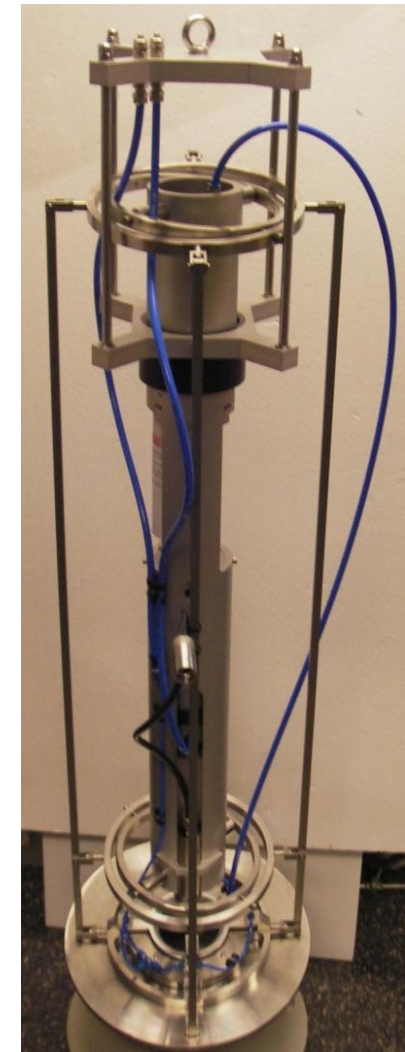
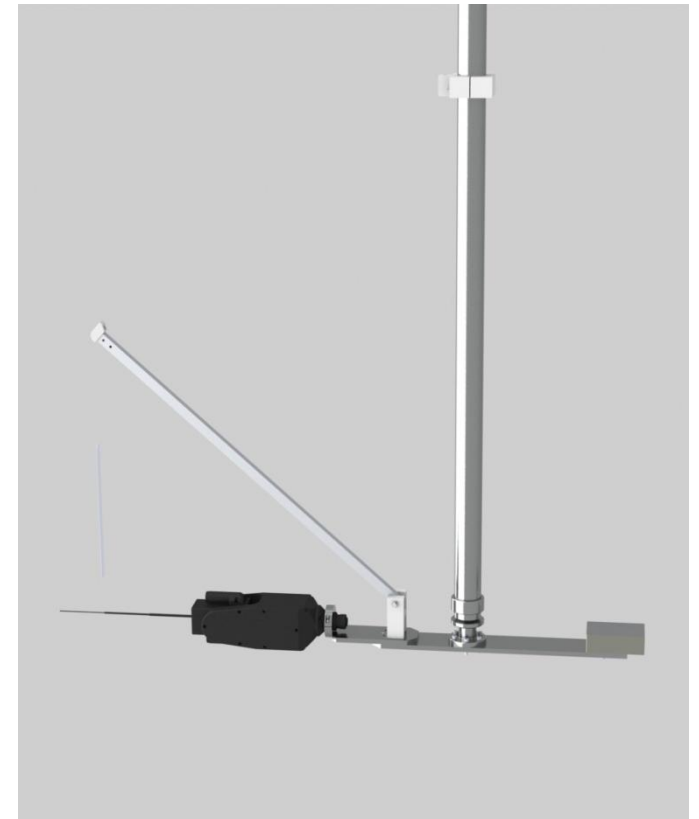


Figure 1: Equipment description

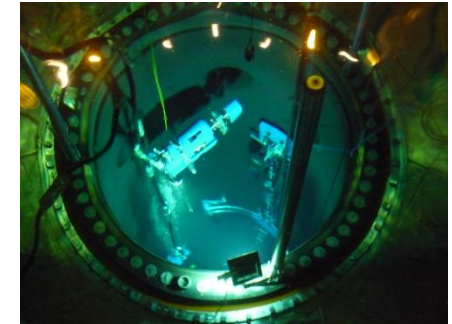
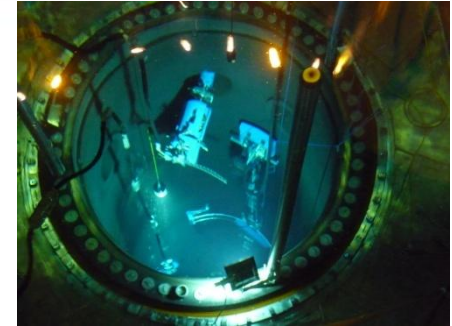
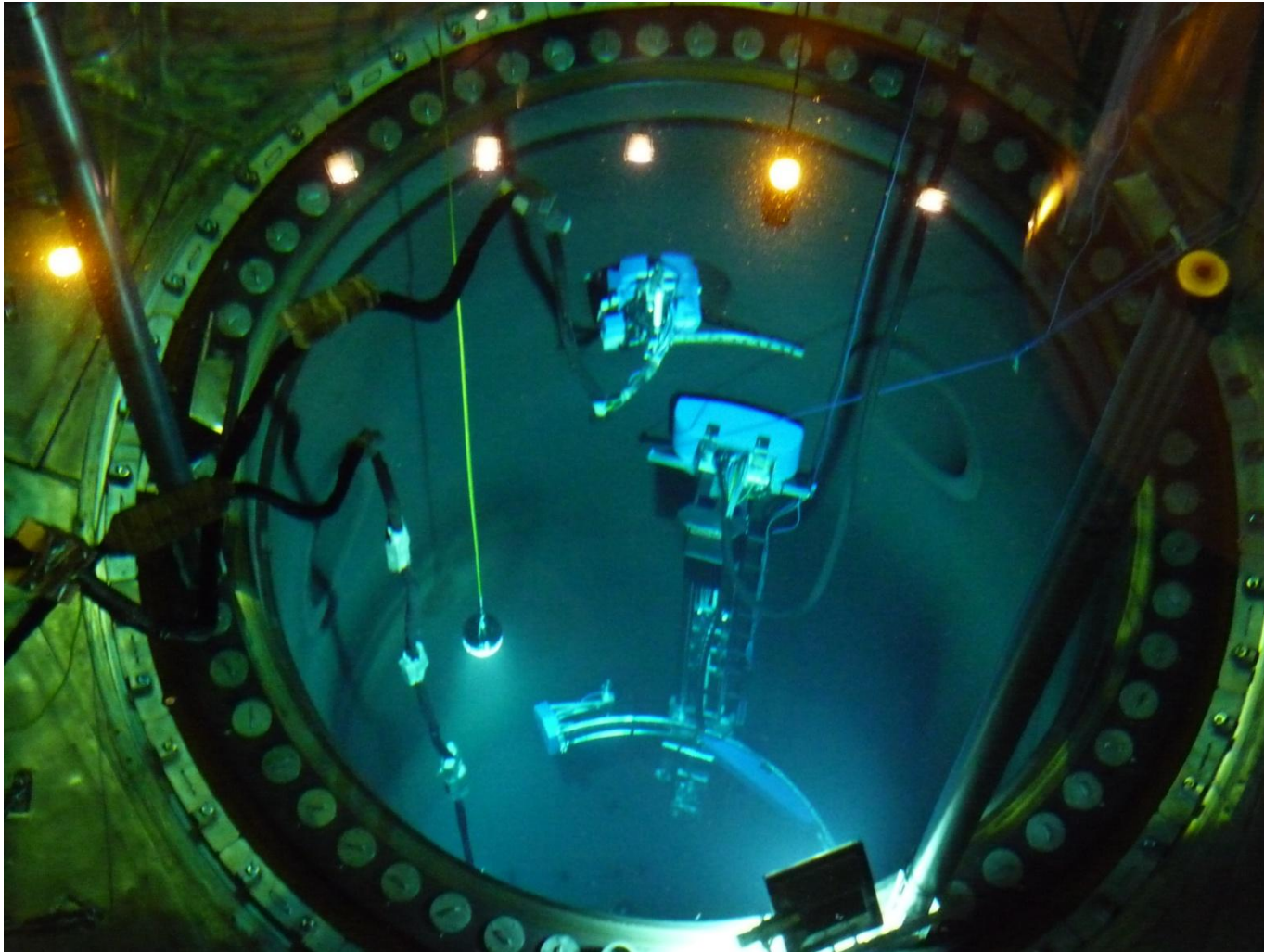


Visual Inspection of Radial Support Welds

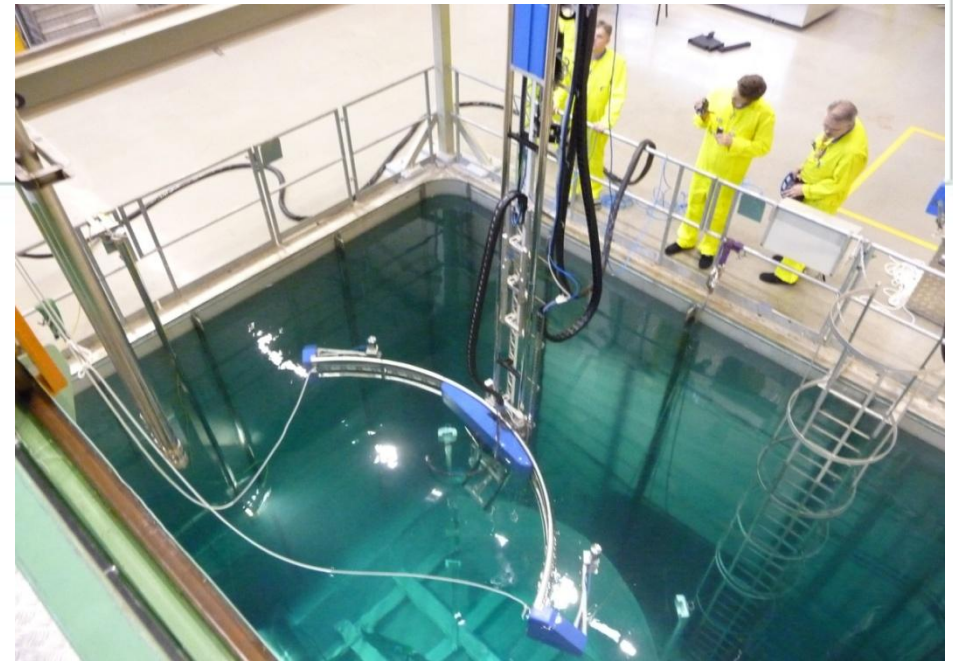
- Qualified inspection; Procedure VT01
- Inspection with a camera connected to the rigid pole-system
- Detection target $20\mu\text{m} \times 5\text{mm}$



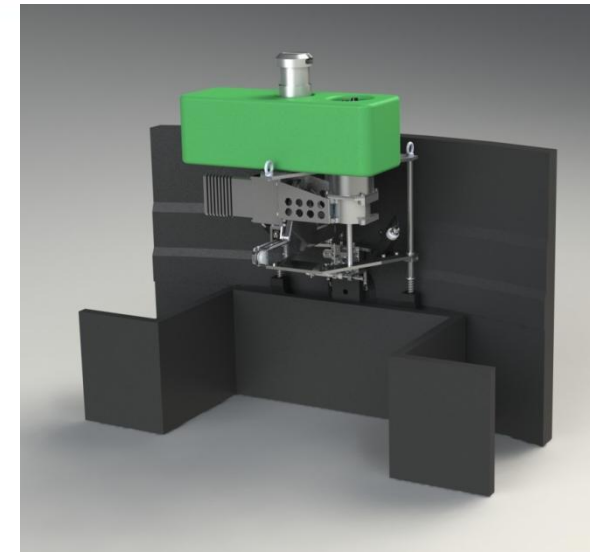
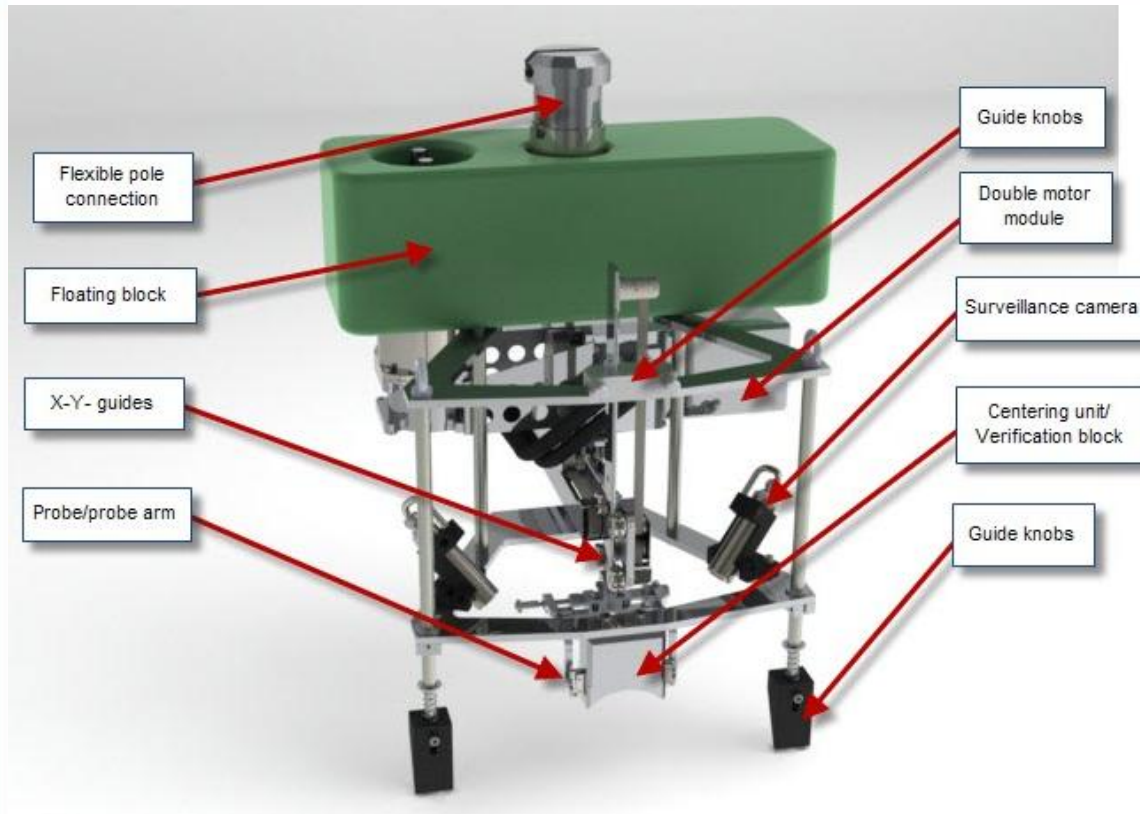
Parallel work in Ringhals 3, September 2010 Full vessel inspection in 5 days. Probably a world record!



Training and qualification



Inspection of stellite cladding on surface of Core Plate Radial Support key



The scanner placed in the mockup

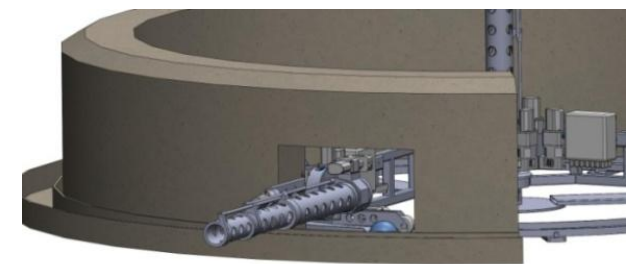
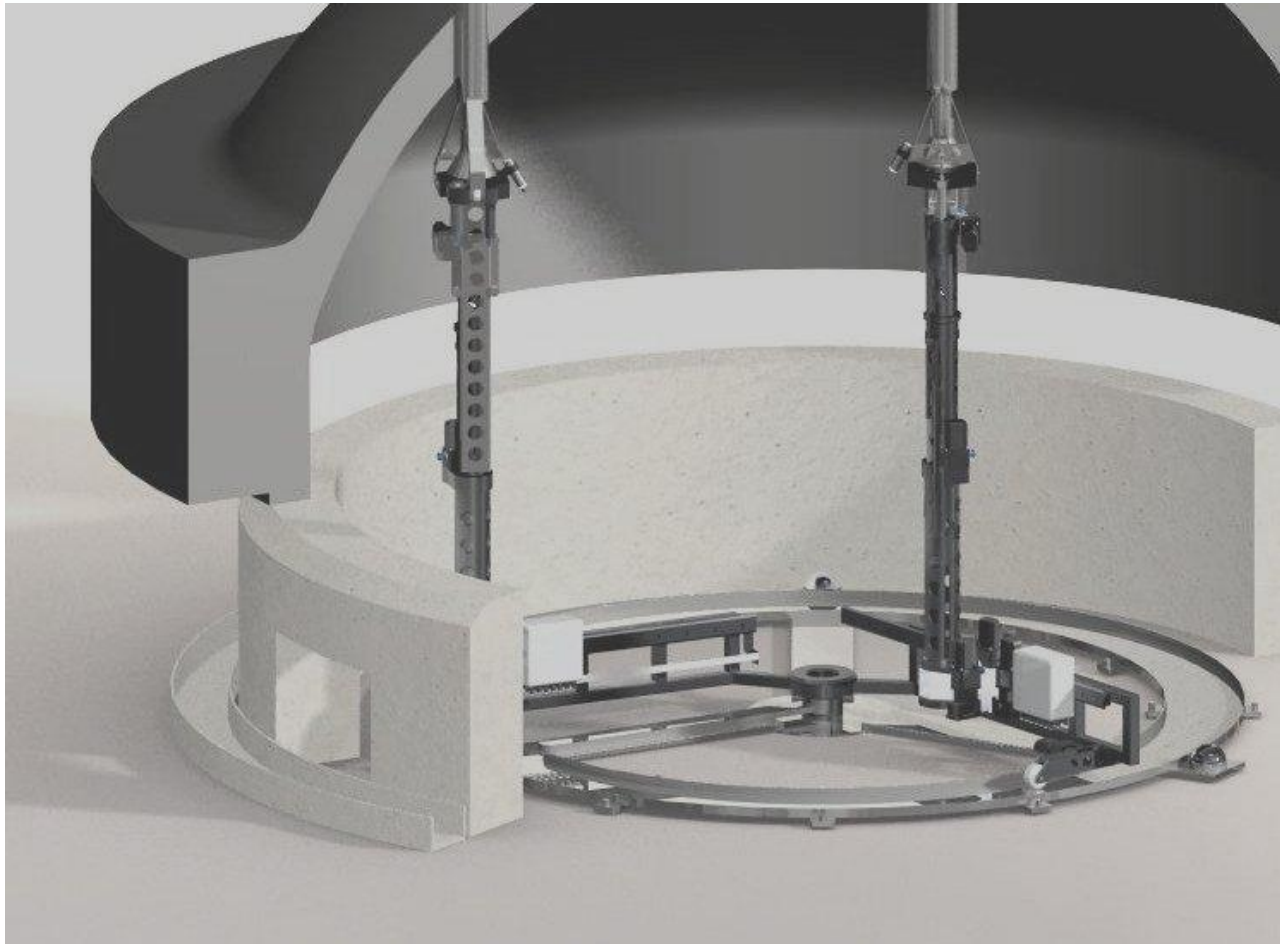


Cracks in the stellite surface

The inspection includes both UT and ET:

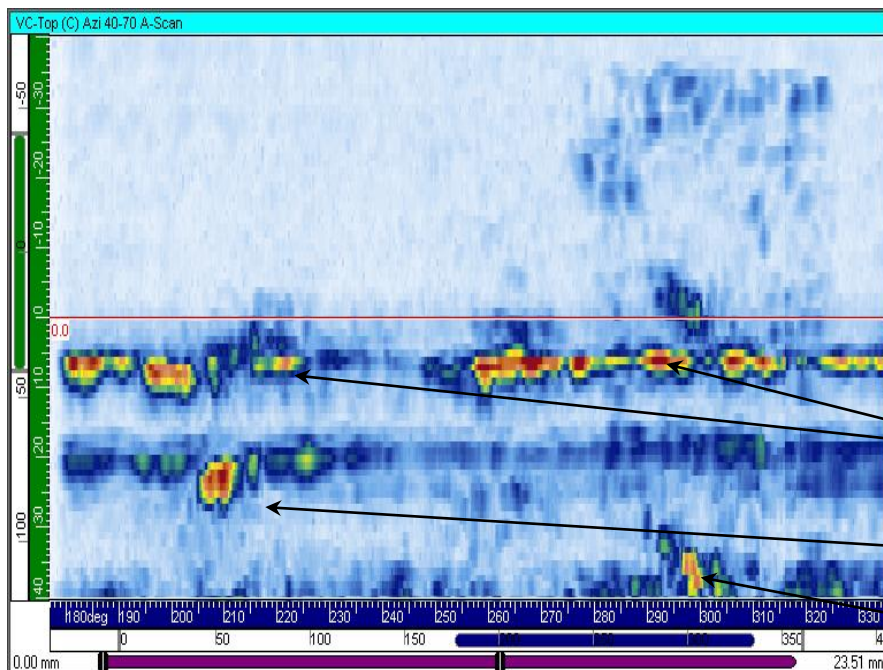
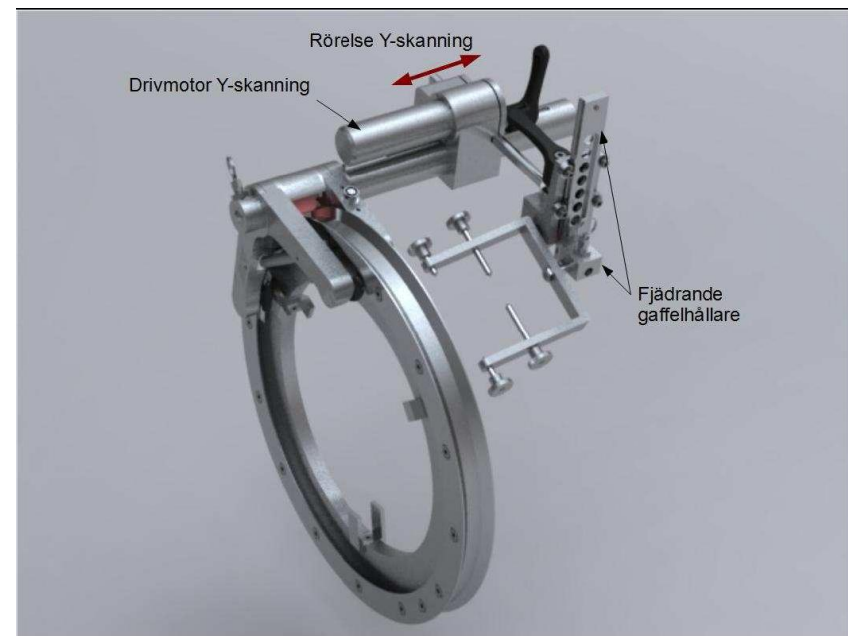
- Surface testing using Eddy Current to establish presence of cracks and their positions
- TOFD testing using multiple probe separations in order to exactly measure crack size over varying depth
- TOFD testing to verify stellite layer thickness
- TOFD testing to detect lack of fusion between stellite layer and base material

The VHP system in inspection configuration and in service mode



PUTS – Mechanized Inspection of stainless steel welds in piping

- The project has qualified Phased array techniques for all Swedish NPPs
- Single sided inspection



Direct longitudinal response

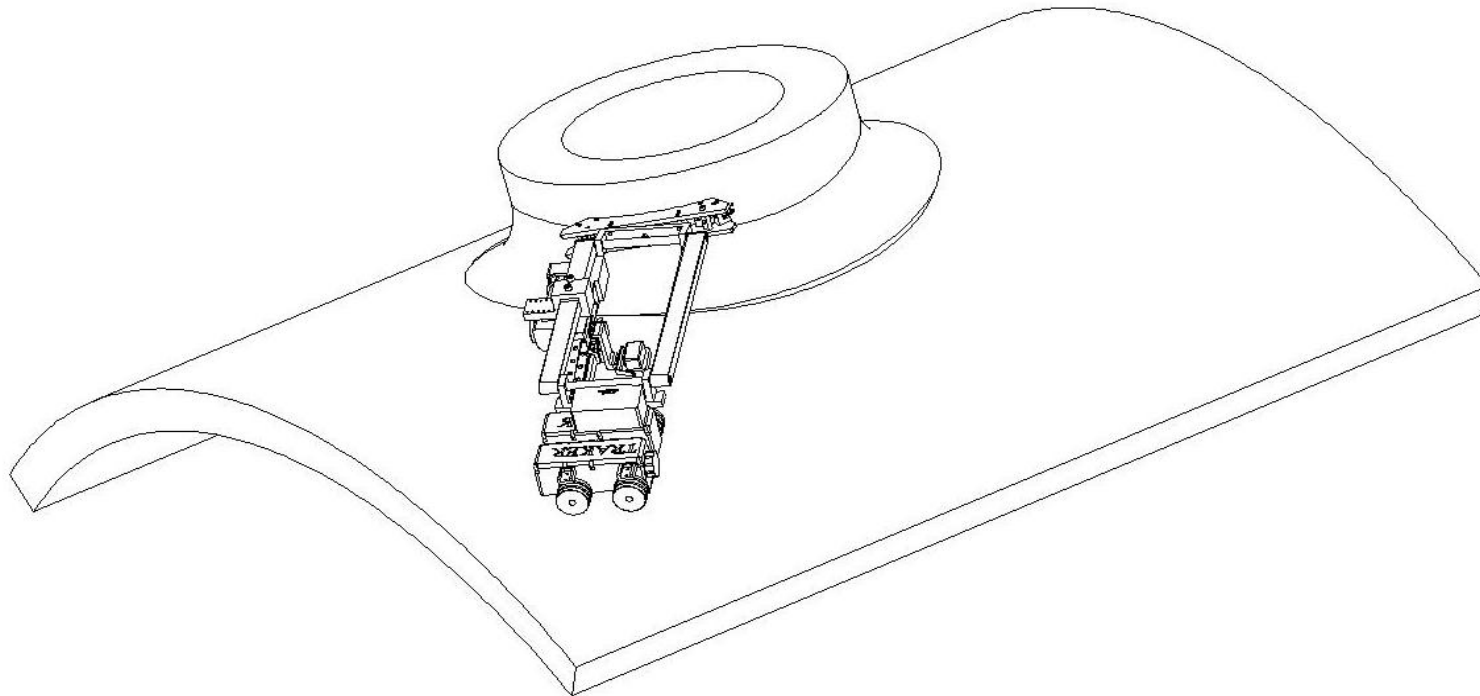
SLL

Shear (S)

Figure: Merge 40-70 degrees

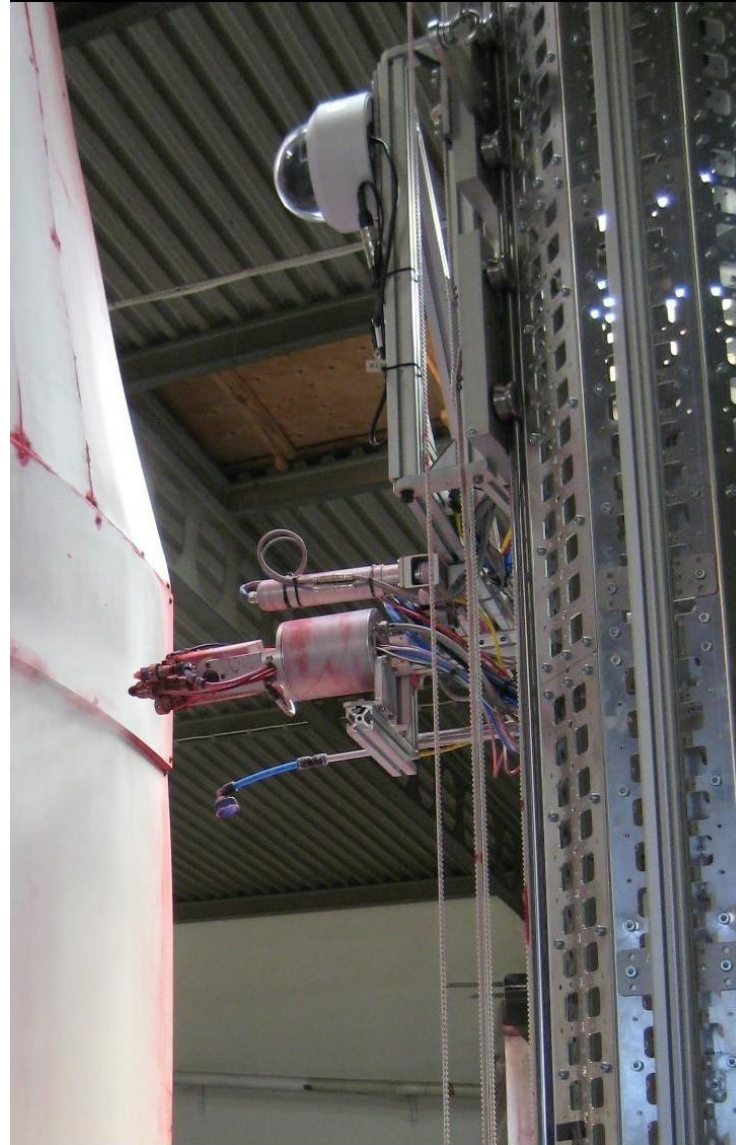
Steam Generator welds

- Qualified technique developed for Ringhals
- Circumferential and longitudinal welds with TOFD technique
- Nozzles with TOFD and pulse echo

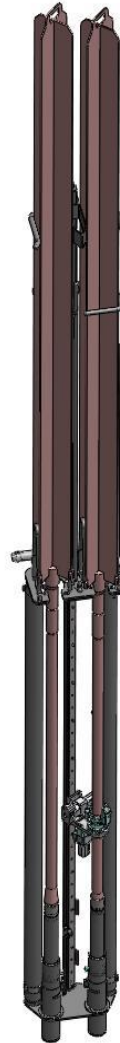


Mechanized PT

OD and ID inspection of steam dryer for Oskarshamn



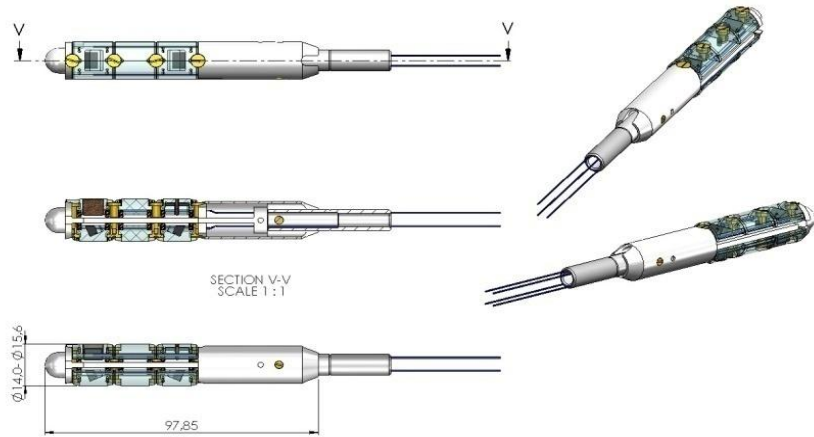
Control rod inspection – new manipulator: Styrbjörn Starke



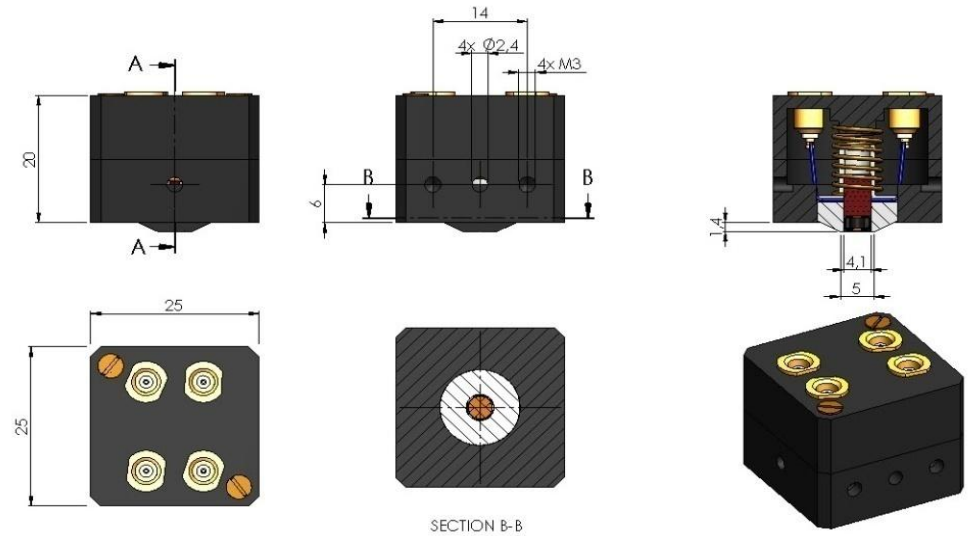
Inspection speed increased
4 times!

- New probe head, UT and ET
- Handles two control rods in parallel
- Two manipulators used, four control rods in operation

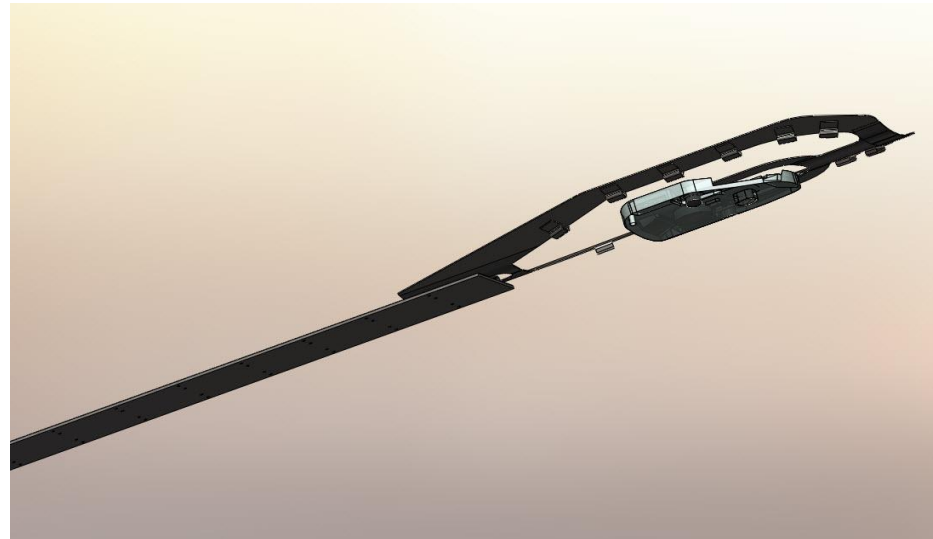
Probe design



ET and UT BMI Nozzle ID



ET Star probe for defects in all directions



ET and UT VHP

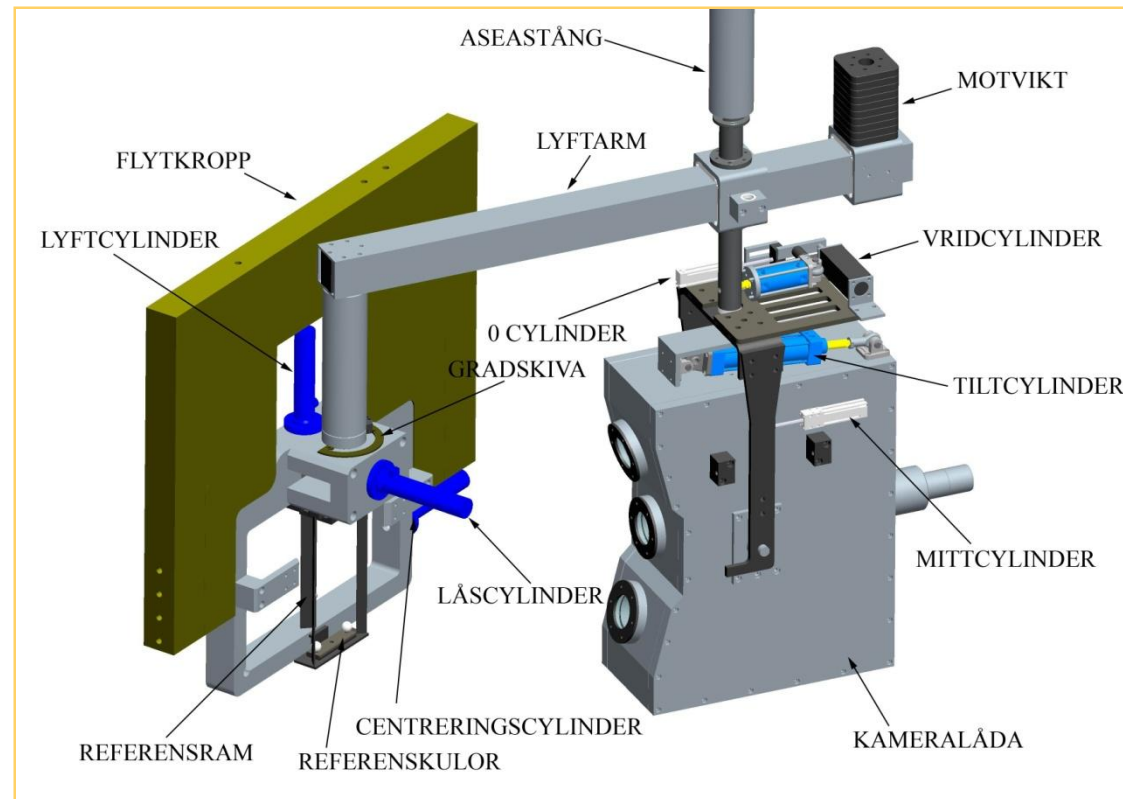
Key support and clevis measurement

➤ GOAL

Measurements of the worn surfaces shall come within an accuracy of $\pm 0,05$ mm depth wise.

On the worn surfaces on the clevis key, the wear shall be reciprocally comparable within an accuracy of $\pm 0,1$ mm.

As a result; cavities in one surface shall be comparable with elevations in the other, this is required in order to determine and show the total play in the application.



The DEKRA advantage

- We are one of the largest organizations for manual and mechanized inspections in Europe!
- Worldwide operations, important to understand local culture and language. Many employees speak Russian.
- Independent supplier of all types of inspection
- Existing solutions for mechanized inspection in Nuclear power plants. State-of-the-art manipulators developed for PWR and VVER
- A broad scope of deliveries together with our partner Tecnatom
- Experienced engineers, projects in PWR, BWR, VVER and RBMK
- QA and QC resources for new plants/upgrade
- Several labs for destructive testing



DEKRA

On the safe side.