

WÄLISCHMILLER

Quality for Safety.



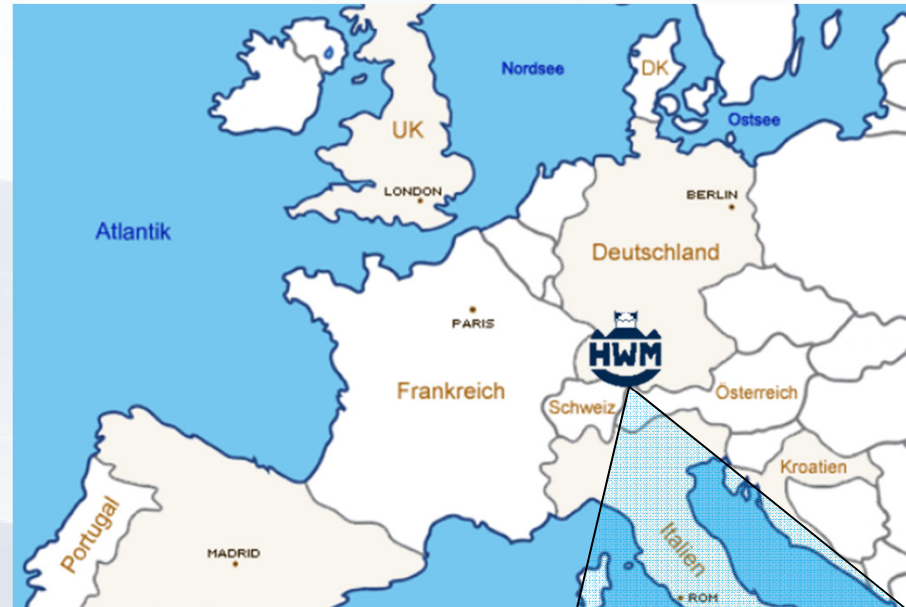
Experience in Decommissioning of Nuclear Power Plants in Germany

Kenji Hara
Wälischmiller Engineering GmbH

Contents

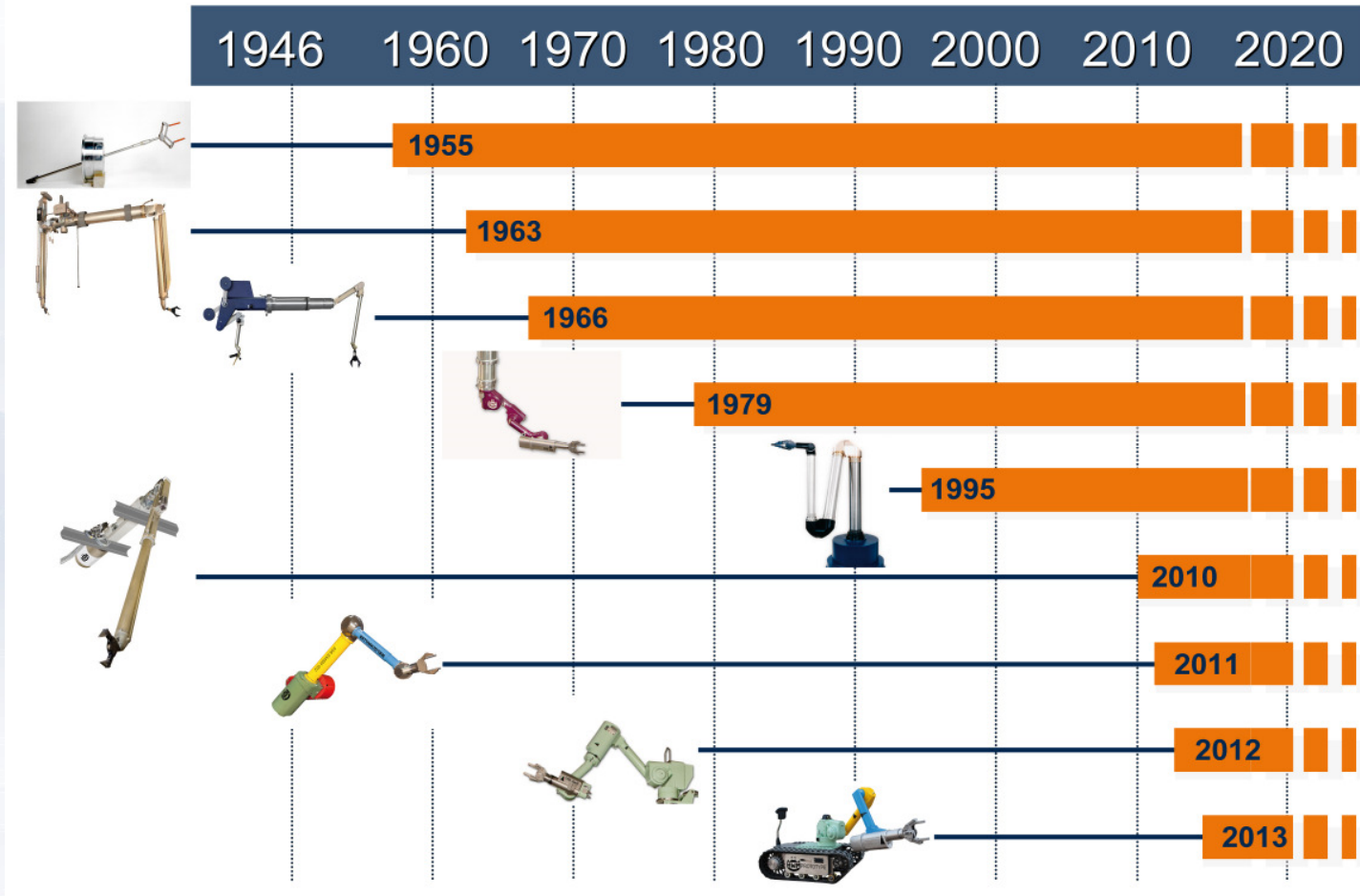
1. Introduction of Wälischmiller Engineering
2. Experience in Germany
3. Technical Requirements and Solutions for decommissioning manipulator

Introduction of Wälischmiller Engineering (HWM)



Introduction of Wälischmiller Engineering

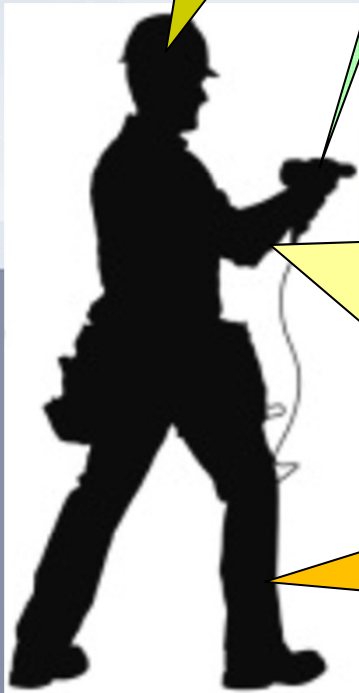
Product Development History



Introduction of Wälischmiller Engineering



Control Software



Tool

Arm

A200

A100

A1000

Telbot

PPS Pre-Positioning System

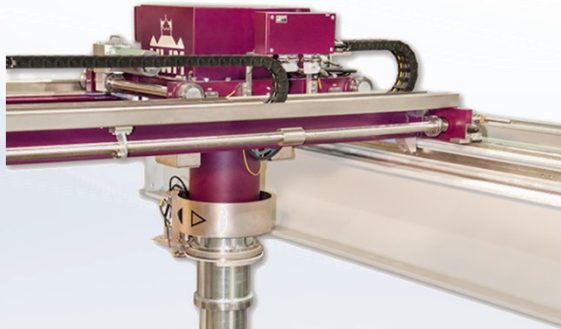
Bridge Carriage telescope

Floor Standing type

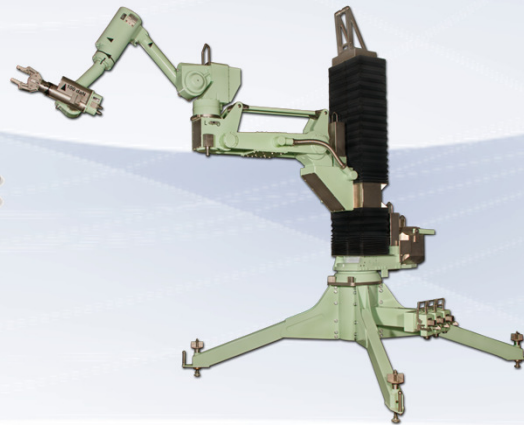
Vehicle type

Type of PPS :pre-positioning system

Bridge, Carriage, Telescope



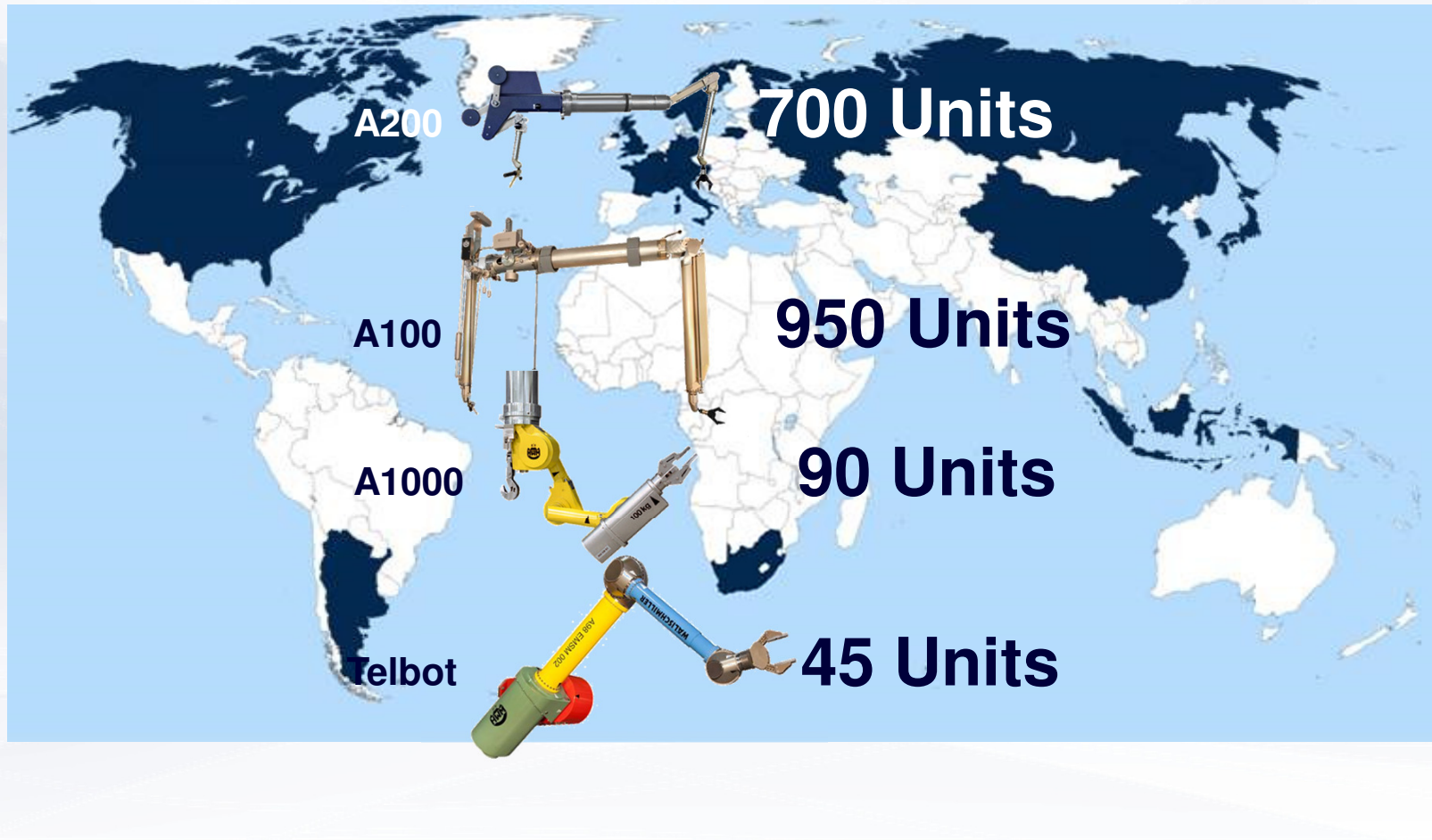
Floor Standing Type



Vehicle Type



Markets



Operating hours of HWM manipulators for decommissioning

United Kingdom: >1.000h
Sellafield Drypac

Belgium: >10.000h
Pamela

France: >17.000h
Phebus, LECA, STAR, Marcoule

Swiss: >2.000h
ZWILAG

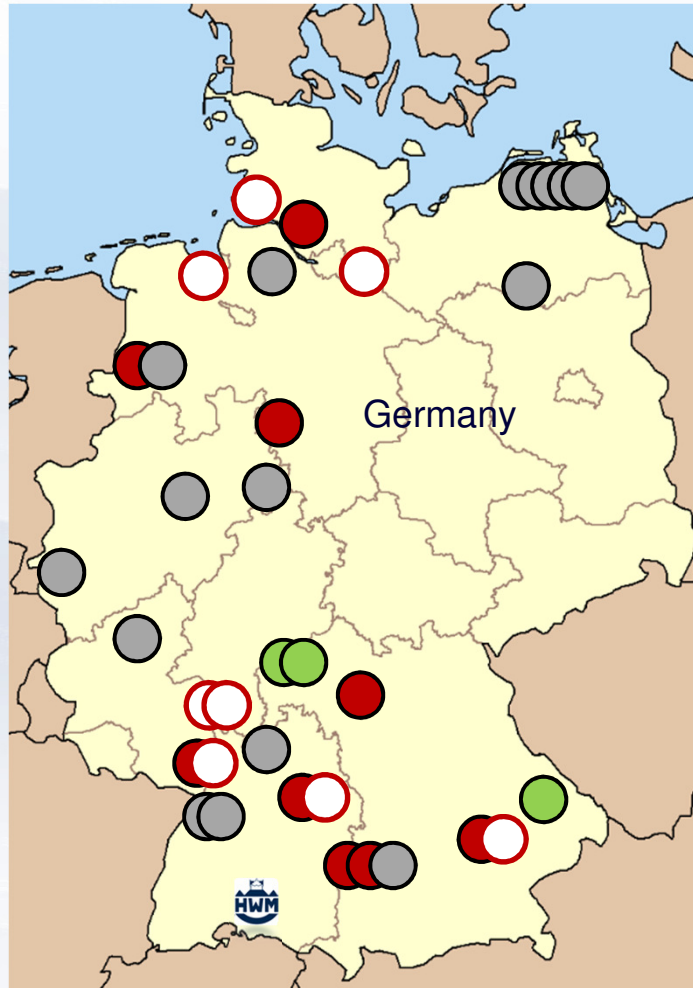
Germany: >21.000h
Greifswald, Obrigheim, Rheinsberg
Research Center Karlsruhe,
Research Center Jülich

China: >1.000h
Research CNPC





Overall >50.000h !!!
UNTIL 2011 !!!

Data from 2011

Experience in Germany

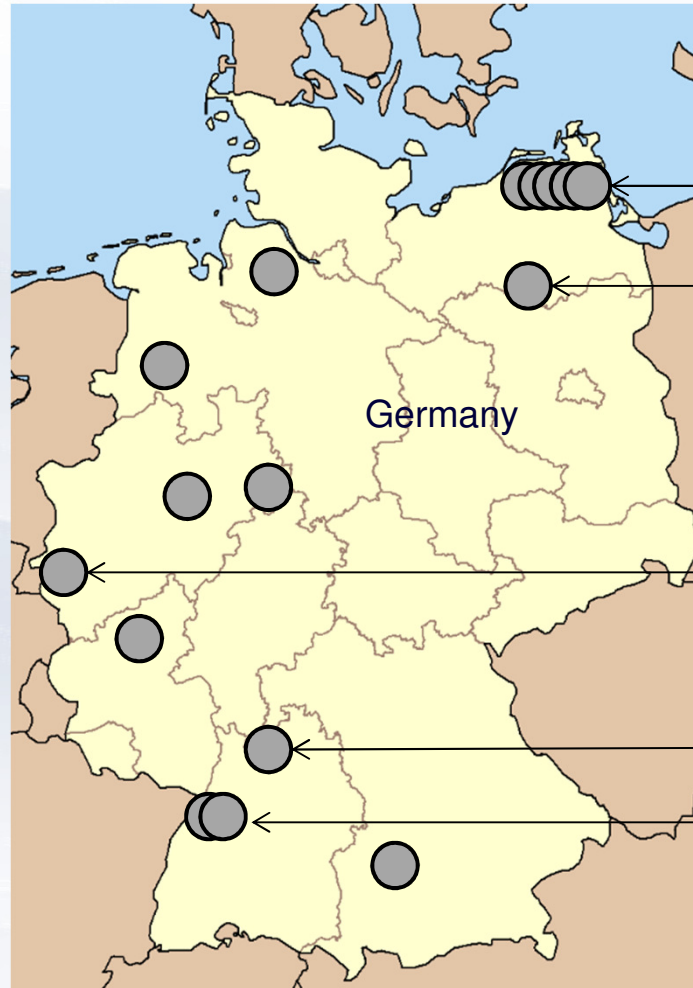


Nuclear Power Plants in Germany

	No. of Reactor
 In Operation	9
 Final shutdown	8
 In Decommissioning	16
 Greenfield	3

Data Source by Deutsches Atomforum e.V. 2013

Experience in Germany



KGR, Greifswald (EWN)

KKR, Rheinsberg (EWN)

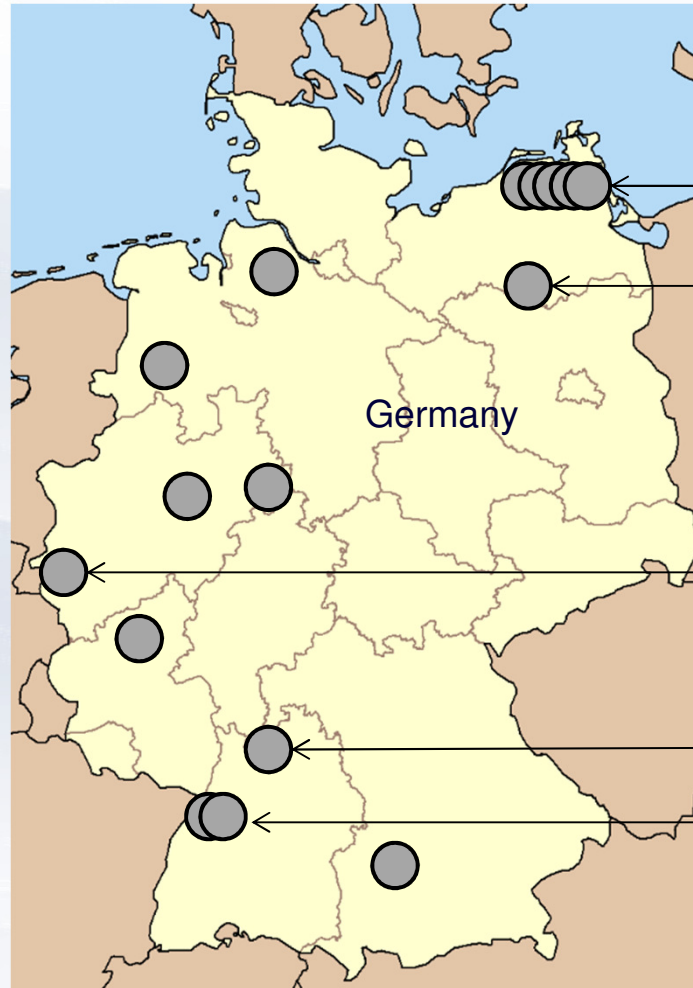
FRJ-2, Jülich (EWN)

KWO, Obrigheim (EnBW)

WAK, Karlsruhe (EWN)

 **In Decommissioning**

Experience in Germany



KGR, Greifswald (EWN)

KKR, Rheinsberg (EWN)

FRJ-2, Jülich (EWN)

KWO, Obrigheim (EnBW, EWN)

WAK, Karlsruhe (EWN)

○ In Decommissioning

KGR, Greifswald (EWN)



Delivered Robot 1



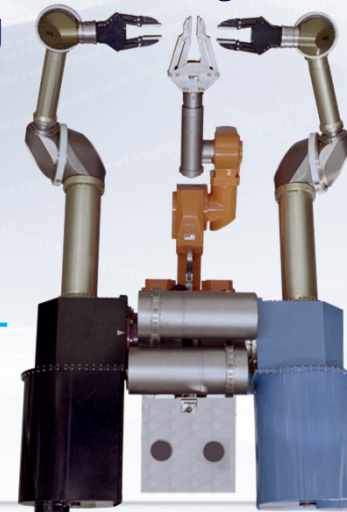
Bridge and Carriage

Telescope

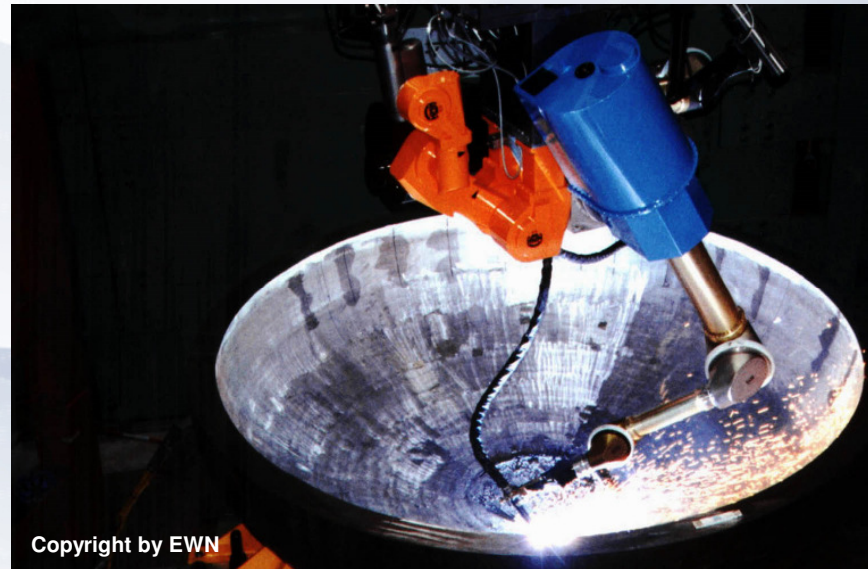
Camera Arm

Telbot 100kg **A1000** 500kg **Telbot** 100kg

Arm

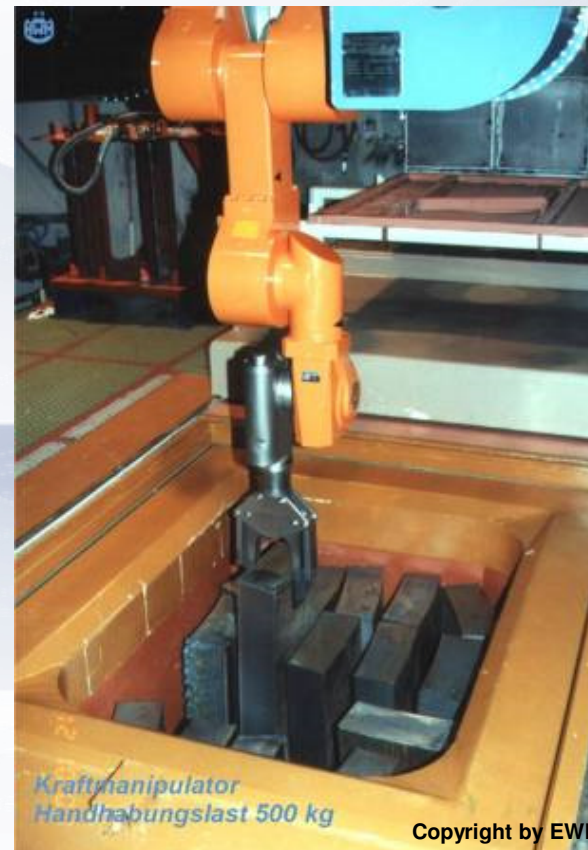


Applied Task 1 : Cutting of Reactor Pressure Vessel with Plasma torch



Reactor Pressure Vessel, 180 mm thickness

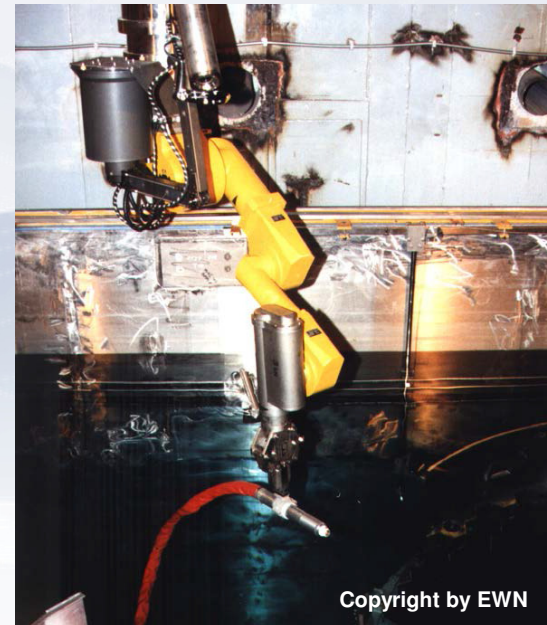
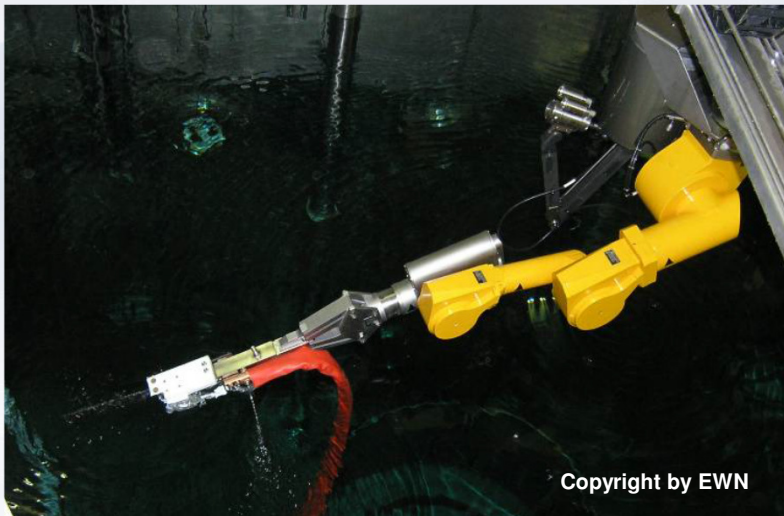
Applied Task 2: Transport and Containerisation Up to weight 400kg cut piece



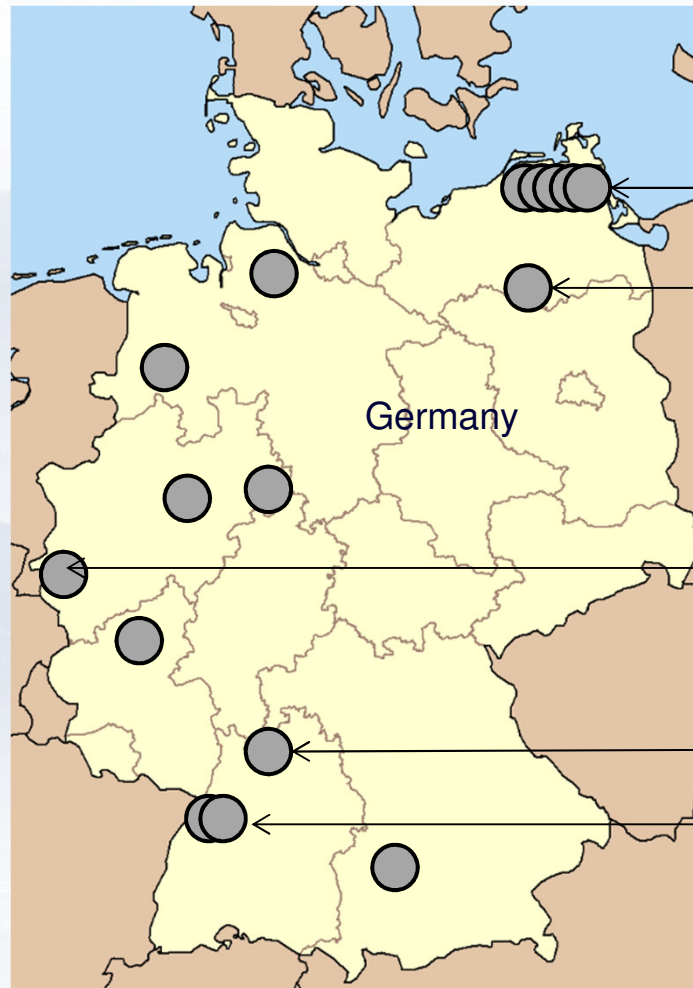
Two A1000 Power Arm into Wet Cutting Station

Cutting technique

- CAMC (Contact Arc Metal Cutting)
- Plasma Cutting,
- Band sawing, etc



Experience in Germany



KGR, Greifswald (EWN)

KKR, Rheinsberg (EWN)

FRJ-2, Jülich (EWN)

KWO, Obrigheim (EnBW, EWN)

WAK, Karlsruhe (EWN)

○ In Decommissioning

KKR, Rheinsberg (EWN)

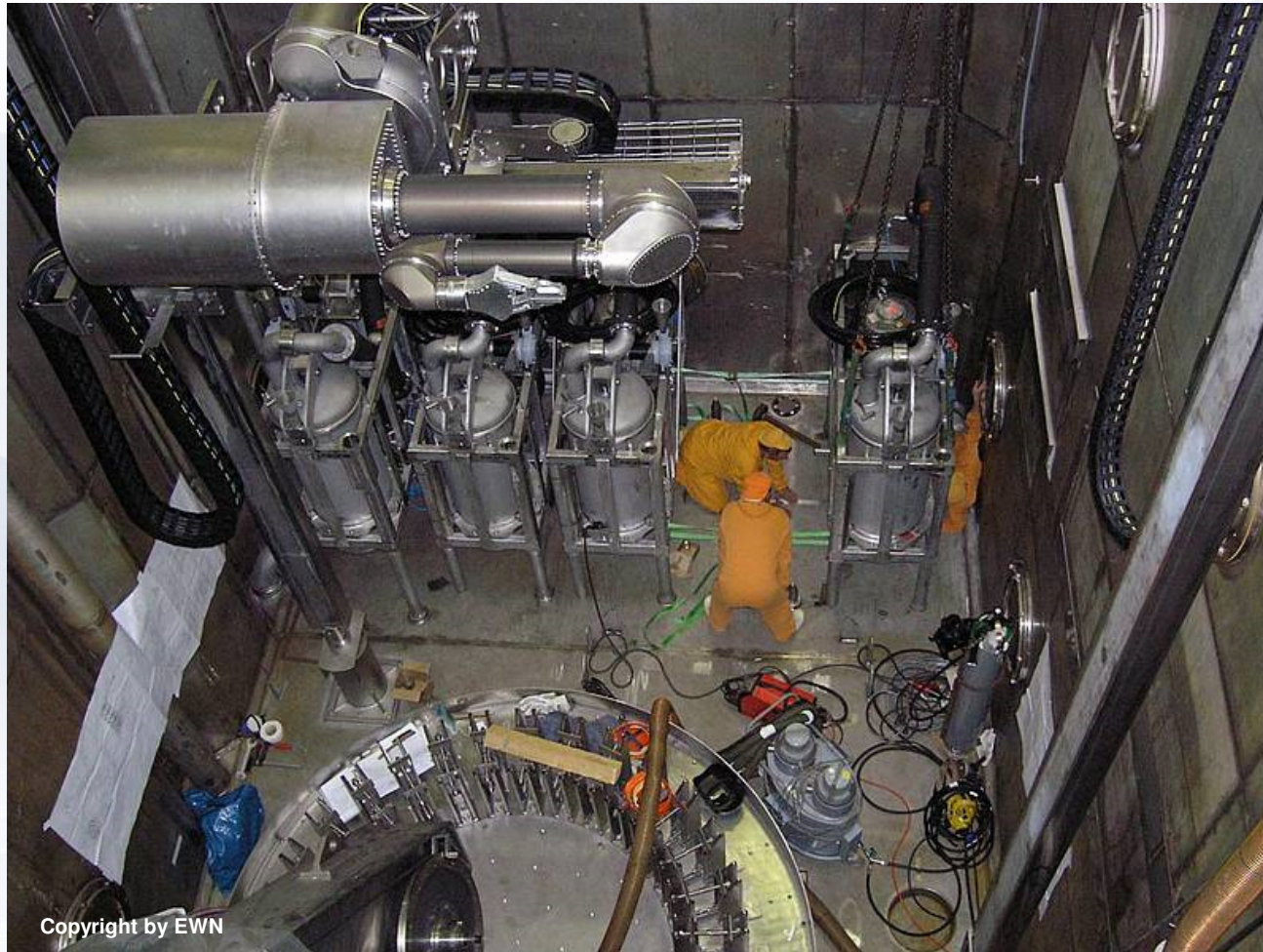


List of source: Homepage EWN

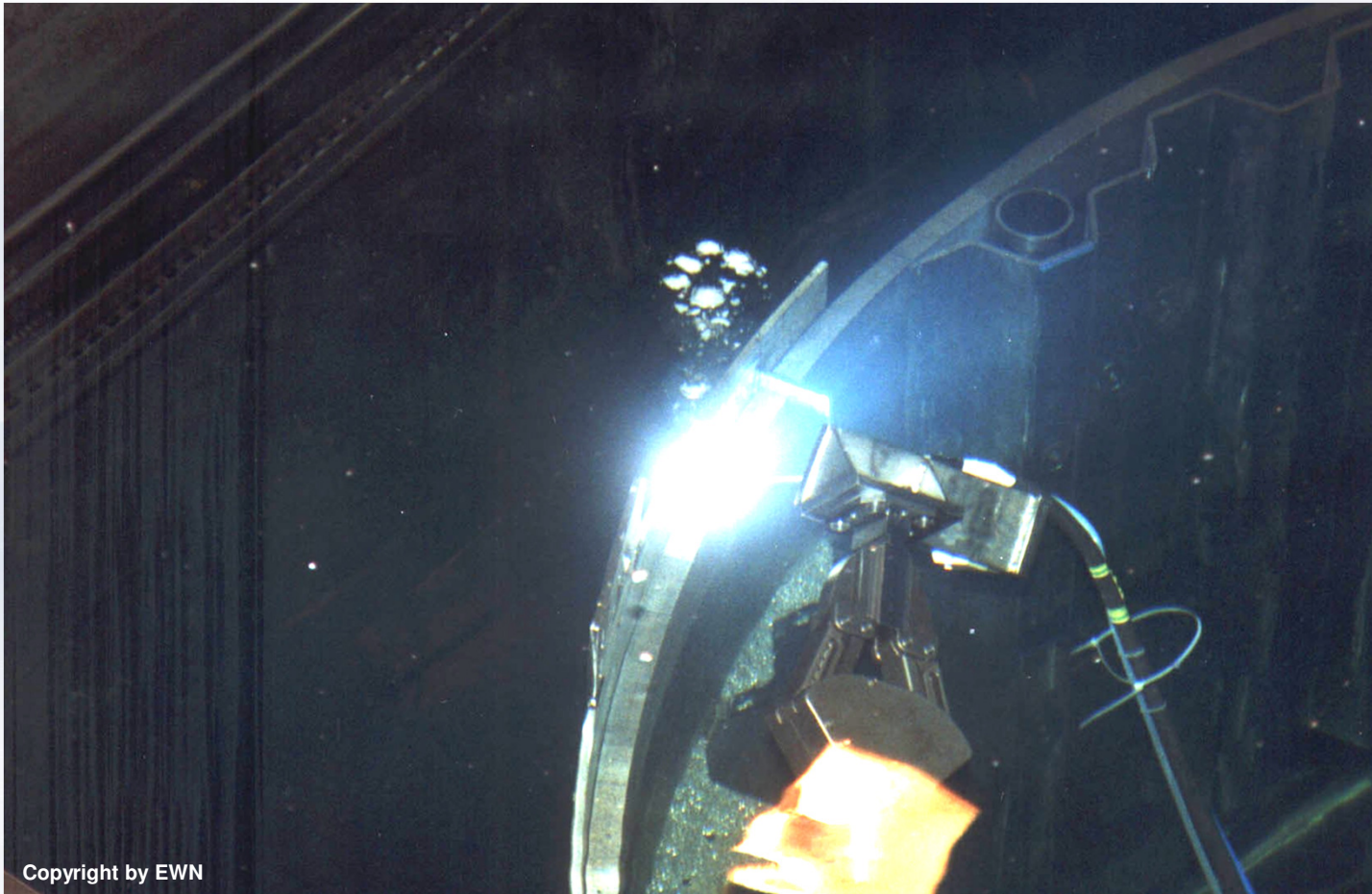
TELBOT

**Payload 100kg
Underwater**



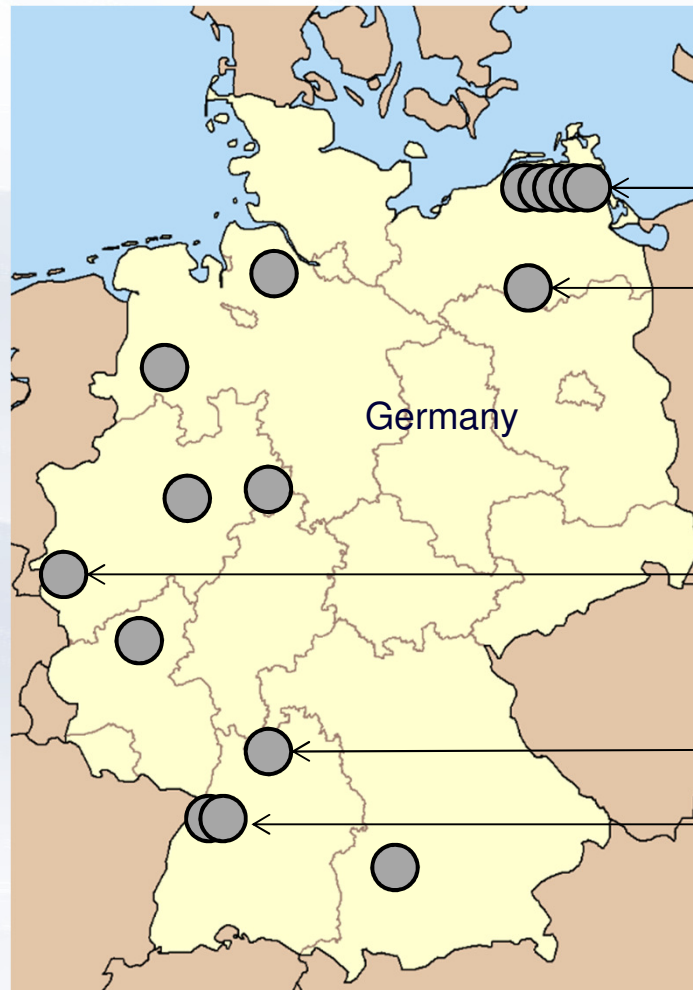


Copyright by EWN



Copyright by EWN

Experience in Germany



KGR, Greifswald (EWN)

KKR, Rheinsberg (EWN)

FRJ-2, Jülich (EWN)

KWO, Obrigheim (EnBW, EWN)

WAK, Karlsruhe (EWN)

○ In Decommissioning

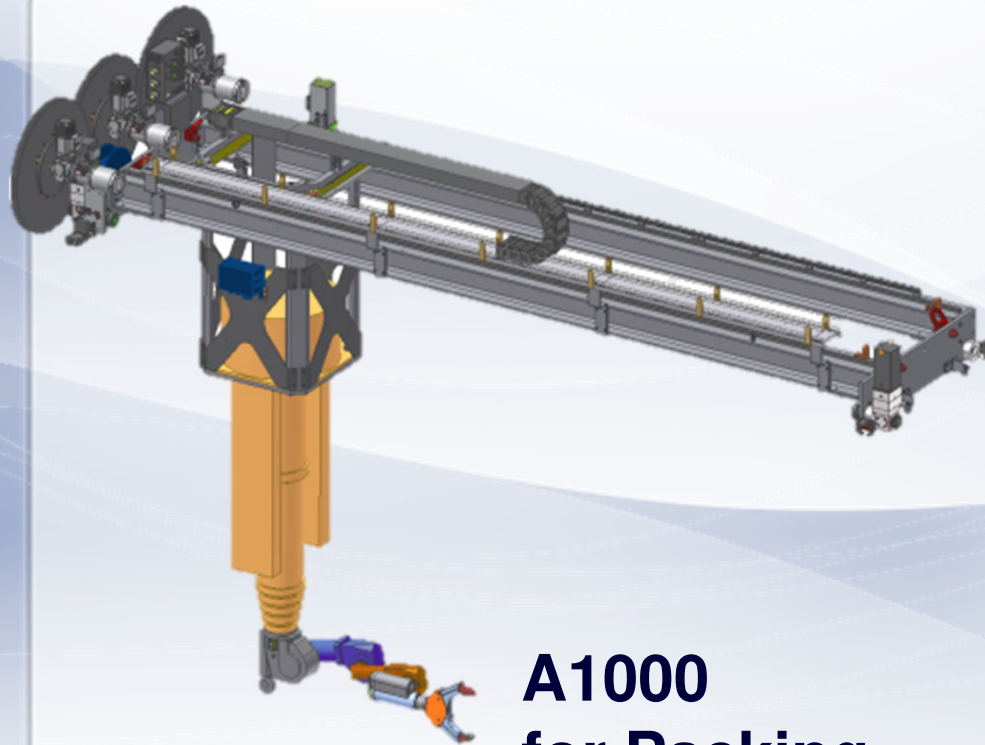
KWO, Obrigheim (EnBW)



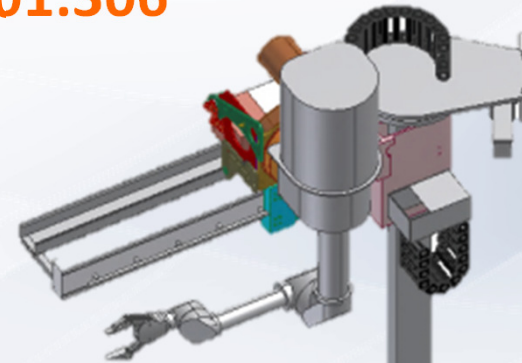
List of source: Homepage EWN

KWO, Obrigheim (EnBW)

Wet cutting area – reactor room R01.306



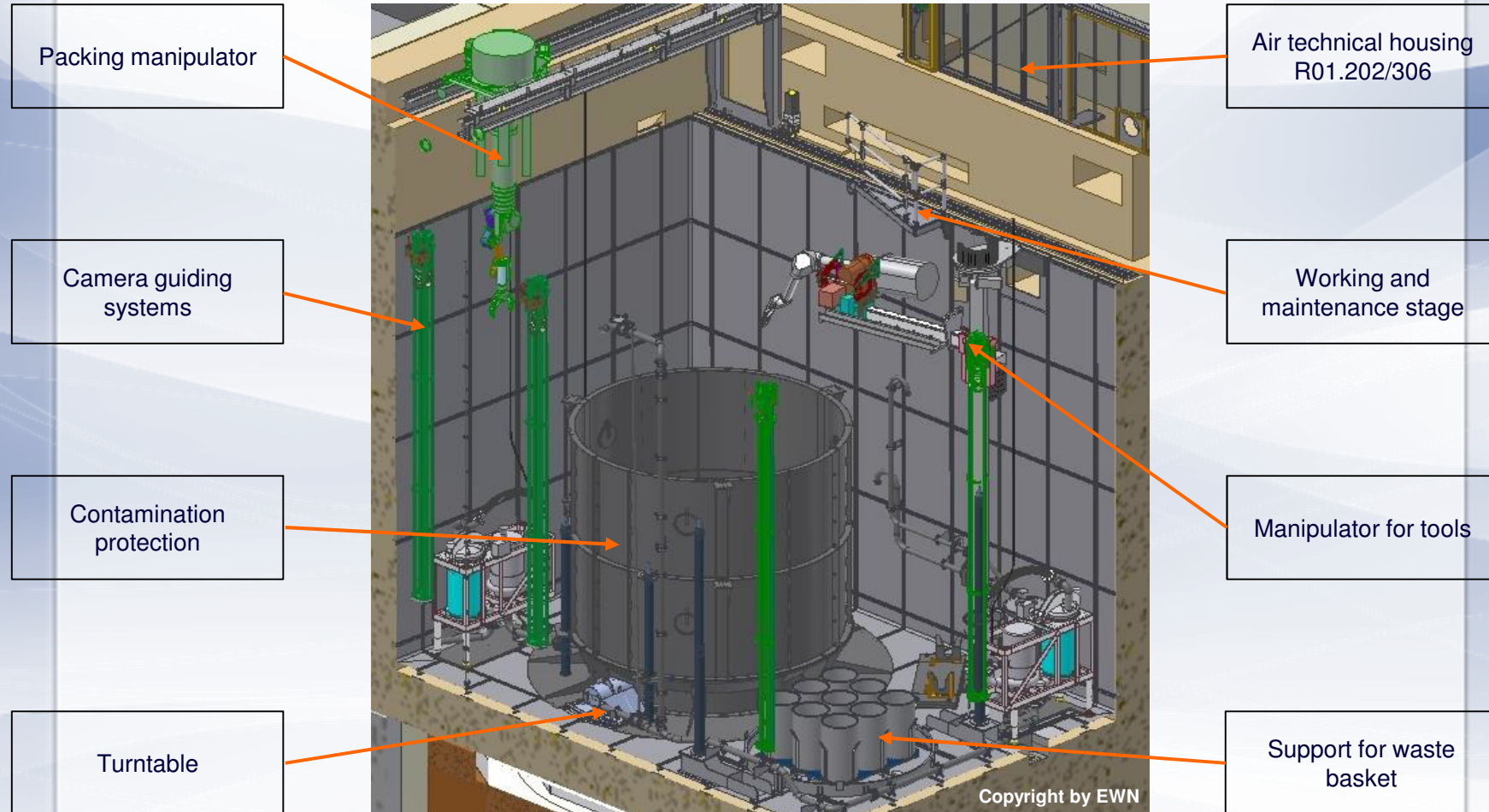
**A1000
for Packing**



**TELBOT
for Cutting tools**

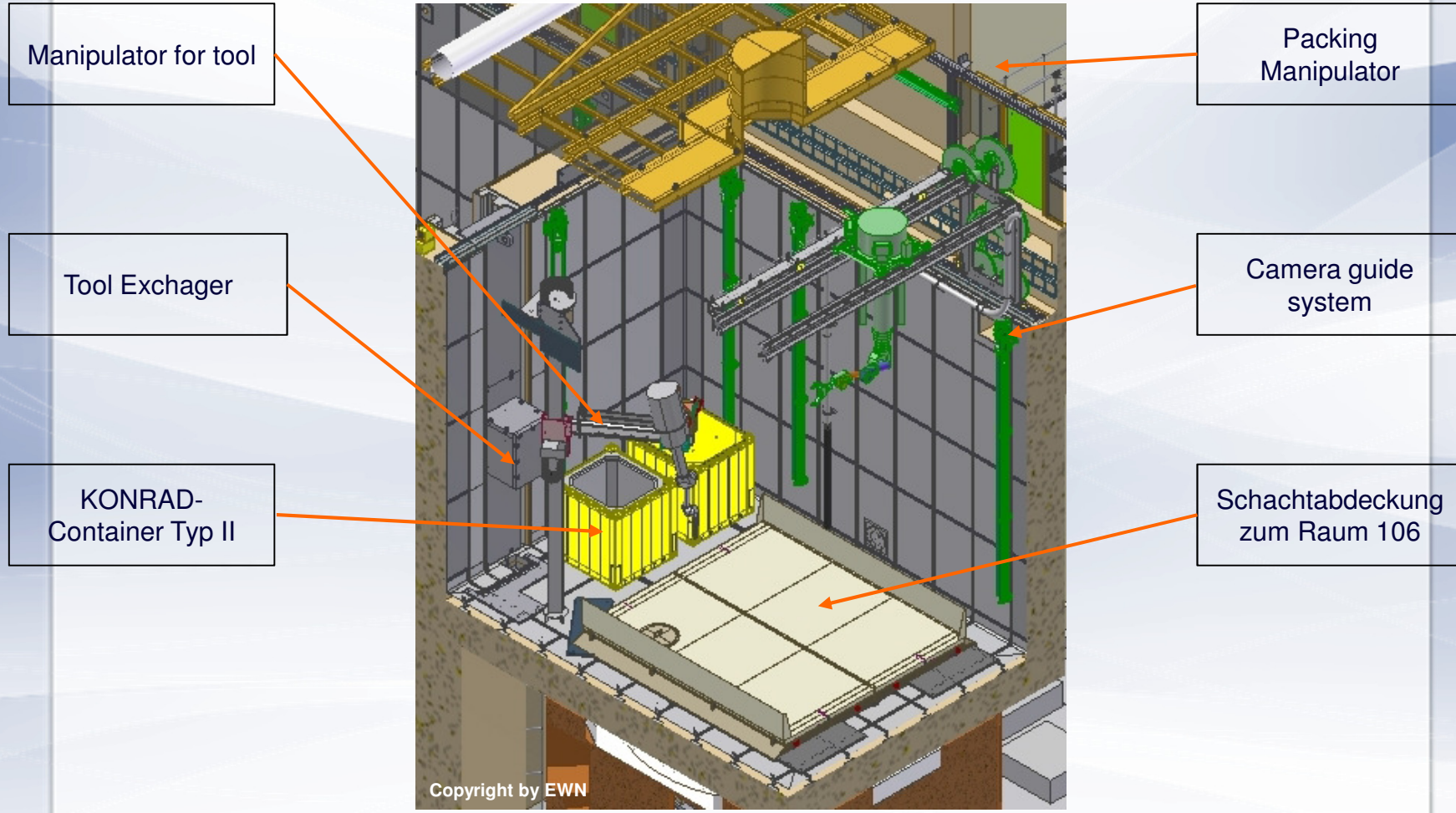
KWO, Obrigheim (EnBW)

Wet cutting area – reactor room R01.306



KWO, Obrigheim (EnBW)

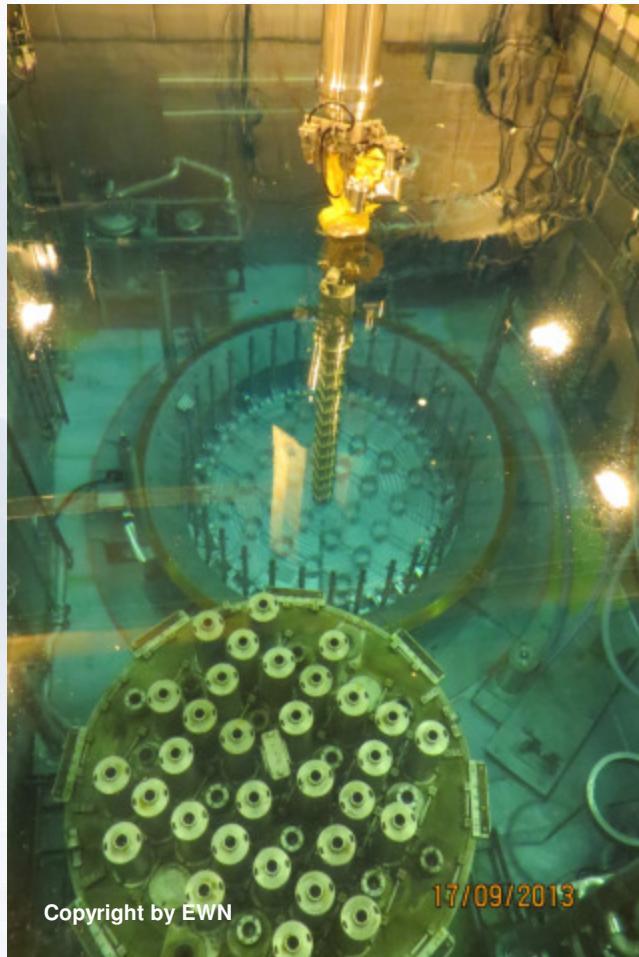
Dry cutting area – reactor room R106/306



Current Fields of Application

Configuration of the equipment carrier

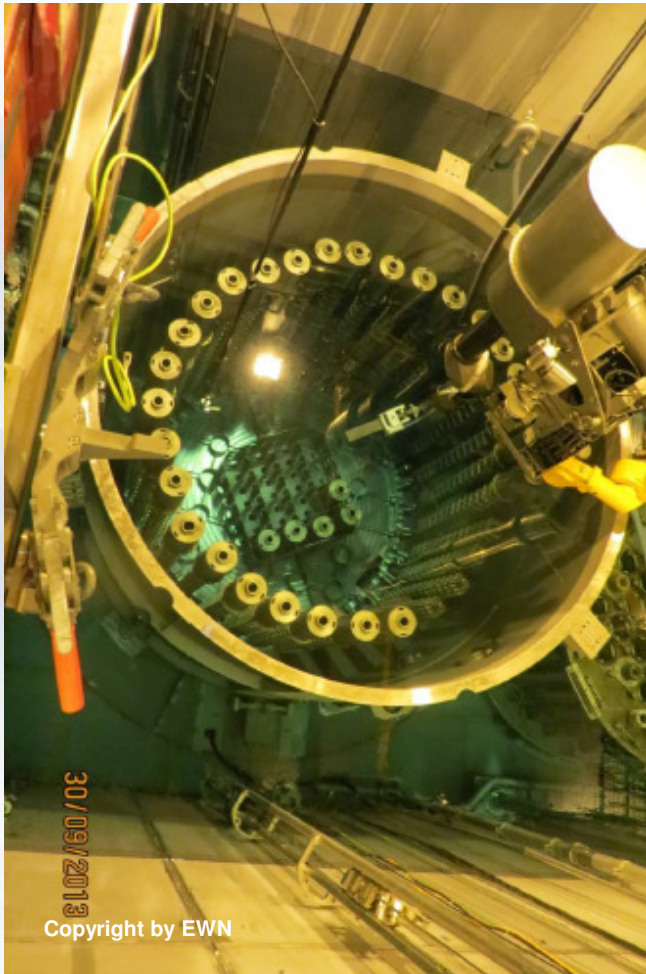




Dismantling of the control rod guide tubes (CRGT) and transport to the turntable

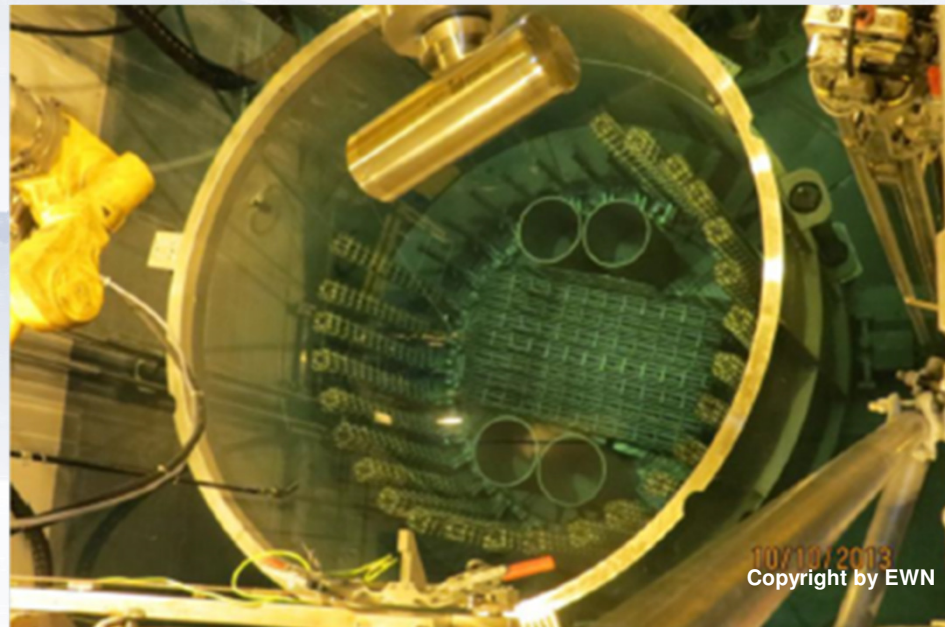
Placing the CRGT on a special holding device of the turntable





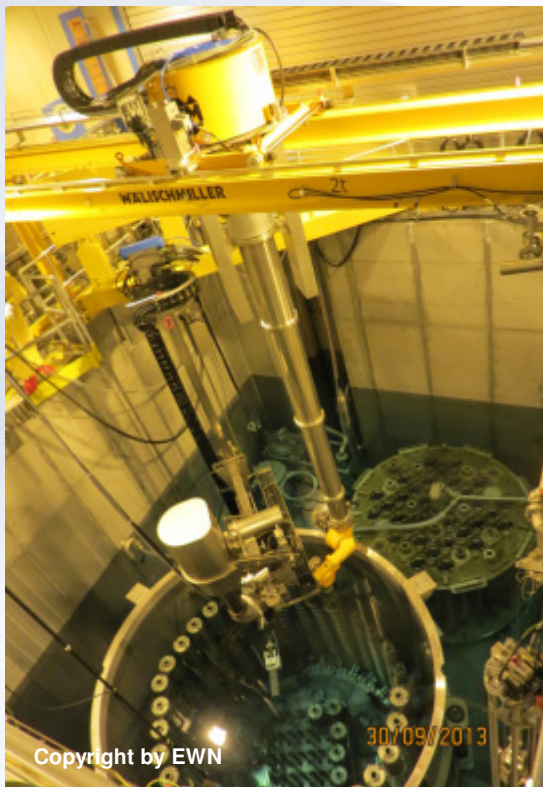
**Mounting of a contamination protection
on the turntable**

**Remotely controlled cutting of the CRGT
from top to bottom**

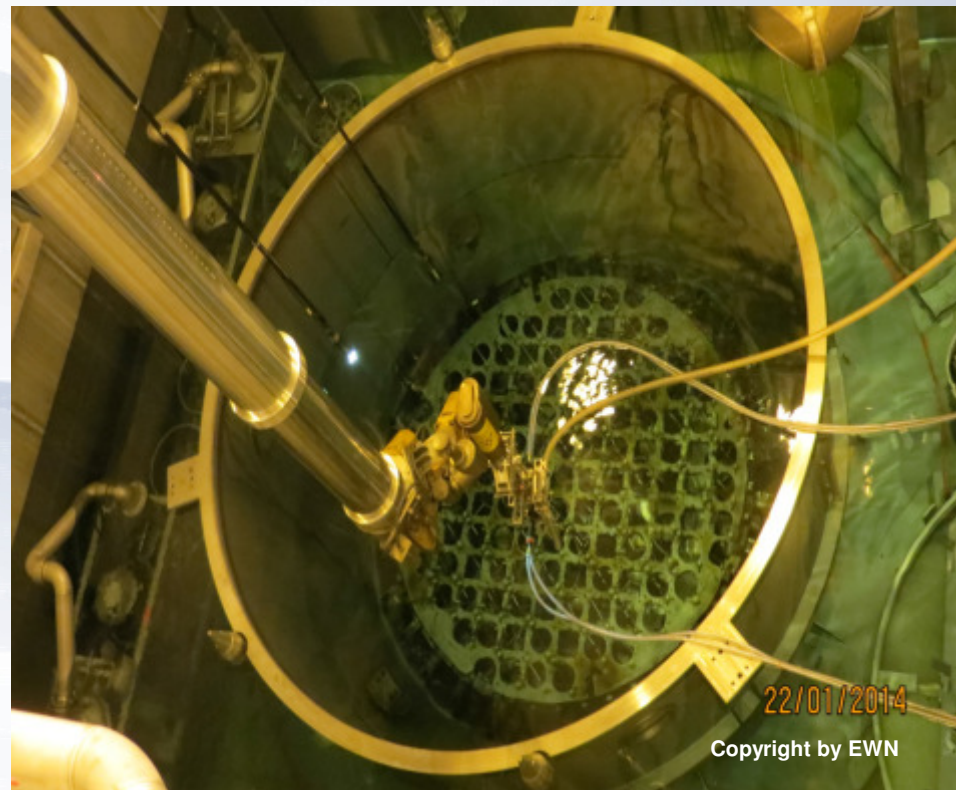


Dismantling of the central control rod guiding

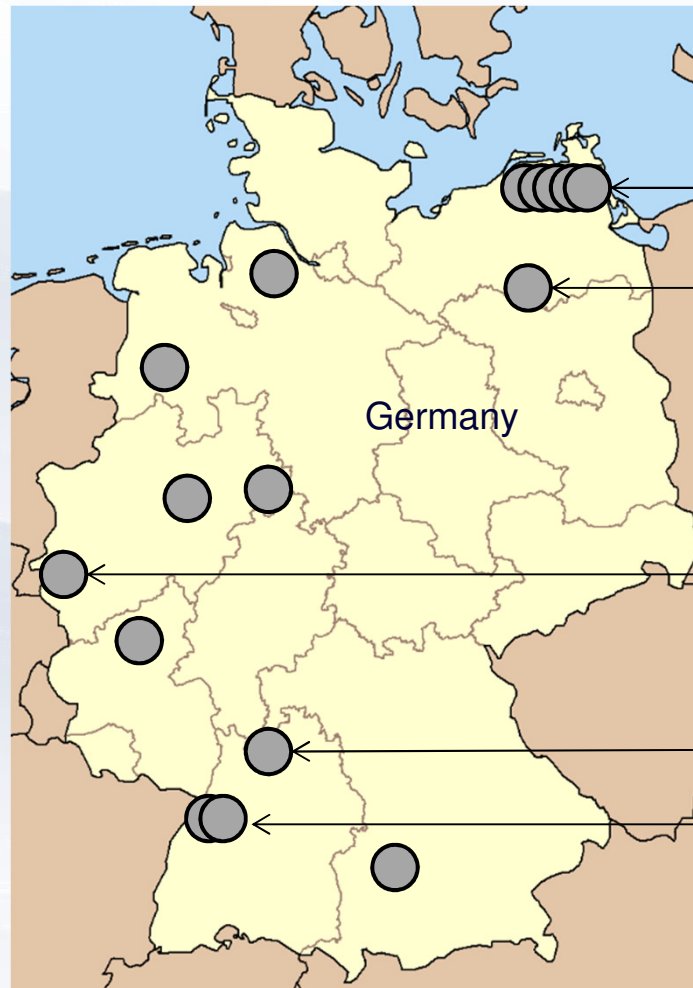
Dismantling of the central control rod guiding inside



Material- Sampling detection from the grid plate of the des OKG



Experience in Germany



KGR, Greifswald (EWN)

KKR, Rheinsberg (EWN)

AVR, Jülich (KFJ)

KWO, Obrigheim (EnBW, EWN)

WAK, Karlsruhe (EWN)

○ In Decommissioning

WAK, Karlsruhe (EWN)





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A1000

Payload: 1000N
Max. reach: 2.6 m



TELBOT x 5 set

Payload: 1000N
Max. reach: 2.7 m



Remote Controlled Dismantling in HLLW-Facilities VEK, LAVA, HWL

Dismantling of the mock-up of a HLLW-tank

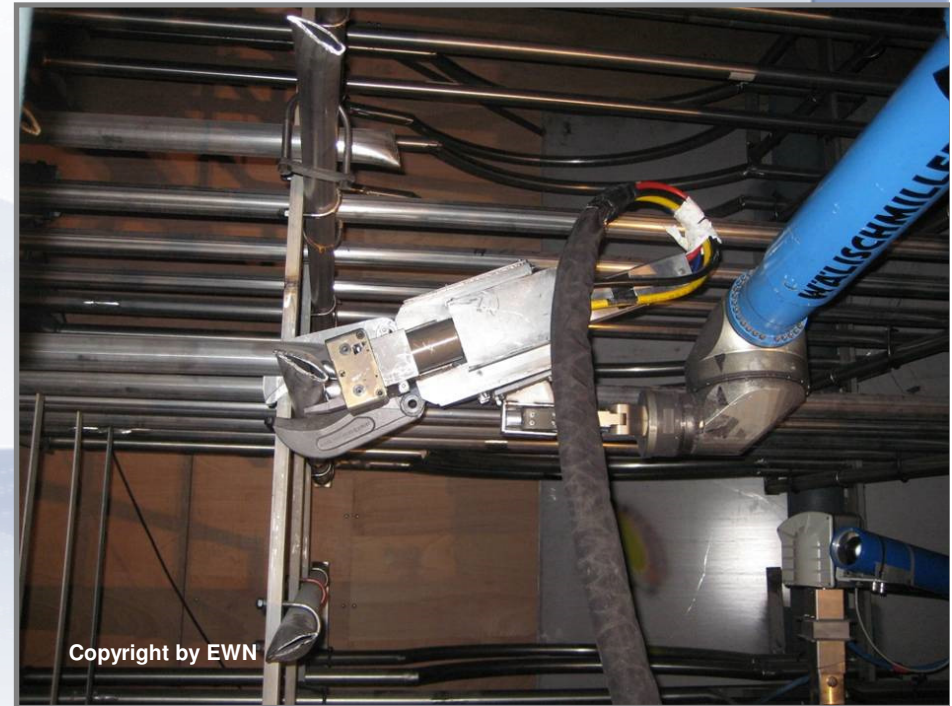


Cutting 10 mm
thick tank wall

Remote Controlled Dismantling in HLLW-Facilities VEK, LAVA, HWL



Dismantling of the mock-up of a HLLW-tank



Present status of the dismantling activities at the mockup

Remote Controlled Dismantling in HLLW-Facilities VEK, LAVA, HWL

Manipulator-traverse with cantilever incl. Telbot for Dismantling Lot 5.3

Arm: TELBOT



Max. 5.2 m

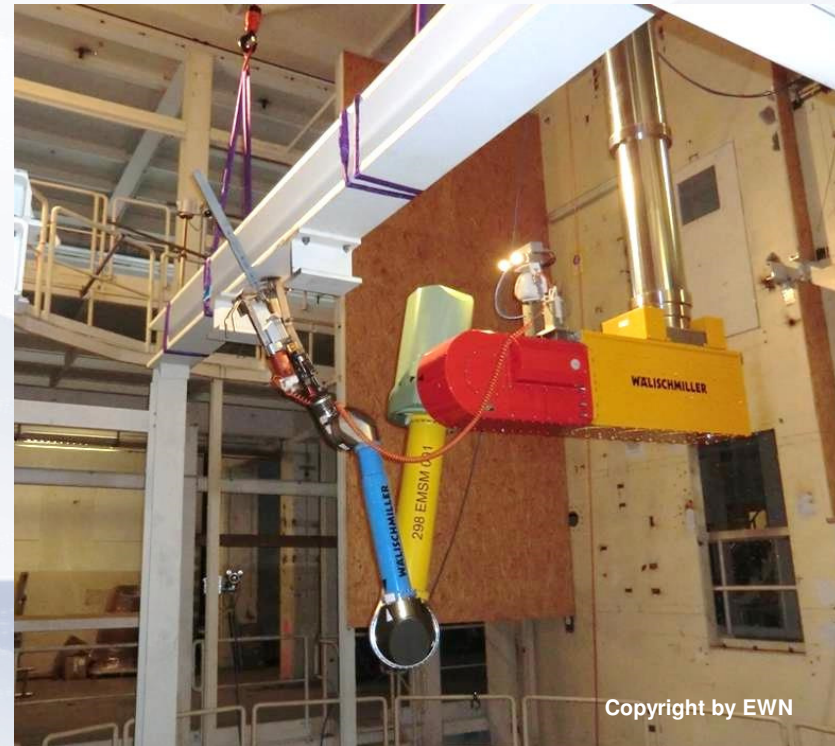
Telescope Travel
8.5 m

Remote Controlled Dismantling in HLLW-Facilities VEK, LAVA, HWL



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Verifying of Vertical Access conditions



Copyright by EWN

Cutting of metallic structure

Remote Controlled Dismantling in HLLW-Facilities VEK, LAVA, HWL

Cutting and Drilling Testing in Mock-up

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Dismantling of the transfer tank



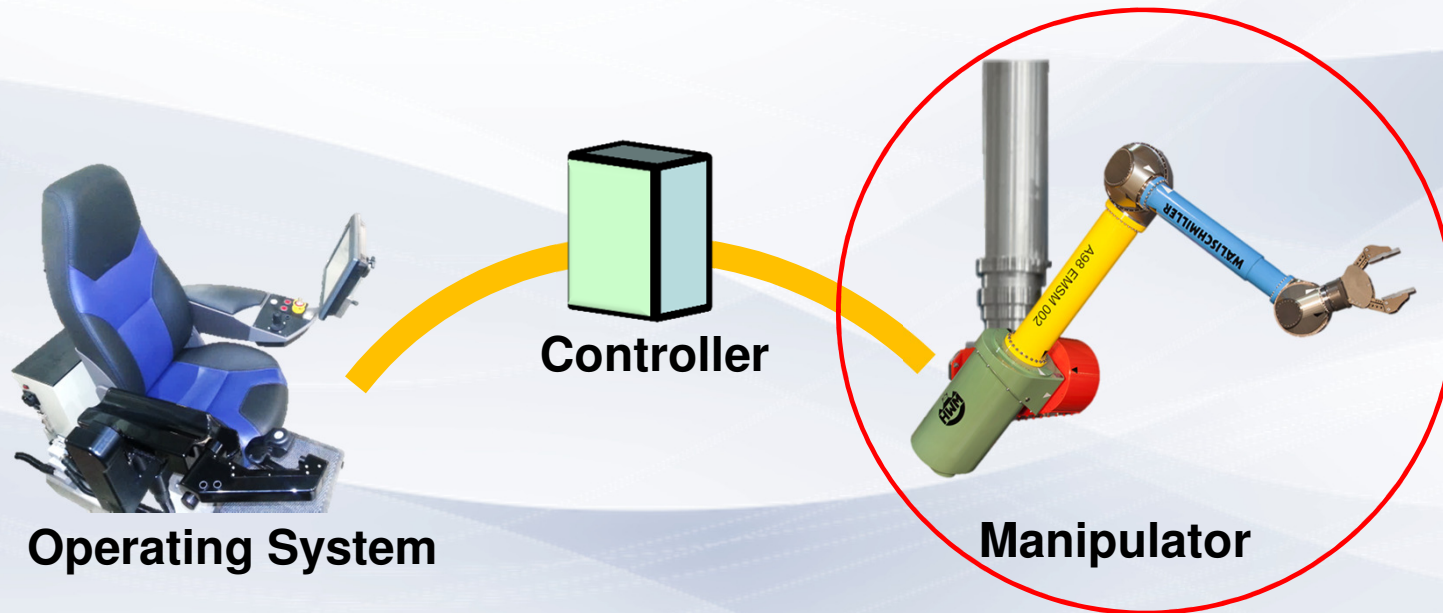
Opening of the Off gas scrubber

3. Requirements and Solutions for decommissioning manipulator

Requirements for decommissioning manipulator

- 1. Optimum Arm Configuration according to individual task condition.**
- 2. Robustness, Durability under hazardous environment**
- 3. Easy Remote Operating Function**
- 4. Collision Protection in complex environment**
- 5. Rescue and Simple Recovery function to minimize dose**

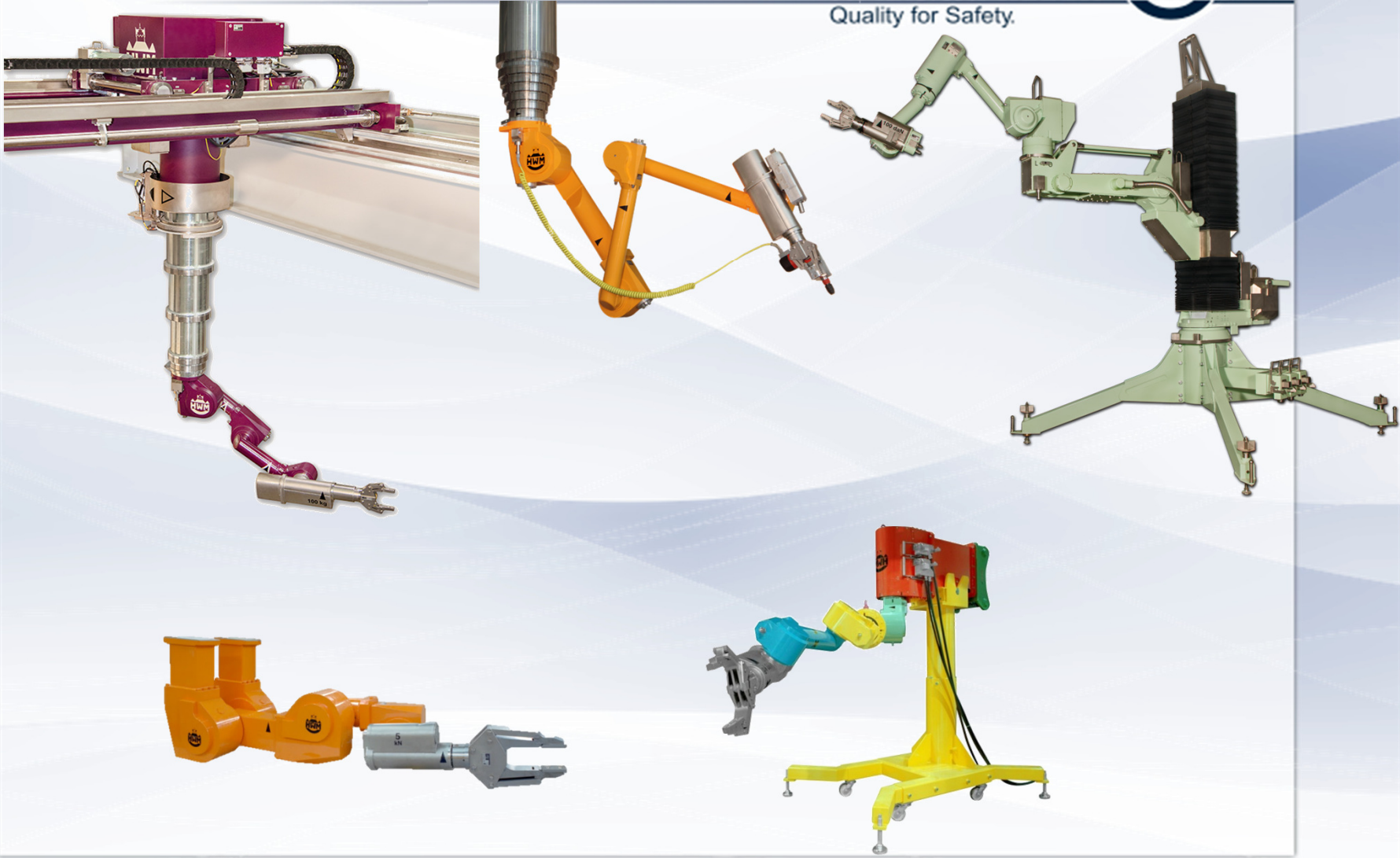
Requirements and Solutions



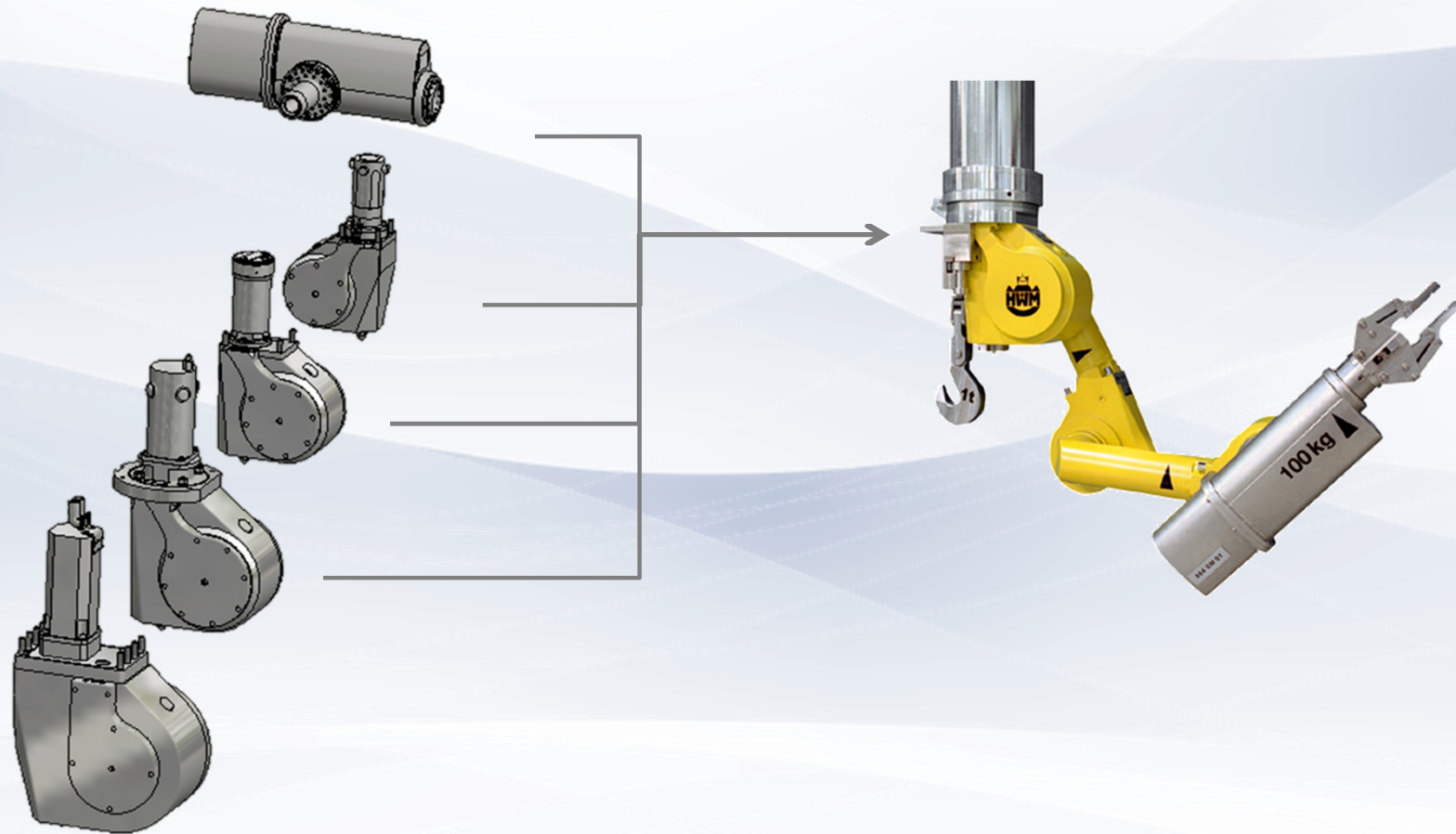
1. Optimum Arm Configuration

A1000 Applications

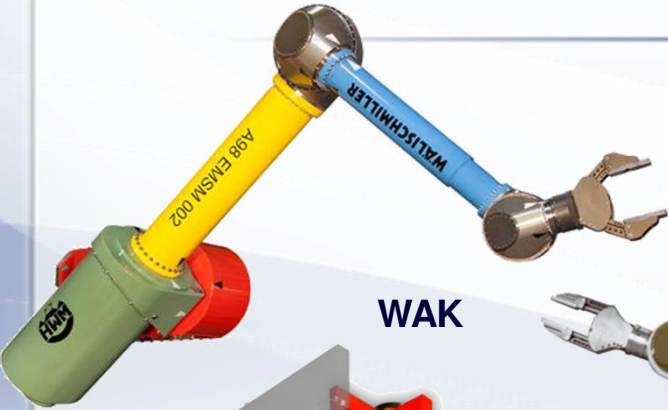
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A1000 Modules

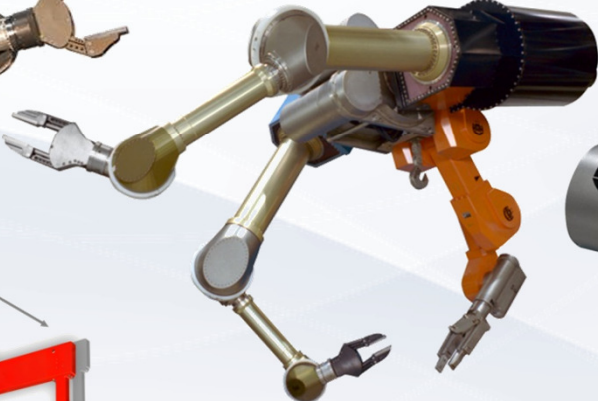


TELBOT® Applications

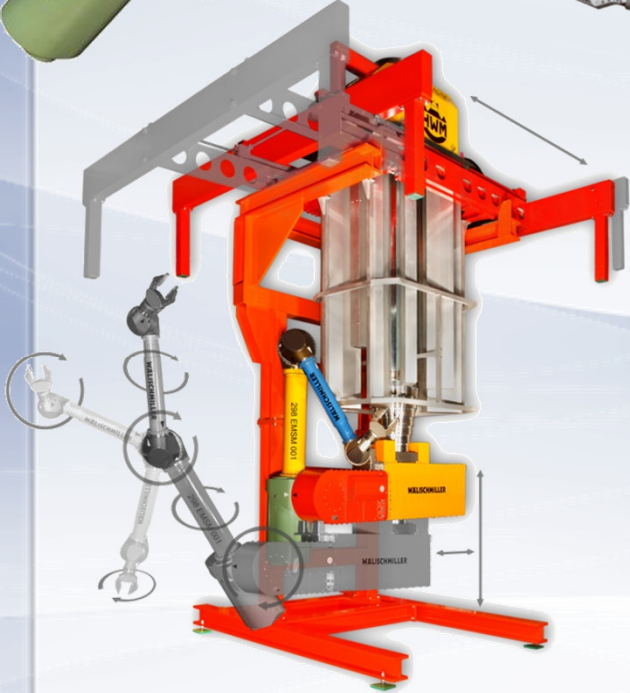


WAK

KKW
Greifswald



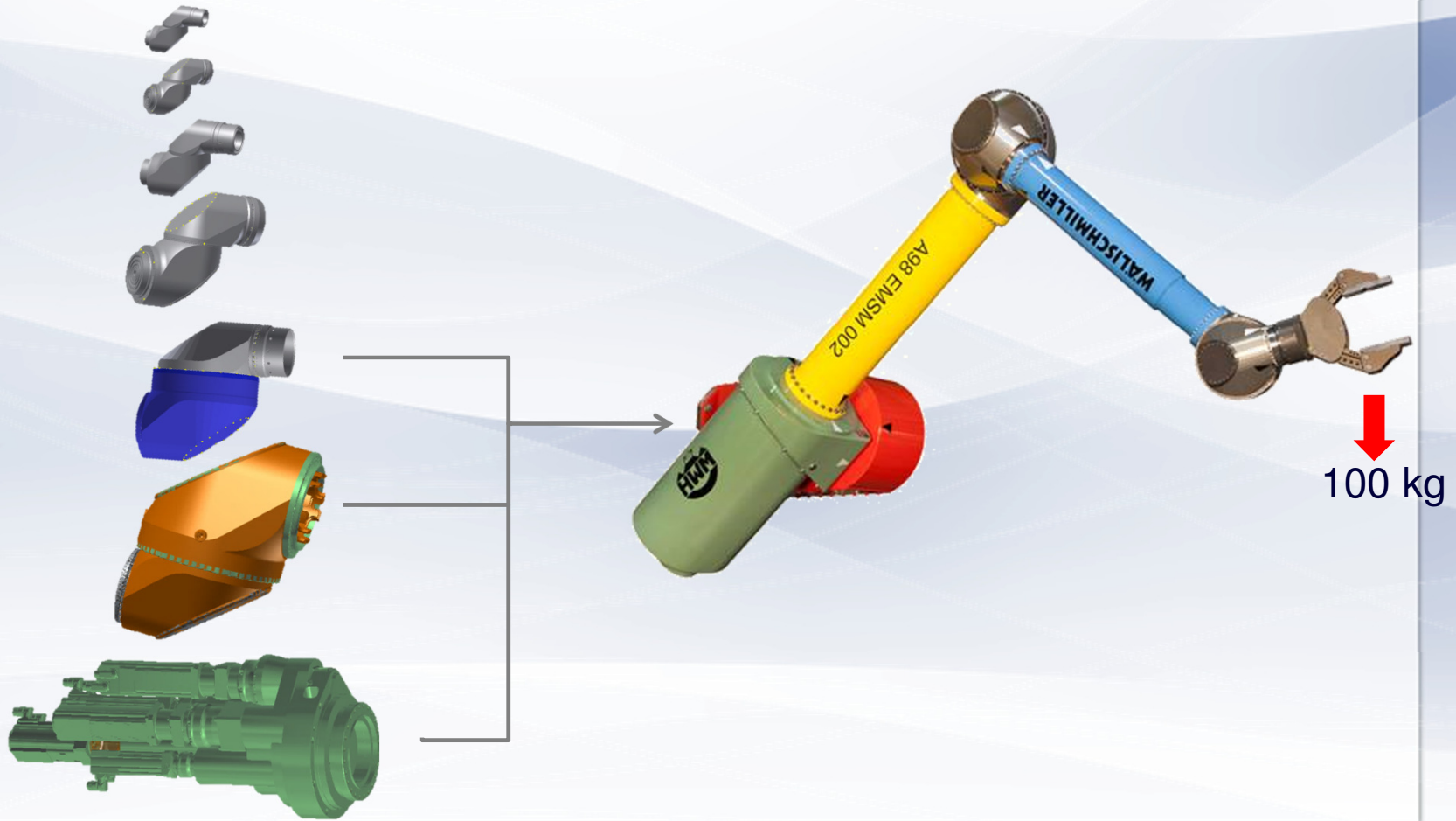
JNFL



WAK



TELBOT Moduls



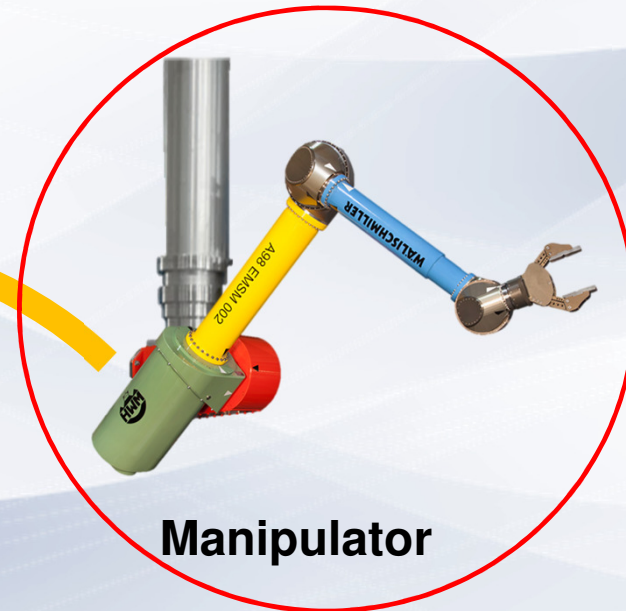
Requirements and Solutions



Operating System



Controller



Manipulator

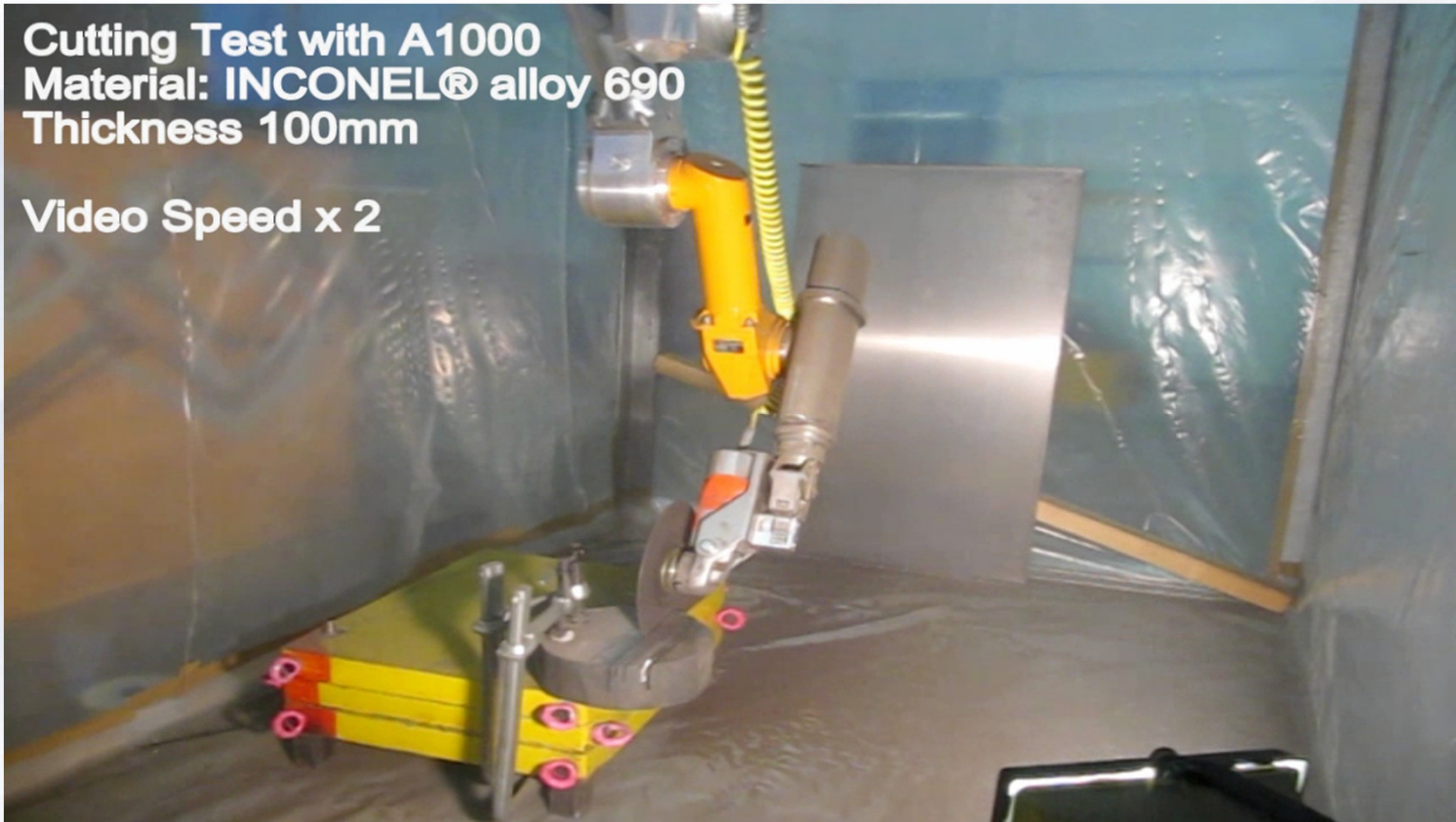
1. Optimum Arm Configuration

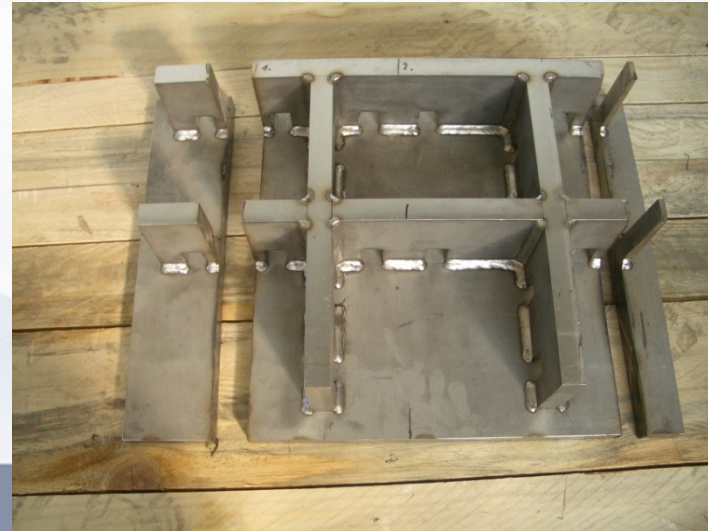
2. Robustness, Durability

Requirements and Solutions

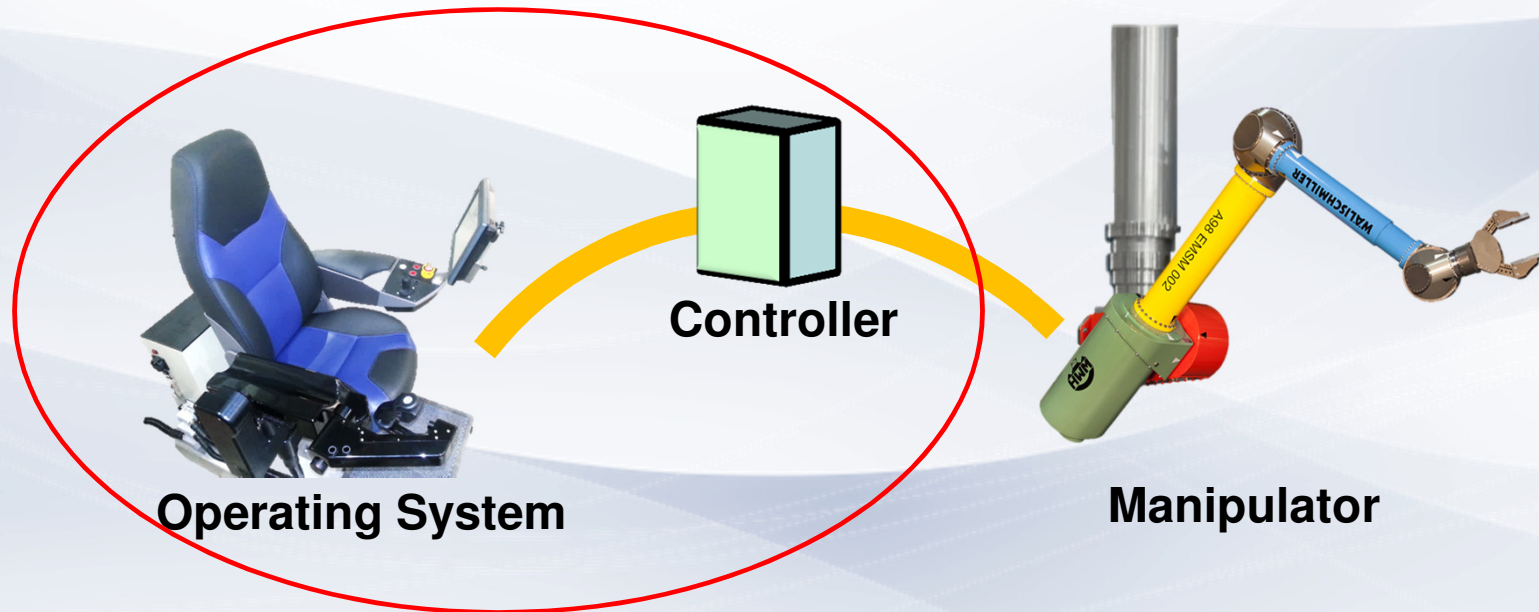
Cutting Test with A1000
Material: INCONEL® alloy 690
Thickness 100mm

Video Speed x 2

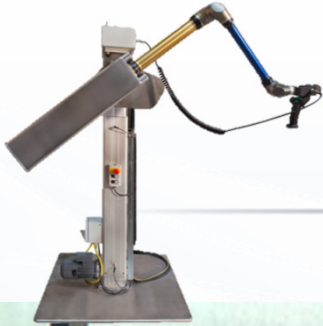




Requirements and Solutions

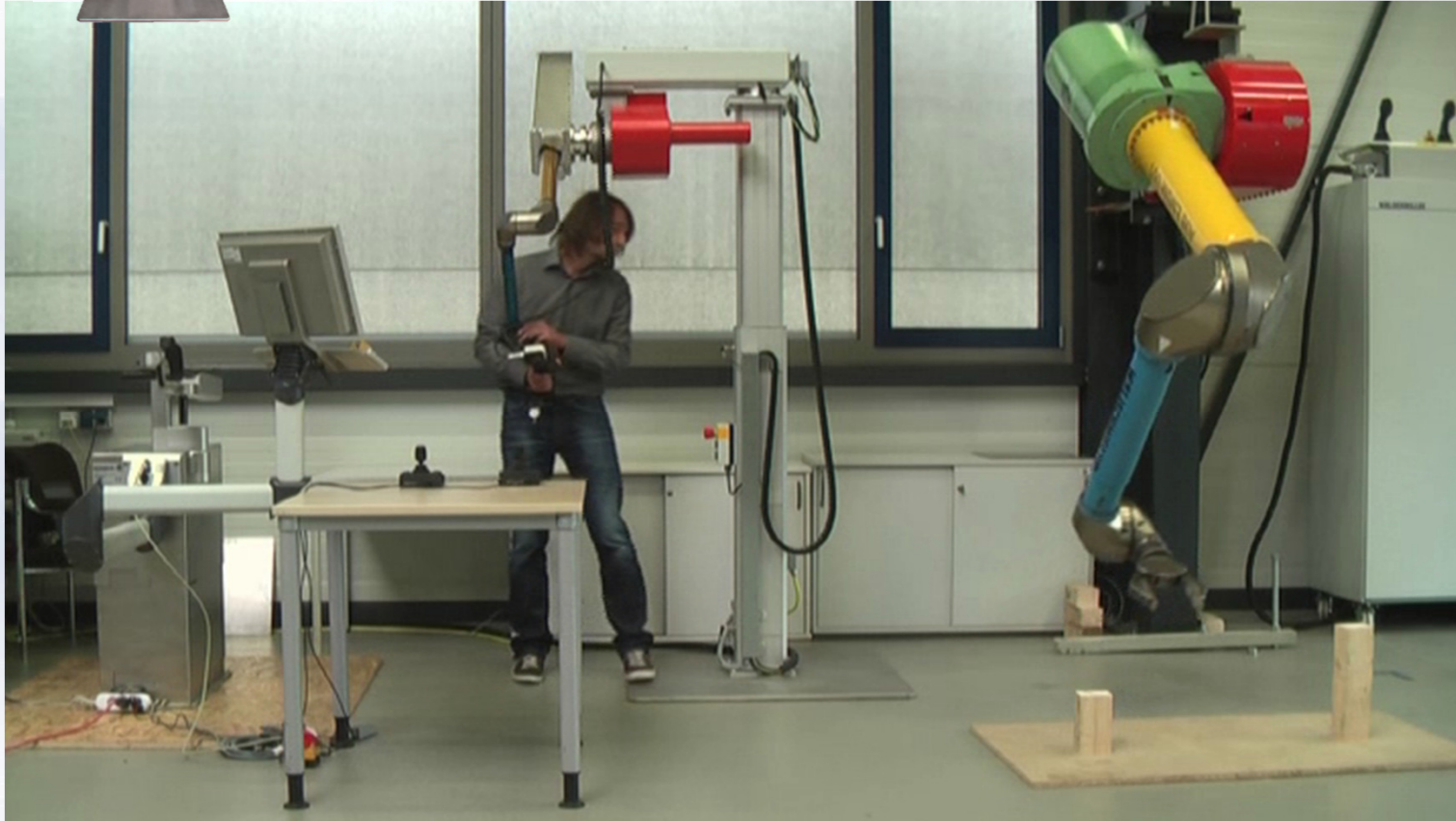


3. Easy Remote Operating Function



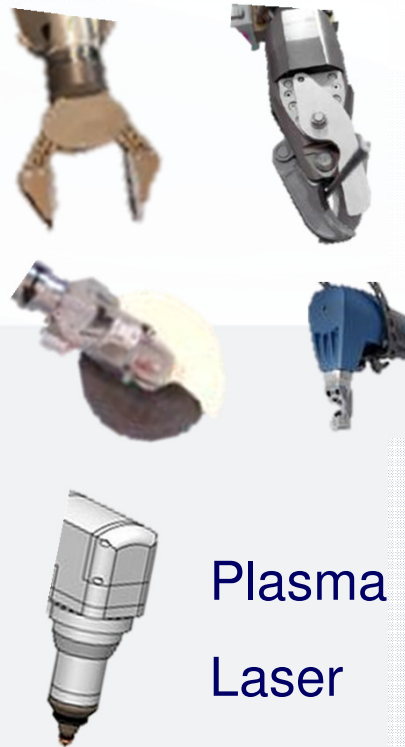
Master Slave Control

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Dismantling Task

3 Control Modes



Plasma
Laser

MS





Master Slave Control

SC

Speed Control on
C.Co-ordinate Control

Goto

Quick **Teach** & human
interactive **play-back** Control

Operation Device	HWM Products	MS	SC	Goto	Force Feedback
Switch & Lever Panel			✓	✓	
Joystick			✓	✓	
Master Arm		✓		✓	✓
JOYARM		✓	✓	✓	✓

Master Arm

WÄLISCHMILLER 
Quality for Safety.



JOYARM



JOYARM



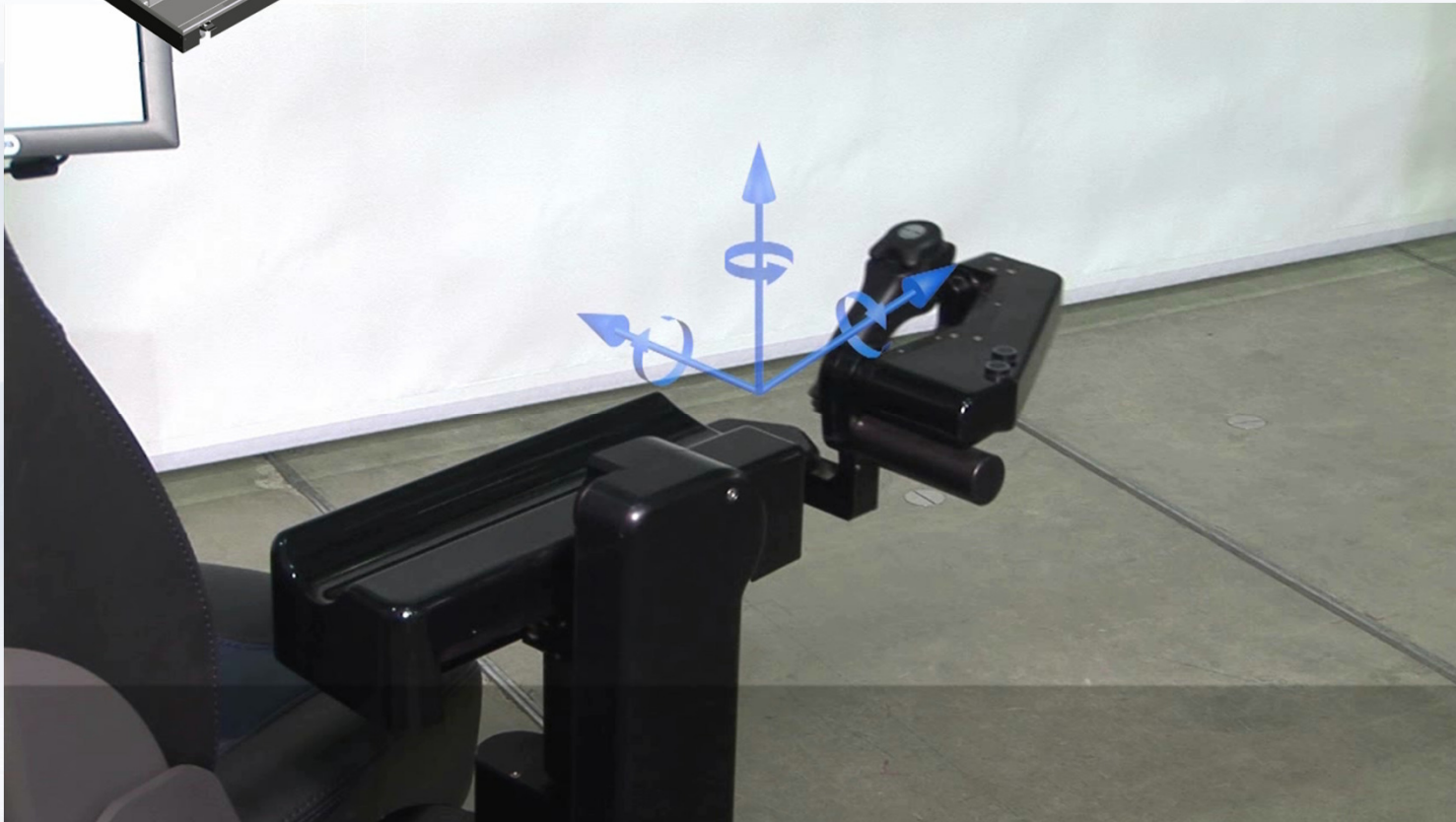
MS

SC

Goto



JOYARM



4. Collision Protection

Collision Avoidance

- Collision detection by 3D real time Simulator

Collision force reduction

- Force Limiter

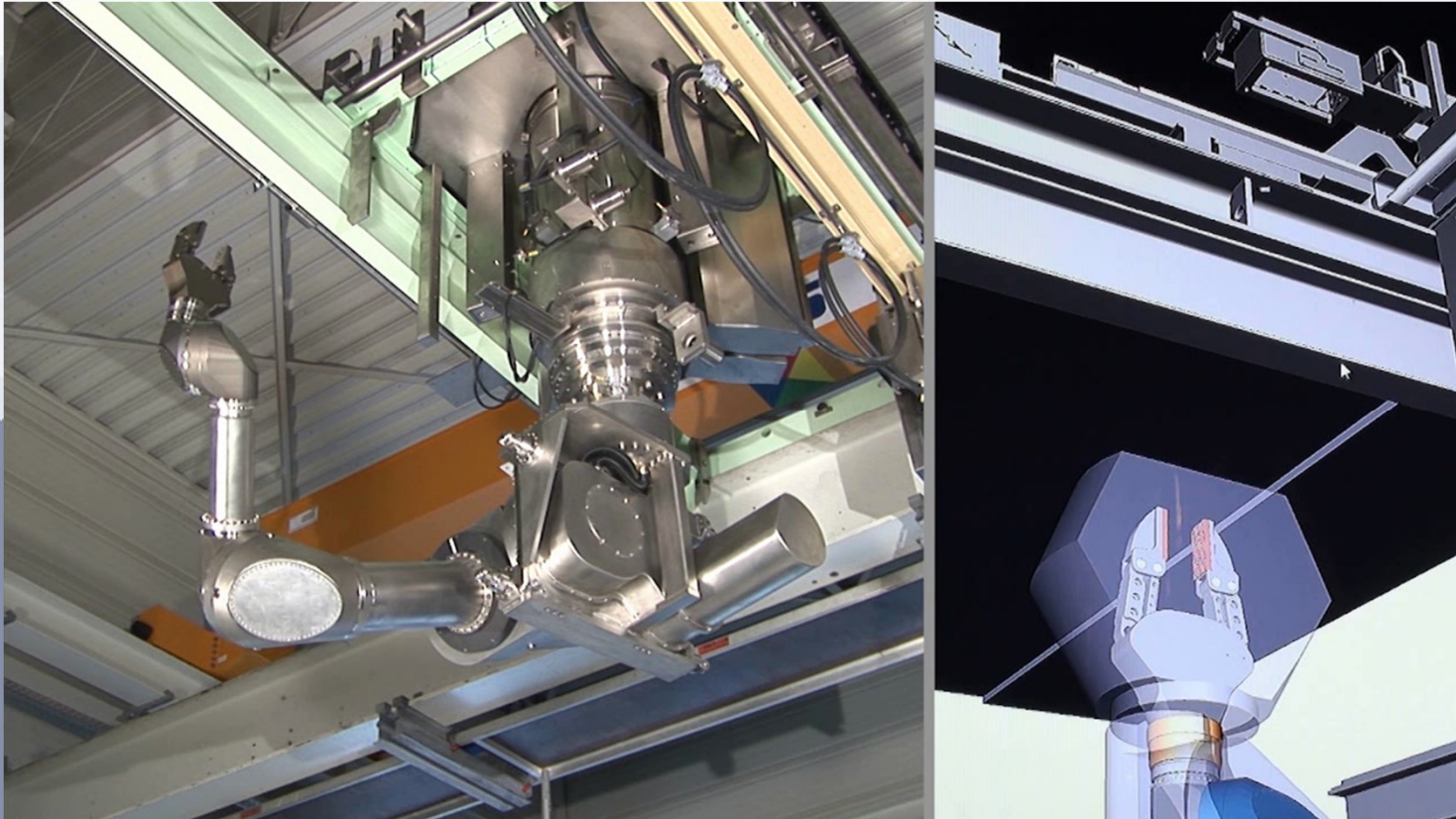
- Compliance Control

 - Mechanical Compliance

 - Software Compliance

- Bilateral Master-Slave Control

Collision Avoidance with 3D Protection Area



Collision Protection

- Collision Avoidance with 3D Protection Area

- Collision Force Limitation

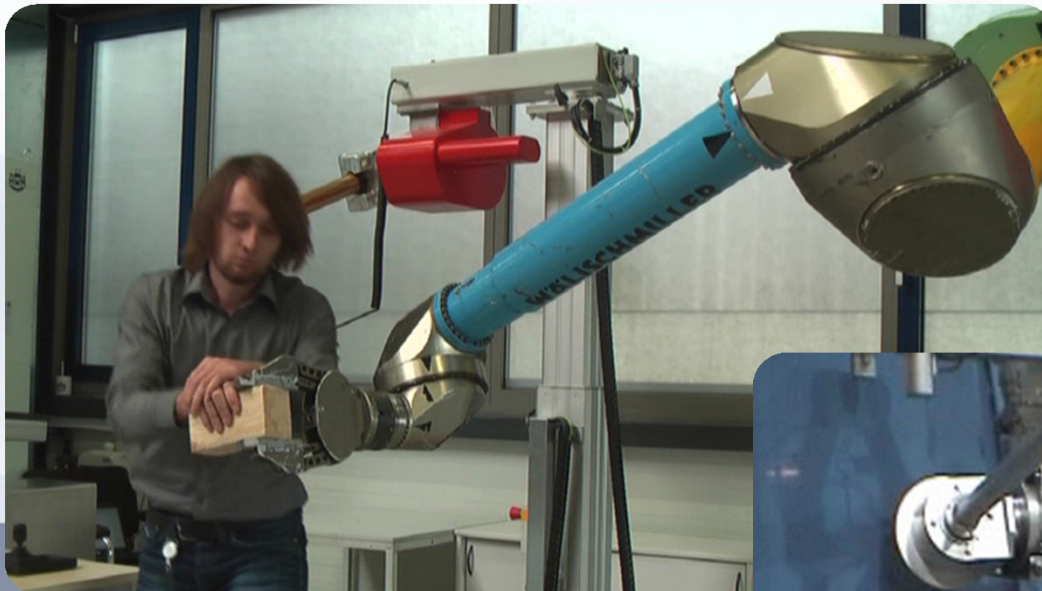
 - Force Limitation

 - Compliance Control

 - Mechanical Compliance

 - Software Compliance

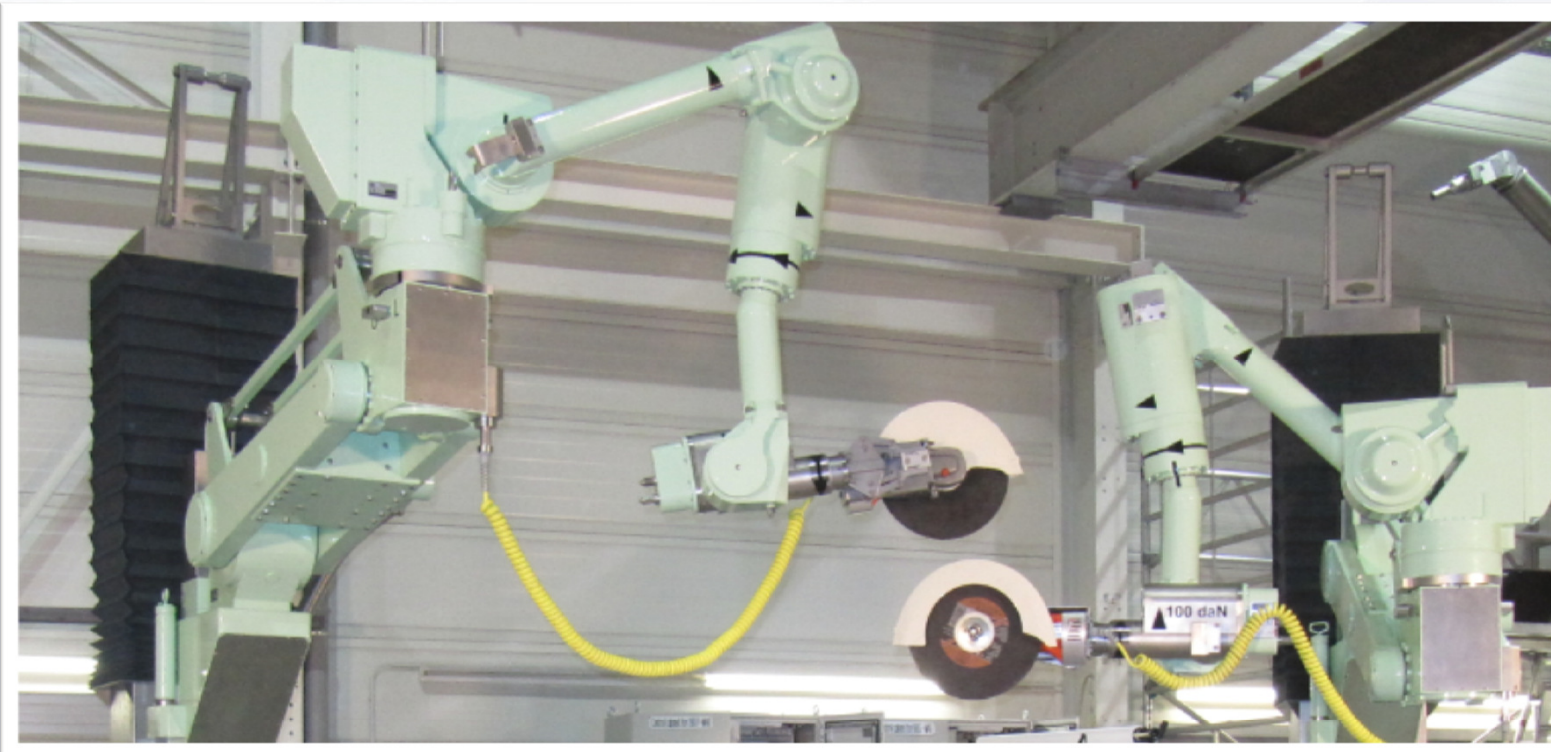
 - Bilateral Master-Slave Control



High Compliance = Soft

5. Rescue and Simple Recovery function

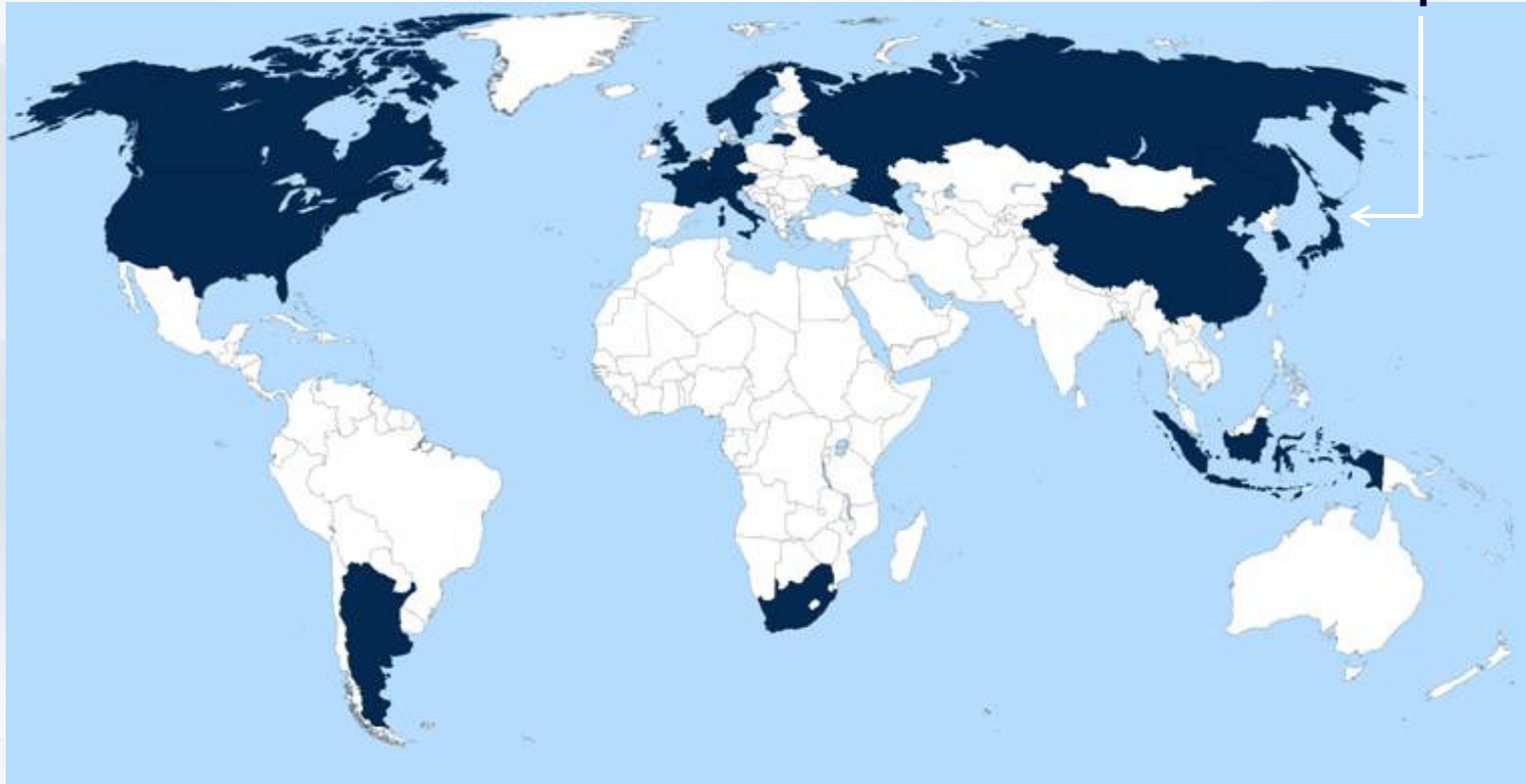
- **Rescue Drive**
 - **Double motor**
 - **External Drive**
- **Exchangeable Drive Unit**



Requirements for decommissioning manipulator

- 1. Optimum Arm Configuration according to individual task condition.**
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JNFL Rokkasho Japan

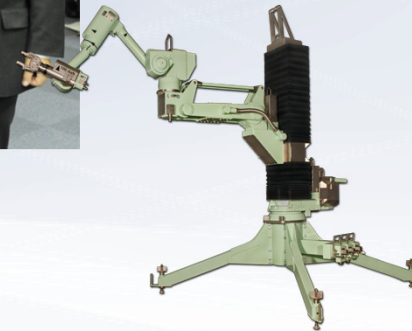




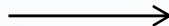
2015
「The JSME-PESD Division's General Awards
Outstanding Contribution to Division's Events」

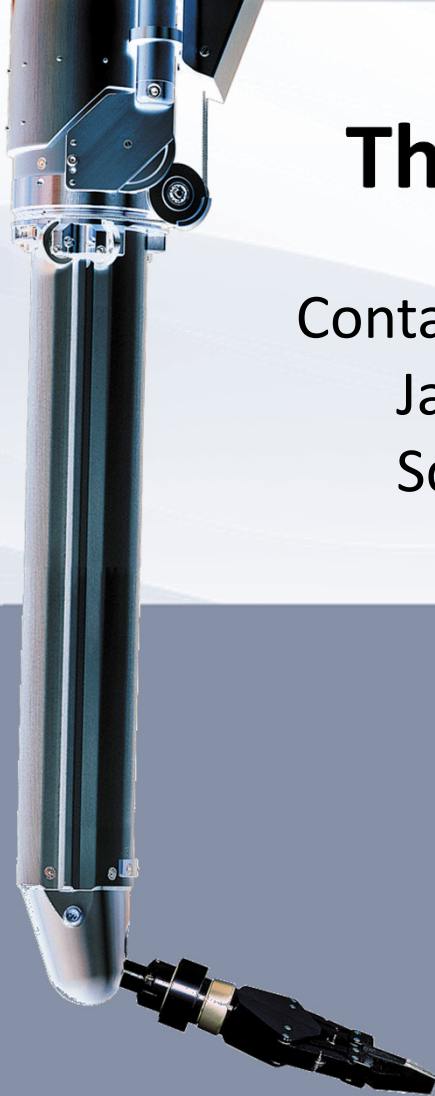


Rokkasho Reprocessing Plant in Japan (JNFL)



Since 1980'





Thank you for your attention.

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88677 Markdorf

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88677 Markdorf**

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Telefax: +49 7544 9514 99

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