Servicing and Repair of Key Equipment when Suppliers Disappear or Stop Offering Support

HOTLAB 2016

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Introduction - What Does Wälischmiller Do?

- Remote handling solutions for over 60 years worldwide
- Application in nuclear and chemical industries
- Mechanical telemanipulators
- Remote-controlled power manipulators
- Robot system TELBOT®
- Certified according ISO 9001:2008, ISO 14001:2015, KTA 1401 and ATEX
Evolution in the Nuclear Industry

- The development of remote handling technology is associated with the expansion of the nuclear industry between the 50s and 70s.
- Ageing manipulators and their regular wear implies to renew the equipment to maintain the output capacity that is lost through deterioration.
- In the last decades, many manufacturers of remote handling equipment disappeared or ceased to support the nuclear market.

**Challenge for operating companies:** find new suppliers who are able to offer servicing or even replace the manipulators according to:

- Stricter regulations
- New materials
- Remote installation in highly contaminated cells
- Adaptation efforts with affordable solutions
- Improvements in remote handling technology (mechanical design improvements, complex robotic functions and force feedback)
Replacement of a „Remote Controlled Power Manipulator“
Replacement of a „Remote Controlled Power Manipulator on a Telescoping Mast“

- Installation by the Belgian Nuclear Research Centre SCK•CEN in one of the hot cells of the research reactor N°2 (BR2) in Mol

- Replacement and installation requirements:
  - Installation on the existing boom hoist which has a vertical movement of 6 m and a horizontal movement of 2.3 m
  - New AC motors for the boom swing hoist
  - The boom swing hoist has to be controlled via the control console of the power manipulator
  - The new power manipulator should not exceed 600 kg
  - Wash-down according IP66
  - Easy inspection and maintenance
  - Lifting capacity on the load hook: 500 kg
  - Handling capacity in the hand: 75 kg in all positions
The Solution: Power Manipulator A1000

- Power manipulator with integrated carriage/telescope
- Arm length: 1,058 + 70 mm
- Gripper opening: 150 mm
- Telescope travel: 2,300 mm
- Weight: 565 kg
- Partly made out high-strength aluminum
- Radiation resistance: 1 MGy

1. Boom swing arm (from the operator)  4. Manipulator arm
2. Carriage  5. Load hook
3. Telescope  6. Electrical equipment
Control System

Standard hardwired control panel  Wireless control panel
Challenges in the Project

- Short delivery time of 9 months
- On-site assembly
- Non-standard nature of the required power manipulator
  - considerably lighter
  - smaller arm component sizes
- Staying commercially competitive with the high-strength aluminum
Success in the Project

- The manipulator was installed successfully in a 13 meter high hot cell.
- Long cables, sensors, motors, manipulator had to be installed at 13 meter height.
- When the installation crew started to work on it, the SAT tests were completed within 10 working days!
Addtional Power Manipulator
Requirements to the Power Manipulator

- Spare power manipulator for the installed H32 manipulator in the HDB-MAW facility of the WAK Rückbau- und Entsorgungs- GmbH
- **Purpose:** Handling of radioactive materials with high dose rate. The extreme field of application requires reliability and a maintenance- and repair-friendly design.
- To guarantee a continuous operation during the processing, a spare manipulator has to be available at the beginning of the projecting disposal campaigns to enable a quick installation if needed.
- The whole manipulator, as well as single functions, such as bridge, telescope or arm parts can be replaced
Power Manipulator for the MAW Facility

- Rail mounted, mobile bridge
- Carriage, which drives on the bridge
- Telescope with a load hook
- Power manipulator arm with 3 joints
- 10.5 to auxiliary hoist on additional and parallel carriage
- Emergency drives for bridge and carriage
- Emergency drive for telescope turn movement
- Emergency lifting unit for telescope
- Cameras on the wrist
- Tilt and pan holder for camera on the telescope
Power Manipulator for the MAW Facility
Challenges in the Project

- Successful achieved in 2016
- First time auxiliary hoist with a capacity of 10.5 to
Electrical Manipulator A4000 with Robotic Function
Requirements of DSRL

- Fuel reprocessing plant at Dounreay Site Restoration Limited DSRL

**Major Requirements:**
- Remote handling equipment that is capable of working at a greater reach than presently achievable with a standard Master Slave Manipulator (MSM).
- Additionally it must have improved dextrous movements to operate within the confines of nuclear cell work areas.
- Deployment horizontally and vertically
- Standard through-wall opening of MSM: 300 mm
Electrical Manipulator A4000 with Robotic Function for Installation in a Shielding Wall

- Max. load capacity: 30 kg in all positions (depending on the arm length, the capacity can be increased)
- Length of arm: 3,500 mm
- Gripper opening width: 100 mm
- Installation in a through-wall opening of 300 mm
Control System of the A4000

- Programmable control system
- Indication and selection of various operating modes of the control system are carried out via a graphic user interface (GUI) on the touch panel screen.
- The movements of the manipulator are driven by position-controlled three-phase motors with rotation angle measurement by absolute value encoders.
Electrical Manipulator A4000
Challenges in the Project

- Existing through-wall opening with a diameter of 300 mm.
- Hot cell highly contaminated
  ➔ increasing the diameter of the opening not possible
- Maximum reduction of all components with a handling capacity of 30 kg in each position and arm length of 3.5 m
  ➔ high torques and size reductions needed a very compact and well-thought-out design.
- Assembly of the subassemblies in the narrow spaces
Replacement of a „Floor Manipulator“
Replacement of a „Floor Manipulator“

- Replacement at the Phénix power station located at the Marcoule nuclear site, France.
- Decision was taken to replace the overhead lifting unit and the previous power manipulator installed on the floor, which consists of a carrier and a manipulator arm.
- Additionally, a power manipulator driving on the same bridge as the overall crane has to be installed.
- The upper power manipulator & floor manipulator cover the whole cell; dimensions: L = 18.9 x W = 6.5 x H = 10.7 m.
- One of the two grippers should access any point in the cell. An overlapping area (min. 500 mm) to transfer equipment between the manipulators is required.
Combination of Upper Power Manipulator & Floor Manipulator
Arrangement of the Components

- Rolling carrier on the rails
- Mast for the rotation
- Vertical unit for the lifting
- Manipulator arm for the handling
- Electrical installation
- Control command

1. Carrier
2. Mast
3. Vertical unit
4. Manipulator arm
5. Camera
Challenges in the Project

- Non-standard nature of the power manipulator and the customised design of the carrier, mast and vertical unit (parallelogram).

- Remote installation of the manipulator and the cables without human access

- Transport of the floor manipulator with the lifting unit to circumvent the existing power manipulator
  ➔ special compact remote handled connectors were developed. It allowed a quick and easy connection/disconnection of the cables in the cell. The lever is operated with the overhead lifting unit.
Management of Key Suppliers
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- How to manage the delivery of spare parts after decades?
  - Vertical range of production (produce all parts by oneself)
  - Key suppliers
- Alternative suppliers ➔ other interfaces?
- Considering in the design of the manipulators the exchangeability of components with intermediate interfaces
- No dependence on a single supplier
- Higher flexibility
- Consequently we are able to deliver spare part kits as long as the manipulator is working. We deliver spare parts for equipment which is in use since 30 years and is still working.
Conclusion
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- Replacement of equipment is possible with a design principle in variable subassemblies like the power manipulator system A1000
- Develop customisable solutions
- Key of success: Trust and solution oriented relationship
- Many very difficult remediation challenges will require the next generation of remote handling and robotics to achieve success.
- Retrieval, transport, reprocessing and ultimate disposal of radioactive material must employ remote solutions to protect the work force and the environment. The solutions must me rugged, reliable, and nimble.
- New solutions and equipment that meet the precise need of the situation and protect the workers and the environment in new and effective ways.
Thank you for your attention

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