

## SM5/KKL Manipulator / BWR 6 OD Nozzle Configuration

### Background

One of the most challenging tasks for Non-Destructive Examinations (NDE) is the inspection of austenitic welds and dissimilar welds. If the examinations are hampered by poor accessibility of the inspection areas in combination with high dose rates, high temperature and scaffolding work the inspection equipment has to fulfill unique requirements.

The manipulator system SM5/KKL has been developed by Westinghouse especially for inspections of Reactor Pressure Vessel nozzle safe-ends and associated piping from the outside surface where all austenitic and dissimilar metal welds are located between the reactor pressure vessel (BWR) and the biological shield. These areas are extremely difficult to access and result for the inspection crew in increased workloads due to high radiation level, limited space, high temperature and work on scaffolds

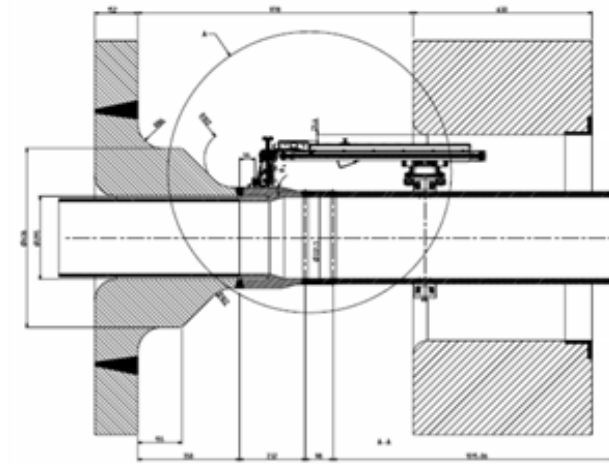


Figure 1: Manipulator Setup

### Description

The SM5/KKL allows performing these inspections in a very short time frame.

The SM5/KKL is easy to handle, which led to a shorter setup-time and thus to a lower radiation exposure of the personnel. Quick release connections and a dovetail and key design for the guiding ring and all changeable parts like scanner arms and probe systems allow for a precise and rapid assembly of the manipulator outside of the biological shield in an area with a low radiation level.

Through the use of pneumatic elements, pre-adjustable to different diameters, rapid adaption to the pipe is ensured. (Time used for setup: ~ 6 min).

The SM5/KKL is qualified for the inspection of BWR-nozzle-welds according to ENIQ requirements and to the ENSI-Guideline B07 and fulfills the requirement of the DIN25435-1.

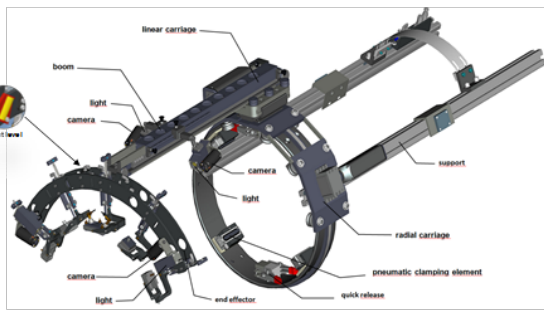


Figure 2: SM5/KKL

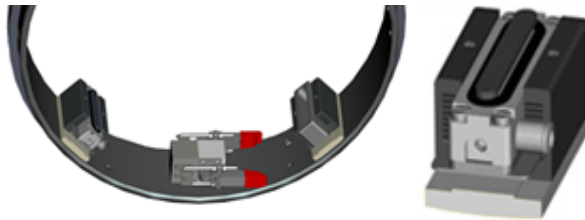


Figure 3: Quick Release Connection and Pre- Adjustable Pneumatic Element

Because of the poor accessibility of the nozzles and the high radiation exposure the positions of the weld center lines and their relative position to one another are measured with sufficient accuracy using UT-technique in combination with the positioning camera, which is fixed at the same level as the probe tipping point. For later inspections this position is set as the 0-point for axial positioning. The accuracy tolerance of the measured weld positions is  $\pm 3\text{mm}$ .

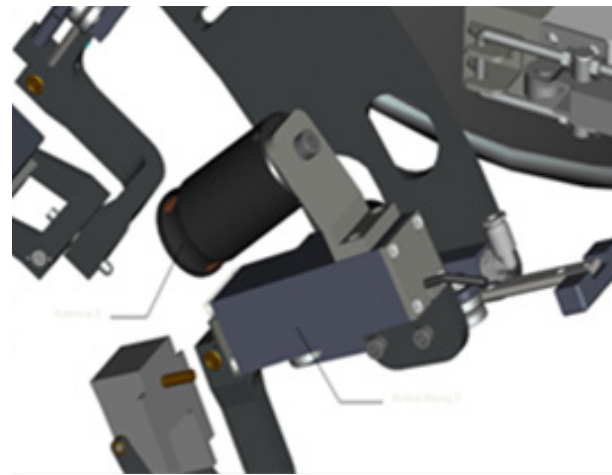
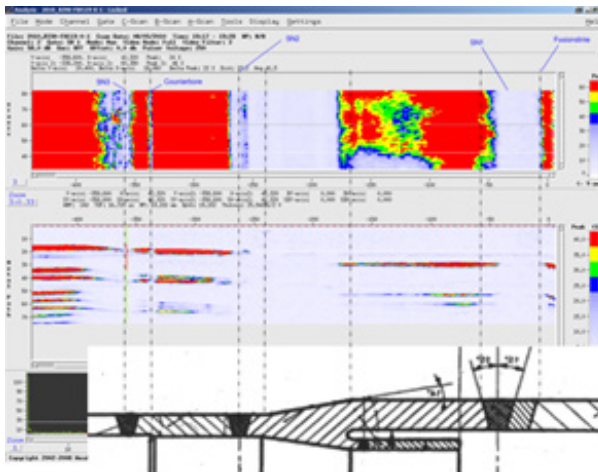


Figure 4: Identification of weld centerlines / Positioning Camera

## Benefits

- Shortens inspection time
- Reduces dose exposure to personell
- Easy to mount and handle
- Flexible/ easy to adjust to fit unexpected obstacles, or changed enviroment
- Qualified by ENIQ and ENSI B07 guidelines
- Fulfills DIN25435-1

## Experiences

Since using the SM5/KKL system at NPP Leibstadt all inspections have been carried out successfully.

- All Project Steps within scheduled Timeframe
- Data Acquisition time was reduced to 60%.
- Collective Dose was reduced to 50%
- Excellent Data Quality in all examined areas with no rescans
- All the proposed examination coverage was achieved