

## NOK CRDH

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### 2.2 NOK CRDH INSPECTION ISSUE

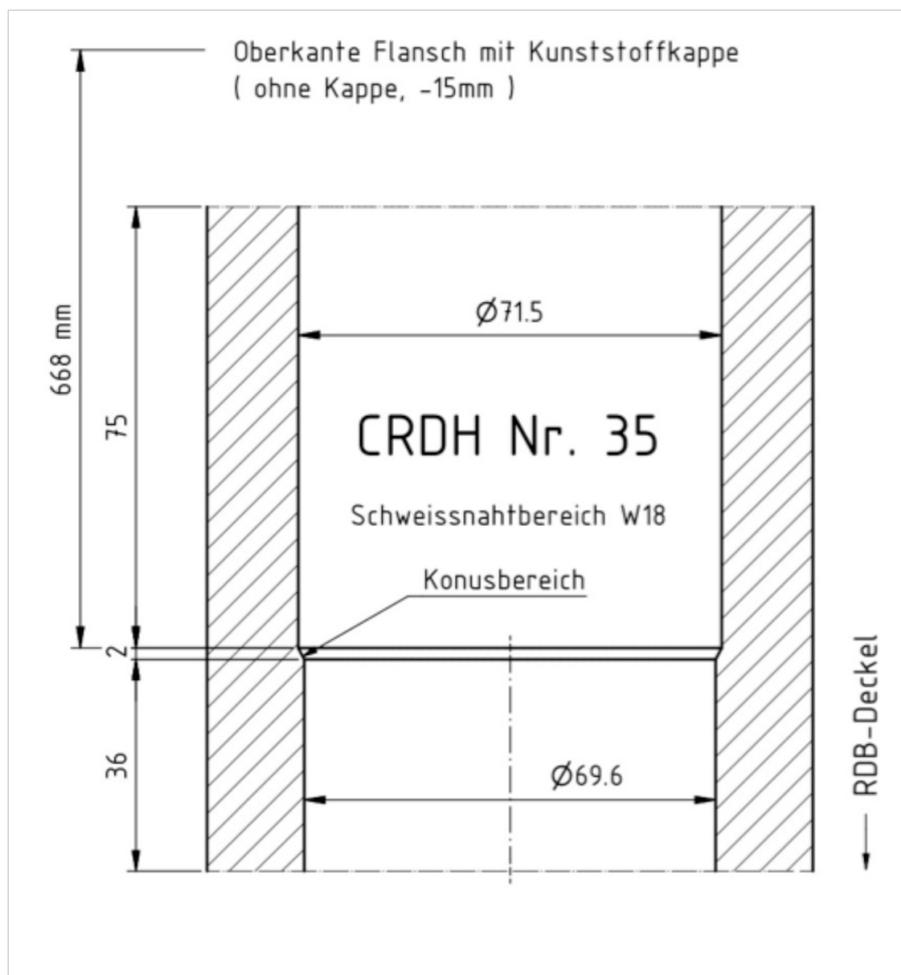
In the nuclear power plants operated by the Nordostschweizerische Kraftwerke AG (NOK) an eddy current inspection technique is used to inspect dissimilar metal weld in the RPV upper head penetrations. NOK had successfully qualified the inspection technique before planned outage of the year 2008. Qualification has been carried out by samples with EDM-notches.

However, during in-service inspections of the head penetrations in the outage 2008, problems arose due to unanticipated geometry of the target area. The ID contour, contrary to the expectation, was not smooth. It had a small counterbore, that prohibited the ET probe to have constant contact. As a result, a disturbing indication along the circumference was obtained. This indication, caused by the poor coupling of the eddy current probe, could mask possible real indications.

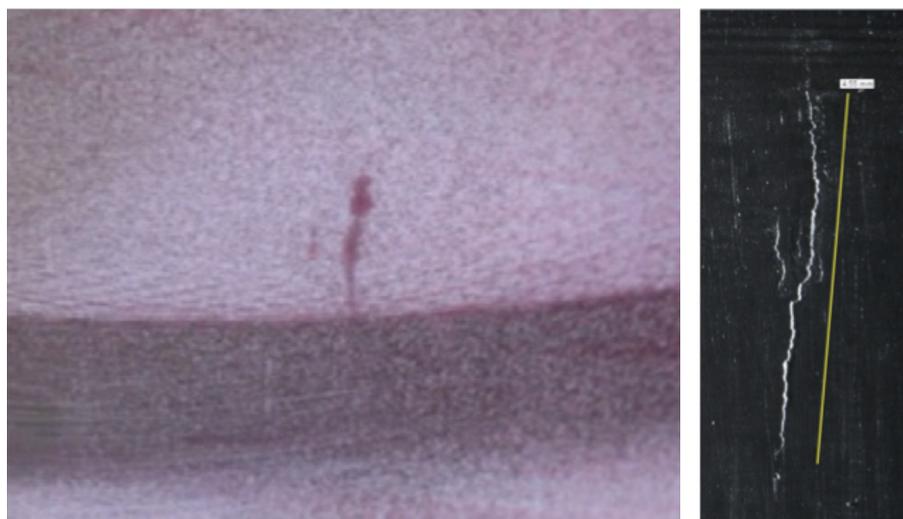
The regulator did not accept the inspection results, and required the plant to optimize the inspection technique to overcome the geometric restriction present. Consequently, when the optimization of the technique has been done, both the qualification and the performed in-service inspections have to be redone. The upper head shall be replaced in about four years, so the developed system will have short useful life and the effort planned accordingly.

So, it was decided first to apply a qualified moulding technique on three penetrations to determine the ID contour. This investigation showed that there is an inner diameter difference between 1.5 and 2 mm and that the counterbores have different steepness. Next figure (Fig. 4) shows a drawing of the geometry based on the moulding result. Next step was to manufacture a sample representing the geometry of the real penetrations. Realistic flaws were needed to achieve reliable inspection results. The sample had to contain realistic cracks in different positions in the weld area. Furthermore, as the sample was already finished, the applied production technology had to deal with this.

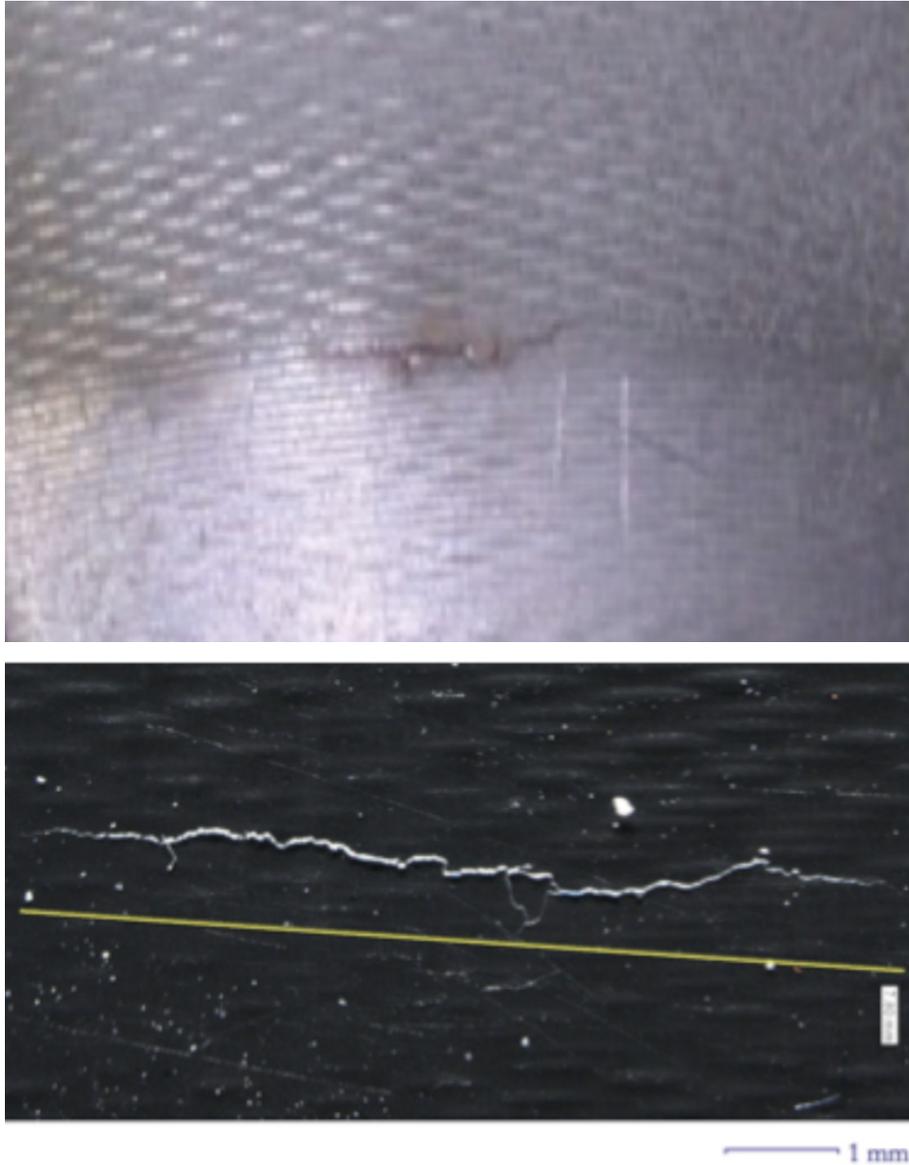
The plant decided to use Trueflaw cracks based on the criteria that realistic cracks were needed and they had to be put in a ready-made sample. Two different crack depths were specified, 1 mm and 3 mm. The 1 mm depth was for the ET inspection and 3 mm for the additional UT sizing technique. As the moulding technique was also used for the in-service inspections, this sample was to be used for a verification test of the technique's capability, to show that there are no cracks in the penetrations inspected by the moulding technique. Next figures (Fig. 5 and 6) show examples of PT done (by Trueflaw) and the corresponding moulding inspection result. Moulding inspection results are photographs of the replica taken from the sample.



**Figure 1**  
Example of a penetration ID contour.



**Figure 2**  
PT indication with corresponding moulding indication (with secondary crack).



**Figure 3**  
PT indication with  
corresponding  
moulding  
indication.

In the near future the sample shall be inspected by the ISI technique used in 2008. The plant expects that it will be possible to show that cracks would have been detected even with the non-optimized inspection technique and that the already performed inspections of year 2008 can be accepted. And the authority questioned performance of the inspection techniques would be confirmed. Thus the real cracks used in an additional open development sample could solve a complex problem that otherwise would have lead to extensive rework with a part that will soon be replaced. However, if a complete new qualification should be required, further samples with Trueflaw cracks will be used.