PIONIC

"The Program for Investigation Of NDE by International Collaboration"

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PIONIC

- **PIONIC** -"The **P**rogram for **I**nvestigation **O**f **N**DE by **I**nternational **C**ollaboration"
- Established to facilitate collaborative information sharing and the leveraging of resources by organizations in government, industry, and academia with technical expertise in the Non-destructive Examination (NDE) of commercial nuclear power facilities.
- PIONIC follows the examples of its predecessor programs: the Program for Inspection of Nickel Alloy Components (PINC), and the Program to Assess the Reliability of Emerging NDE Techniques (PARENT) which focused on the collection of empirical NDE reliability data.
- Participants provide resources in the form of in-kind contributions.
- PIONIC is scheduled to continue into 2022

PIONIC Participants

- **United States**
  - Pacific Northwest National Laboratory, Richland (PNNL), Washington, USA
  - United States Nuclear Regulatory Commission (NRC), Washington D.C., USA
  - Electric Power Research Institute (EPRI), Charlotte, North Carolina; USA
- **Sweden**
  - Swedish Radiation Safety Authority (SSM), Stockholm, Sweden
  - Swedish Qualification Center (SQC), Täby, Sweden
- **Finland**
  - Technical Research Centre of Finland Ltd. (VTT), Helsinki, Finland
  - Aalto University, Helsinki, Finland

PIONIC Participants

- **Switzerland**
  - Swiss Federal Nuclear Safety Inspectorate (ENSI), Brugg, Switzerland
  - Swiss Association for Technical Inspections Nuclear Inspectorate (SVTI), Wallisellen, Switzerland
- **Japan**
  - Japan Power Engineering and Inspection Corporation (JAPEIC), Yokohama, Japan
  - Mitsubishi Heavy Industries, Ltd. (MHI), Kobe, Japan
- **South Korea**
  - Korea Institute of Nuclear Safety (KINS), Daejeon, Republic of Korea
  - Sungkyunkwan University (SKKU), Suwon, Republic of Korea

PIONIC Topics

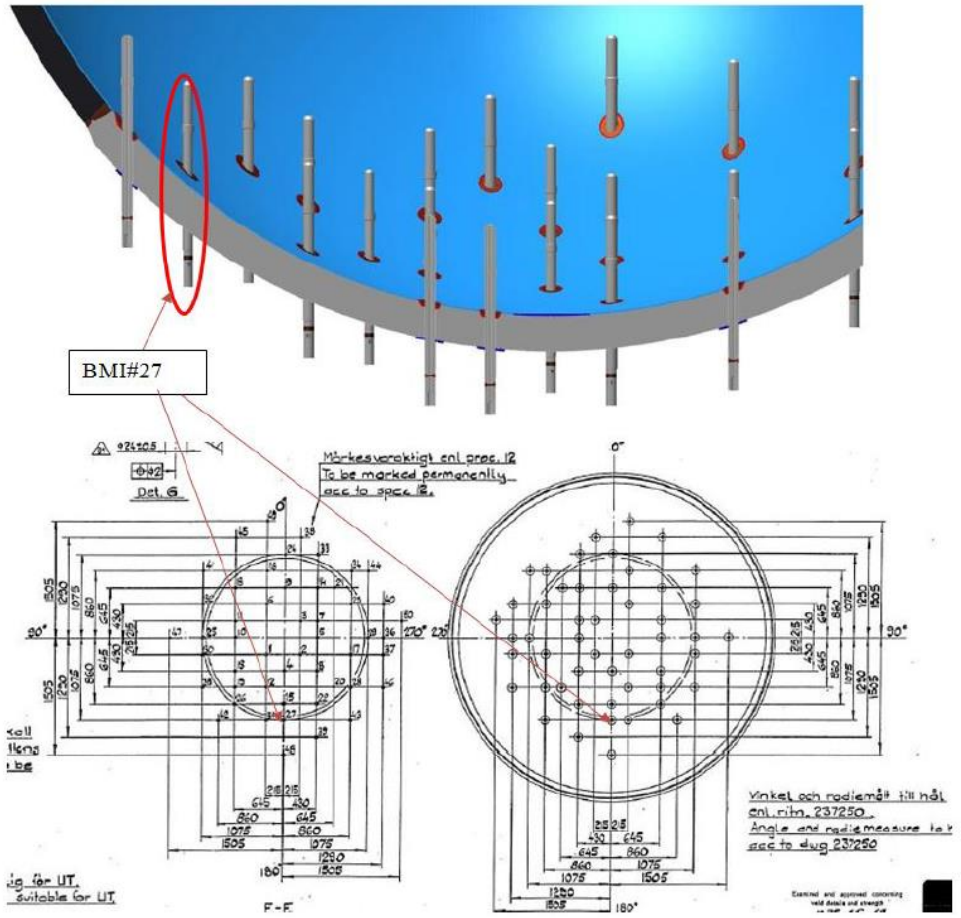
- **PIONIC Topics:**
  - **Topic Area 1**: NDE Modeling and Simulation:
    - Exploring capabilities and limitations regarding the applications of NDE modeling/simulation software
  - **Topic Area 2:** Flaw Relevance Evaluation:
    - Define the relevance of the crack parameters and Manufacture a BMI test block with representative qualification defects
  - **Topic Area 3:** Materials Degradation Monitoring in Extended Periods of Operation:
    - Conduct "mini-round robin" exercise to evaluate the ability of several techniques to monitor the amount of thermal aging in CASS materials, dissimilar metal welds, and stainless steel welds
  - **Topic Area 4:** Probability of Detection (POD) Analysis:
    - POD is the de-facto metric for quantifying the performance of NDE techniques
    - In PIONIC, the objective is to further explore the applicability and limitations of data collected in PINC and PARENT to provide guidance on end-use of the data
    - Emerging "virtual flaw" tools may provide a low cost method for understanding limitations of data collected in PINC and PARENT and for augmenting the data to enhance applicability

Sweden Participation

- Sweden participates in all Topic Areas except Topic Area 3
- Sweden has the lead of **Topic Area 2** - Flaw Relevance Evaluation
- The following topics are included in this task:
  - Define the relevance of the crack parameters performed by SKI (SSM): SKI Reports 1995:70 and 2006:24
  - Update the data in the reports with data from other countries, for example from US
  - Make available the SSM report 2017:10
  - Manufacture BMI test sample (Bottom Mounted Instrumentation Nozzles) with relevant qualification defects
  - Implement an international Round Robin Testing (RRT) on the BMI test sample
  - Perform modeling corresponding to the tests made in RRT
  - Create so-called virtual defects based on test data obtained from fingerprint and RRT
  - Make POD analyses against the sources found by RRT as well as the virtual defects
  - Finalize and draw conclusions about testing techniques and modeling

BMI Test block

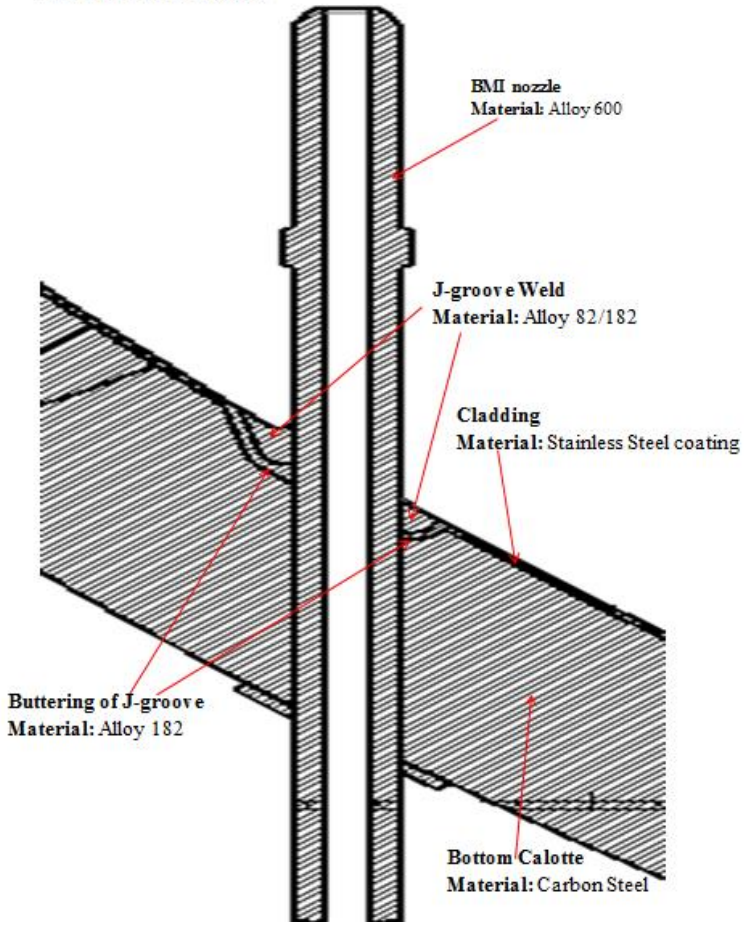
- Manufacture a test block to simulate the BMI #27 of Ringhals unit 4 with realistic defects



BMI Test block

BMI- nozzles geometry, material and dimension

Figure: BMI Nozzle description



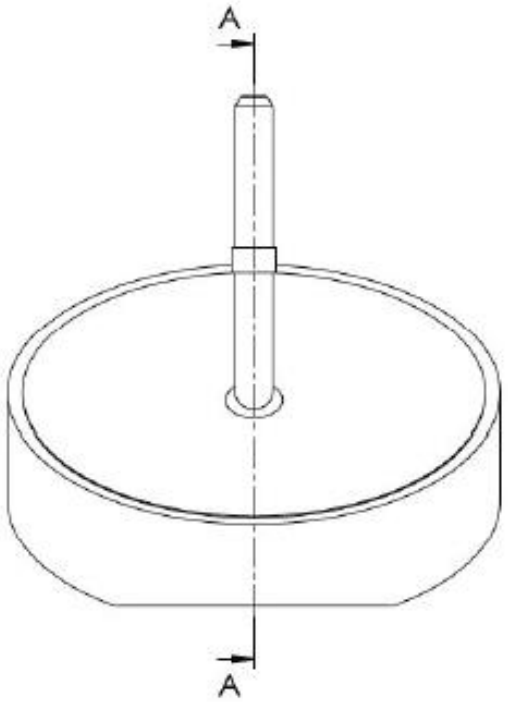
BMI-nozzle	Material	Welding method/ (Welding procedure)
Bottom Calotte	Base material: Carbon Steel	
BMI Nozzle	Base material: Alloy 600	
Cladding	Stainless steel coating	
Buttering of J-groove	Welding material: Alloy 182	MMA (MA-12B/43-11)
J-groove Weld	Welding material: Alloy 82/182	MMA-TIG (MA-TIG-43/43-11)

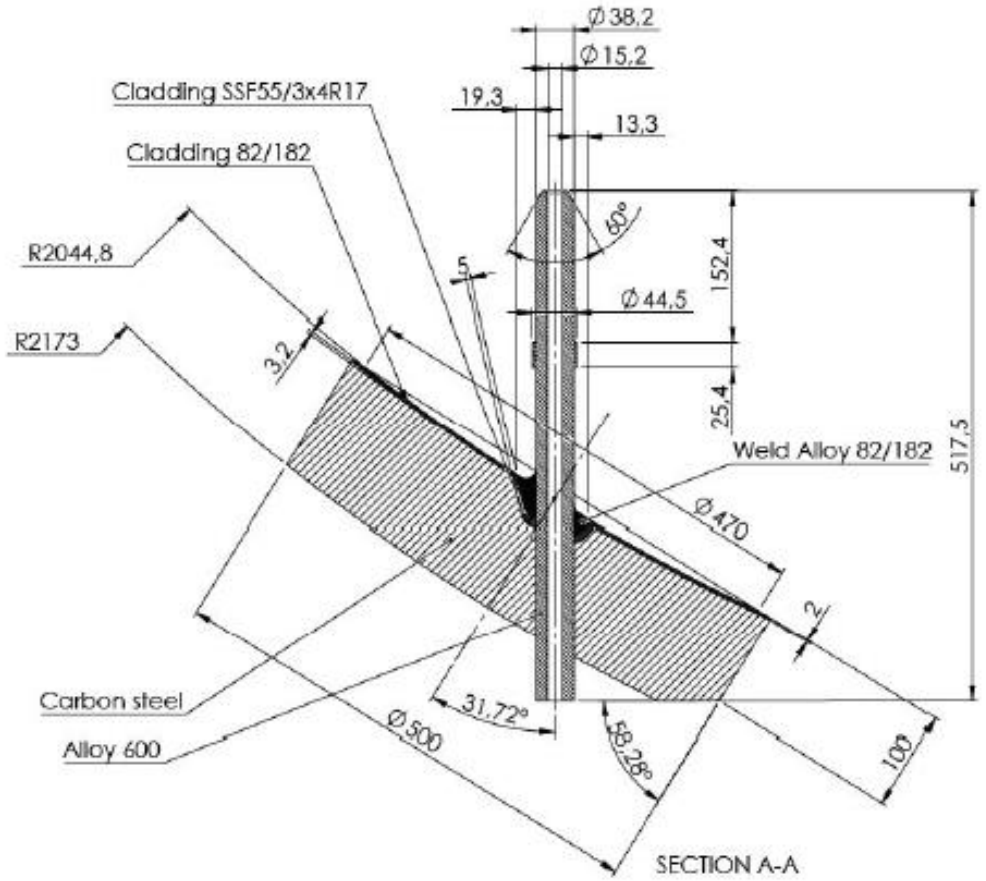
BMI Dimensions:

- Internal diameter (ID): 15.24mm
- External diameter (OD): 38.2 mm
- Wall thickness, T= 11.48mm

BMI Test block

- The overall weight of the block will be approximately 225kgt sample



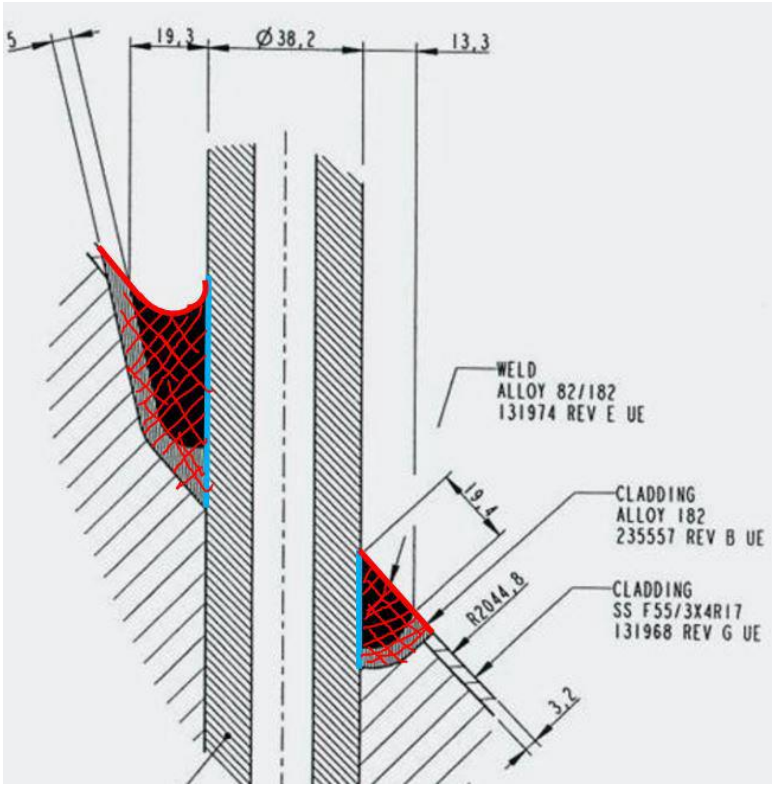


BMI Test block

Defects:

- The test sample will **not** contain all thinkable combinations of defects that may occur in the object. It will only contains realistic IDSCC defects in the J-grove as follows:
  - Lack of fusion in fusion line between the J-groove weld and the tube; see blue area
  - Circumferential IDSCC in the J-groove weld*; see red areas
  - Axial IDSCC in the J-groove weld* –, see red areas

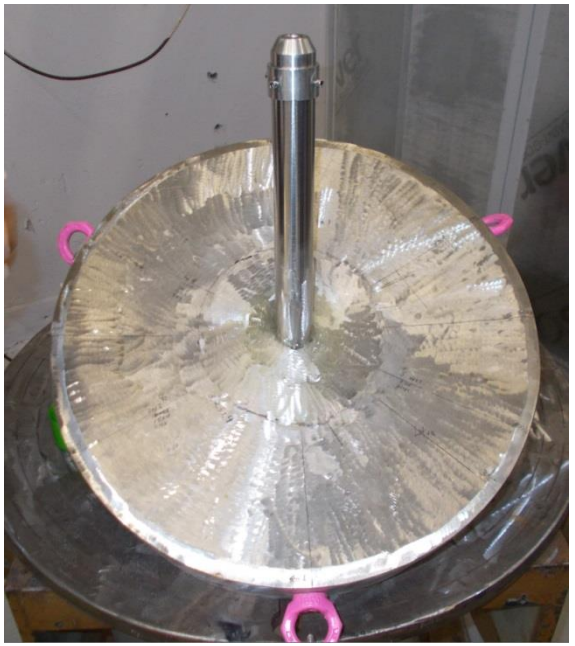
***Remarks:** All IDSCC defects are PWSCC i.e. will be opened to the wetted surface.



BMI Test block

Machining the weld preparation

Welding the buttering



BMI-block finished

Time Schedule

- Technical Justification (draft)– week 30 - 40, 2018
- Request for proposal – 12th of Dec. 2018
- SAAB Offer – 21st of Dec. 2018
- SQC PO – 28th of Jan 2019
- Design of the BMI-block – week 48, 2018 to week 9, 2019
- Start the manufacturing of BMI-block – week 12, 2019
- Finish the manufacturing of BMI-block – week 45, 2019
- Last review of the As Built Drawings – week 48, 2019
- Delivery of BMI-block – week 49, 2019
- Fingerprint of BMI-block – week 10, 2020
- Round Robin of BMI-block – week 22, 2020

Conclusions

- PIONIC is a continuation of international collaboration in research investigations of NDE for commercial nuclear power components
- Participants benefit from collaborative information sharing and the leveraging of resources by organizations in government, industry, and academia with technical expertise in the nondestructive examination (NDE) of commercial nuclear power facilities.
- In PIONIC, participants are providing unique contributions to improve understanding in four main topic areas
- In the PIONIC project, Sweden focuses to:
  - Define the relevance of the crack parameters
  - To manufacture a BMI-block representing the component in a Swedish NPP with realistic defects
- This will contribute to maintain and further develop a process for the Swedish license holders to effectively and reliably qualify the NDE systems in accordance with the requirements from the authorities and license holders,