

## Status of Program for the Inspection of Nickel Alloy Components(PINC)

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### 1. Introduction

After several PWSCCs were found in Bugey(France), Oconee, Arkansas, Crystal Fever, Davis-Basse(U.S.A.), USNRC and PNNL the research on PWSCC under the project name of PINC. The aim of the project was 1) to fabricate representative NDE mock-ups with flaws to simulate PWSCCs, 2) to identify and quantitatively assess NDE methods for accurately detecting, sizing and characterizing PWSCCs, 3) to document the range of locations and morphologies of PWSCCs and 4) to incorporate results with other results of ongoing PWSCC research programs, as appropriate.

For this aim, PINC group was organized by three task groups. Task group 1 is Morphology Atlas (TG-Atlas) group. Task group 2 is NDE Technology Assessment (TG-NDE) group. Task group 3 is Data Analysis group (DAG).

In the September 2007, the PINC international research was introduced in this society. In this presentation, the status of PINC meeting after September 2007 was explained. KINS participated in 10<sup>th</sup> PINC meeting in October 2007 and 11<sup>th</sup> PINC meeting in April 2008. During these meeting, KINS participate in NDE, Atlas and DAG group and discussed results were explained.

### 2. PINC Project and Participation of Korean Organizations

Morphology Atlas (TG-Atlas) group (Task group one) aims 1) to compile existing work on crack morphology of PWSCC, 2) to correlate with NDE data, when available, 3) to develop an electronic Atlas (database) of NDE and metallography information and 4) to perform new NDE, fractography, and metallography. TG-Atlas group provides PINC members PWSCC/ NDE database. KINS, KPS (Korea Plant Service and Engineering) and KAERI (Korea Atomic Energy Research Institute) participated in this group. KPS supported 3 BMI (Bottom Mounted Instrumentation) mock-ups and one of three mock-ups was used in the destructive test. KAERI fabricated BMI nozzles with autoclave and PWSCCs in BMI mockups. The cracked BMI nozzles were supplied for the PINC mock-ups.

NDE Technology Assessment (TG-NDE) group (Task group two) aims 1) to perform Round Robin Test(RRT) of NDE techniques on PWSCC and simulated cracks, 2) to apply techniques to detect and size cracks, 3) to assess techniques to manufacture test blocks, 4) to survey relevant materials and geometries, and 5) to integrate findings of regulatory application

and process qualification. Currently, USA, Japan, Europe and Korea have mockups of DMW, RVHP and BMI for RRT. Three organizations were involved in the preliminary RRT using 4 mockups.

Data Analysis group (DAG) (Task group three) aims 1) to analyze the procedures, 2) to analyze and characterize the flaws and 3) perform the regression analysis. All organizations were involved in DAG. Fig.1 shows the flow chart of data analysis.

### 3. Task Group 1 (TG-Atlas) Activity

Task group 1 is Morphology Atlas (TG-Atlas) group. TG-Atlas group compiles existing work on crack morphology of PWSCC, correlate with NDE data, when available, develop an electronic Atlas (database) of NDE and metallography information and perform new NDE, fractography, metallography.

In October 2007 10<sup>th</sup> PINC meeting, TG-Atlas group provides PINC members PWSCC/ NDE web-based database. This database includes morphology and NDE information provided from OHI 2 CRDM crack (Japan), Tsuruga-2 pressurizer nozzle cracks, North Anna 2 CRDM cracks (USA) and etc.

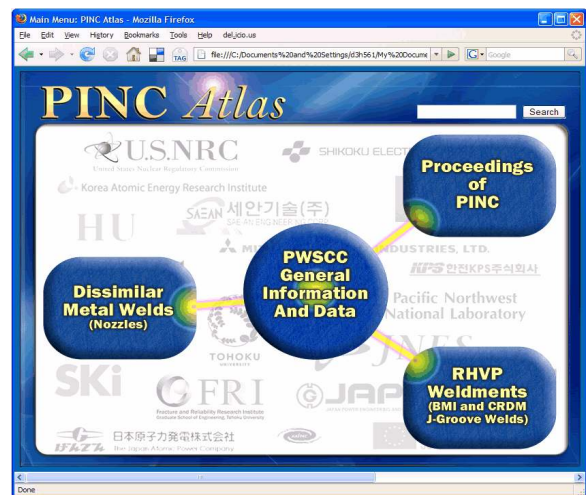


Fig. 1 Web-based PWSCC Database

In April 2008 11<sup>th</sup> meeting, TG-Atlas group provide fracture test result. JNES (Japan) did destructive test for the Mockup PINC 2.1-6. Test result was utilized by DAG group to grade the RRT result.

### 4. Task Group 2 (TG-NDE) Activity

Task group 2 is NDE Technology Assessment (TG-NDE) group. TG -NDE perform Round Robin of NDE techniques on PWSCC and simulated cracks, assess techniques to detect and size cracks, assess techniques

to manufacture test blocks, consider relevant materials, geometries and integrate findings for regulatory application, process qualification.

In order to assess NDE methods, USA, Japan, Europe and Korea got the mock-ups of DMW, RVHP and BMI together for RRT. These mock ups contain actual or fabricated PWSCC. By these mock ups, RRT has been performed.

4.1 DMW(Dissimilar Metal Weld) RRT

DMW RRT has finished at 2007 September in Korea.

4.2 BMI RRT

BMI RRT was performed since 2007 September. Table 1 shows the PINC BMI RRT schedule. For the preparation of BMI RRT, 1 Korea RRT teams (KPS) have held seminar 5times and did perform preliminary RRT using 4 mock-ups.

From Pre BMI RRT, it was learned that axial crack J-weld outside is difficult to detect and new standard for axial defect detection may be made. Circumferential crack more than 0.3" from OD to J-weld outside is difficult to detect. Axial Crack is more difficult to find than circumferential crack. Detection Technique for J-weld outside indication need to be improved in the near future.

KPS has finished PINC BMI RRT during March.

data has been collected by PNNL and USNRC and very helpful for regulation and research.

By participating task group 2, Korea NDE team can learn and develop the detection and sizing technique for dissimilar metal weld. These techniques were not prepared yet in Korea but have to be utilized for the inspection of the pressurizer of NPP. PINC RRT mock-ups will be helpful to training.

By participating task group 3, KINS and KEPRI will evaluate the NDE result. It is expected that lesson from comparing USA, Japan, Europe and Korea NDE result and discussing the problem occurred during the inspection with NRC and PNNL expert will be learned.

REFERENCES

- [1] PINC 6<sup>th</sup> International meeting report (Japan)
- [2] PINC 7<sup>th</sup> International meeting report (USA)
- [3] PINC 8<sup>th</sup> International meeting report (USA)
- [4] PINC 9<sup>th</sup> International meeting report (Japan)
- [5] PINC 10<sup>th</sup> International meeting report (Finland)
- [6] PINC 11<sup>th</sup> International meeting report (USA)
- [7] 1<sup>st</sup> RRT Team Seminar (Korea)
- [8] 2<sup>nd</sup> RRT Team Seminar (Korea)
- [9] 3<sup>rd</sup> RRT Team Seminar (Korea)
- [10] 4<sup>th</sup> RRT Team Seminar (Korea)
- [11] 5<sup>th</sup> RRT Team Seminar (Korea)
- [12] 6<sup>th</sup> RRT Team Seminar (Korea)
- [13] 7<sup>th</sup> RRT Team Seminar (Korea)
- [14] 8<sup>th</sup> RRT Team Seminar (Korea)
- [15] 9<sup>th</sup> RRT Team Seminar (Korea)

Table 1 PINC BMI RRT schedule

2007			2008					
October	November	December	January	February	March	April	May	June
PNNL Finger print								End of BMI RRT, Destructive examination
	EPRI							
	Zetec							
			Europe	Europe	Korea			
						Japan		

5. Task Group 3 (TG-DAG) Activity

Task group 3 is Data Analysis group (DAG). In the 12<sup>th</sup> PINC meeting, scoring tolerance, probability of detection (POD) curve, POD/false call (FC) by team and POD by flaw were discussed. Detail discussion result can not be opened until NRC releases NUREG report.

6. Conclusion

By participating PINC project, Korean participant has good opportunity to participate in PINC task group 1, 2 and 3.

By participating task group 1, KEPRI and KINS can share morphology and NDE information provided from OHI 2 CRDM crack (Japan), Tsuruga-2 pressurizer nozzle cracks, North Anna 2 CRDM cracks (USA). This