

Introduction to the Program for 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 started the research on PWSCC, that is, PINC project. The aim of this project is to fabricate and obtain representative NDE mock-ups with flaws to simulate tight PWSCC cracks, to identify and quantitatively assess NDE methods for accurately detecting, sizing and characterizing tight cracks such as PWSCC, to document the range of locations and crack morphologies associated with PWSCC and observed responses and to incorporate findings from other 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).

USNRC required KINS to participate in PINC project at May 2005. KINS consists Korean consortium which includes KINS, KAERI, KHNP and SKKU at March 2006 and Pre RRT for RVHP and DMW were performed for the preparation of PINC RRT and presented at PINC meeting. PINC DMW RRT has been performed since 2006 August and Japan and Europe finished their RRT. DMW RRT has performed between 2007 June and September in Korea. Korea RRT result was sent to USNRC and PNNL to evaluate result.

2. 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.

TG-Atlas group provide PINC members PWSCC/ NDE database. This database include morphology and NDE information provided from OHI 2 CRDM crack (Japan), Tsuruga-2 pressurizer nozzle cracks, North Anna 2 CRDM cracks (USA) and etc.

KINS, KPS and KAERI participate in TG-Atlas group. KPS will support 3 BMI mock-up and one of three mock-ups will be used for destructive test. KAERI fabricated BMI nozzle as an autoclave and is making PWSCC in BMI mock-up. The cracked BMI nozzle will be supplied for as PINC mock-up.

3. 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.

3.1 DMW(Dissimilar Metal Weld) RRT

DMW RRT has been performed since 2006 August and Japan and Europe finished their RRT. Table 1 shows PINC DMW RRT schedule. DMW RRT was performed between 2007 June and September in Korea. Table 2 shows Korea DMW RRT schedule. For the preparation of this RRT, 5 Korea RRT teams (KHNP, Sean-Kaitec, Seoul National Univ., Doosan, KPS) have held seminar 5times and did perform preliminary RRT using 4 mock-ups.

Table 1 PINC DMW RRT schedule

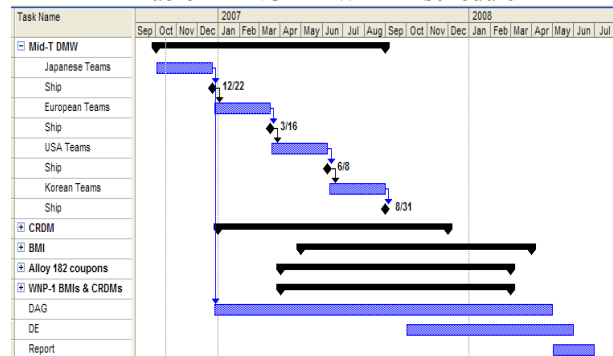


Table 2 Korea DMW RRT schedule

Task Name	Inspection Method	June		July				August				
		21/22	25/29	02/06	09/13	16/20	23/27	30/03	06/10	13/17	20/24	27/31
DMW RRT												
KH team	PA UT	starts	end									
- PINC 2.1-6		06/21	07/02									
- PINC 2.9-10		07/06	07/13									
- Pusan		07/16	07/16									
KK team	Manual UT	starts	end									
- PINC 2.1-6		07/09	07/13									
- PINC 2.9-10		08/27	08/31									
KN team	Potential	starts	end									
- PINC 2.1-6		07/23	07/27									
- PINC 2.9-10	Drop	07/30	08/10									
KD team	Manual	starts	end									
- PINC 2.1-6	UT	08/06	08/10									
- PINC 2.9-10		08/13	08/17									
KP team	PA UT	starts	end									
- PINC 2.1-6		08/20	08/24									
- PINC 2.9-10		08/27	08/31									

From Pre DMW RRT, it was learned that the special transducers are required according to the configuration of mock-ups, and calibration blocks with same welding type and material are required for better inspection sensitivity. Depth sizing of axial defects is more difficult than one of circumferential defects.

3.2 RVHP and BMI RRT

RVHP and BMI RRT will be performed since 2007 September and NRC/PNNL is scheduling CRDM and BMI RRT. For the preparation of RVHP RRT, 2 Korea RRT teams(KHNP and KPS) have held seminar 5times and did perform preliminary RRT using 4 mock-ups.

From Pre RVHP 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.

3 teams for RVHP (KHNP, KPS and Doosan) and 1 team for BMI(KPS) will participate in PINC RVHP and BMI RRT.

4. Task Group 3 (TG-DAG) Activity

Task group 3 is Data Analysis group (DAG). The analysis is organized into three categories. First Category is procedure analysis. This category review how well each procedure be performed. 2nd category is flaw analysis. This category review how easy or difficult each flaw was to detect and characterize. Third category is regression analysis. This category estimate the relationships between inspection performance and important variables, such as flaw size. Fig.1 shows flow chart of data analysis. DAG analyzes procedure, flaw and regression by TD and IP provided by RRT team.

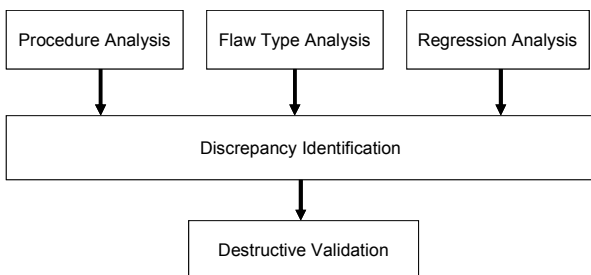


Fig. 1 Flow chart of Data analysis

5. 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 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 6th International meeting report (Japan)
- [2] PINC 7th International meeting report (USA)
- [3] PINC 8th International meeting report (USA)
- [4] PINC 9th International meeting report (Japan)
- [5] 1st RRT Team Seminar (Korea)
- [6] 2nd RRT Team Seminar (Korea)
- [7] 3rd RRT Team Seminar (Korea)
- [8] 4th RRT Team Seminar (Korea)
- [9] 5th RRT Team Seminar (Korea)