

New Research Programs in the Aging and Material Reliability Group

**- NRC-JNES bilateral meeting on Material Related Research -
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New Researches

- Nondestructive Inspection Technologies for the Cast Stainless Steel Piping
- Flaw Evaluation Technologies for Dissimilar Metal Welds
- Integrity Evaluation of IASCC

Nondestructive Inspection Technologies for the Cast Stainless Steel Piping (2009FY-2013FY)

Background

- Detection capability of UT on CASS was verified about 10years ago.
It was concluded that 20% TW crack was detectable.
But, only one type of material (most recent material) was used as the test specimens.
- Although UT inspection is required on CASS piping as ISI program, no sizing capability has been verified yet
- Progress in NDE techniques have been seen over the past 10 years
- The research on CASS inspection has been active in the US and other countries

Background (Cont.)

- *What JNES has done so far* -

-Regional cooperative research program in North East Asia (RCOP2) has been carried out.

-Participants: China, Korea and Japan

-Round Robin Tests on CASS



Japanese test block for the Round Robin Test

Background (Cont.)

- RCOP2 Round Robin Schedule -

Tentative Schedule of Round Robin Test

	2008				2009				2010				
RRT-1 (No.1 TP)	J	C	K										
RRT-2 (No.2 TP)			J	C	K	J	C	K	J	C	K		
RRT-3 (No.3 TP)					K		C		J				

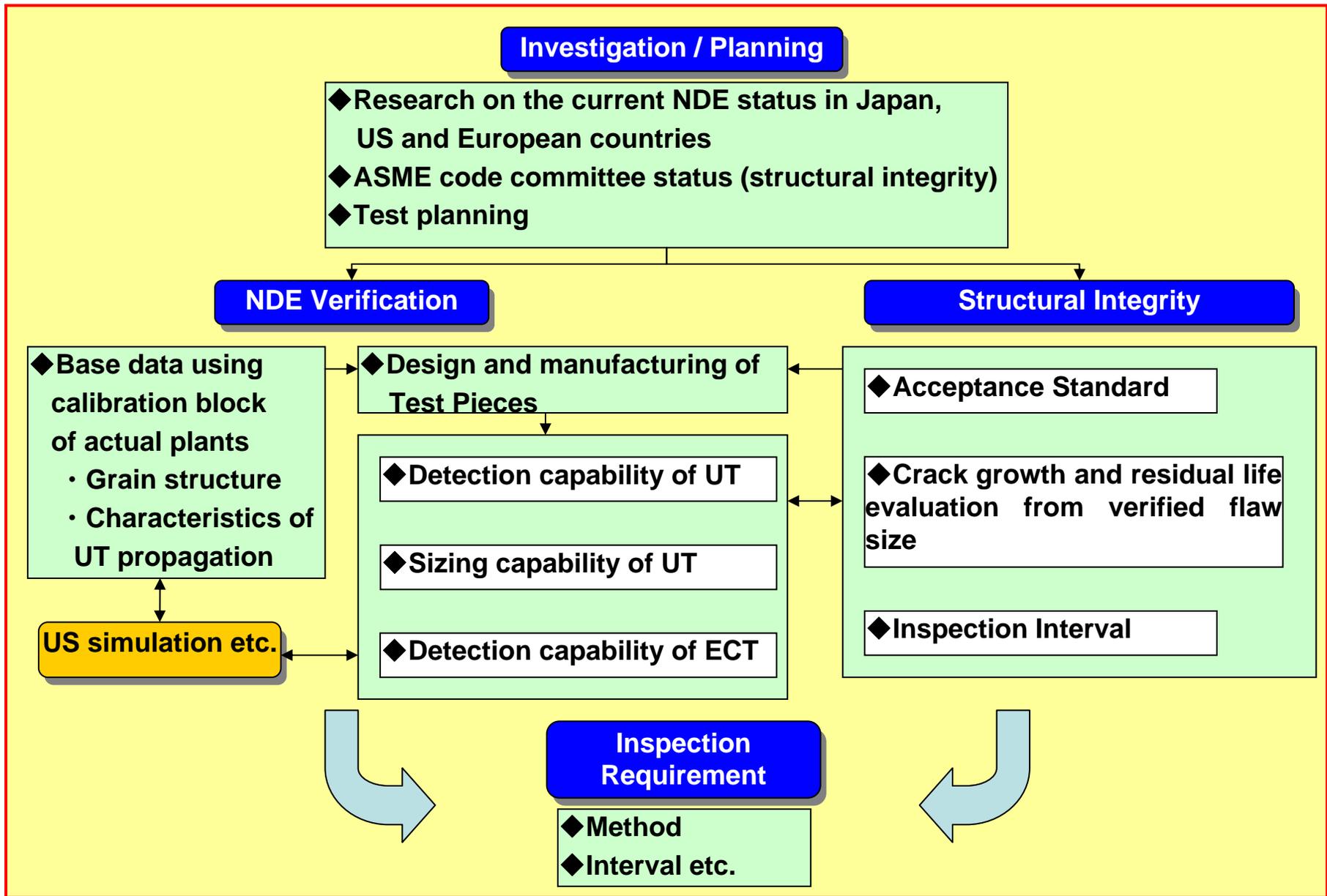
 : Crack Growth Treatment

J: Japan, C: China, K: Korea

Objective of the new research program

- To comprehend the NDE capability on CASS, using up to date technologies
 - Detection capability of UT and ECT
 - Sizing Capability of UT
- To identify the optimal inspection interval
- Summarize the regulatory requirement regarding CASS inspection

Research Flow



Schedule

	2009FY	2010FY	2011FY	2012FY	2013FY
1. Study on the inspection requirement					
a. Planning & investigation	■				
b. Fundamental Data		■			
c. Simulation etc.		■			
2. NDE verification					
a. TP manufacturing		■			
b. Test			■		
c. evaluation of test result				■	
3. summary					
a. inspection guideline				■	

Test materials

- ISI Reference blocks of PWR utility**
- Retired “Fugen NPP” material**
- Material which will be prepared in this study
(Detail will be decided in 2009FY)**

JNES expectation

JNES has proposed to revise the agreement to enhance the scope and activate the cooperation on CASS inspection ASAP

JNES Expectation for the cooperation on CASS inspection research

- **Sharing the test pieces**
JNES expect to use PNNL's test pieces
- **Sharing the NDE test result**
- **Cooperative research if needed**

Expected JNES data

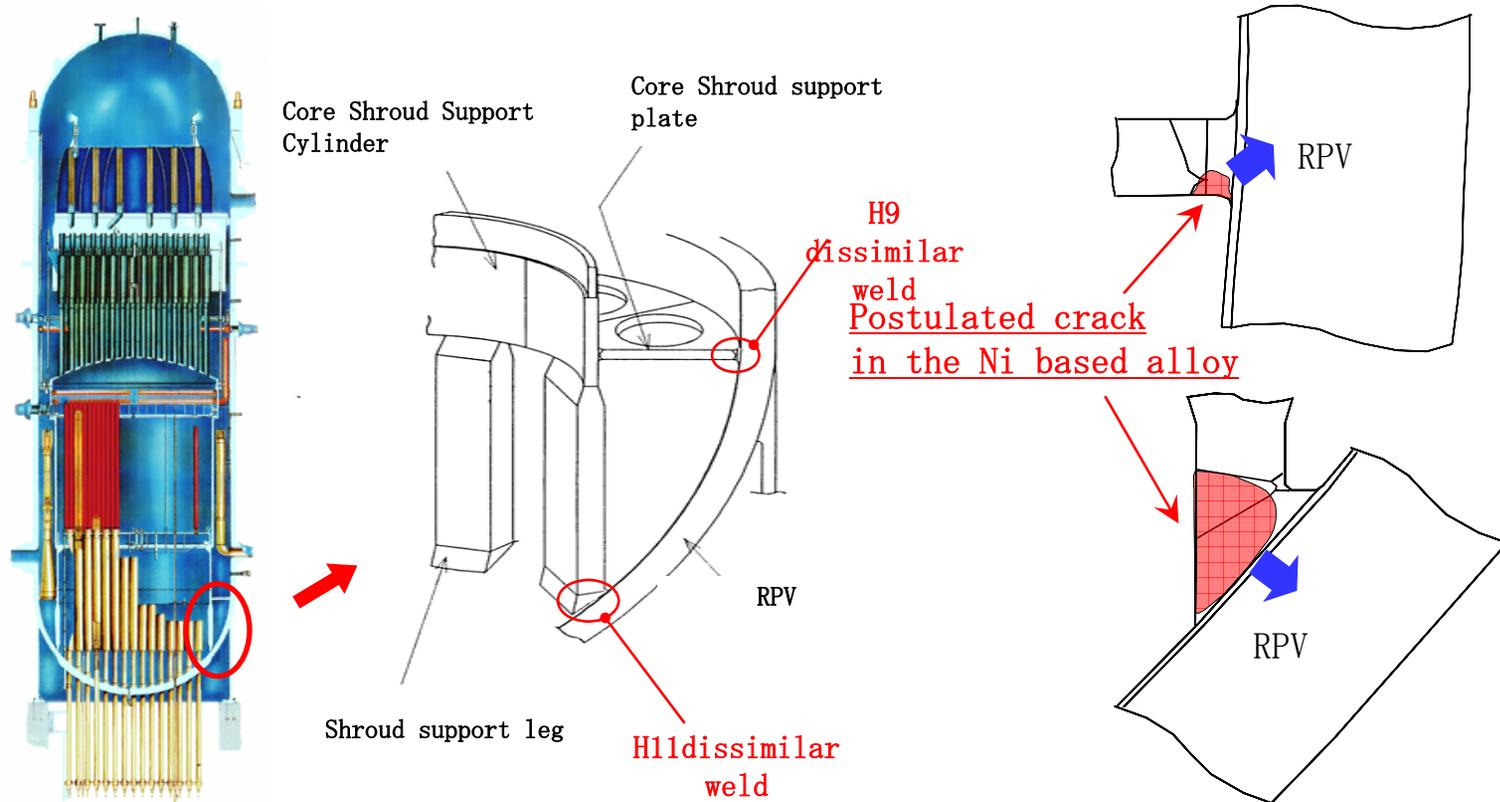
- Information of Grain Structures
- UT characteristics from the calibration block
- UT Simulation using FEM
- Detection and sizing capability of conventional and up to date UT technique in Japan
- Capability of ECT on the CASS
- Study results of critical flaw size and so on

Flaw Evaluation Technologies for Dissimilar Metal Welds (2009FY-2014FY)

Open Item

Will the SCC crack in the Ni based alloy weld metal be arrested at the dissimilar metal boundary?

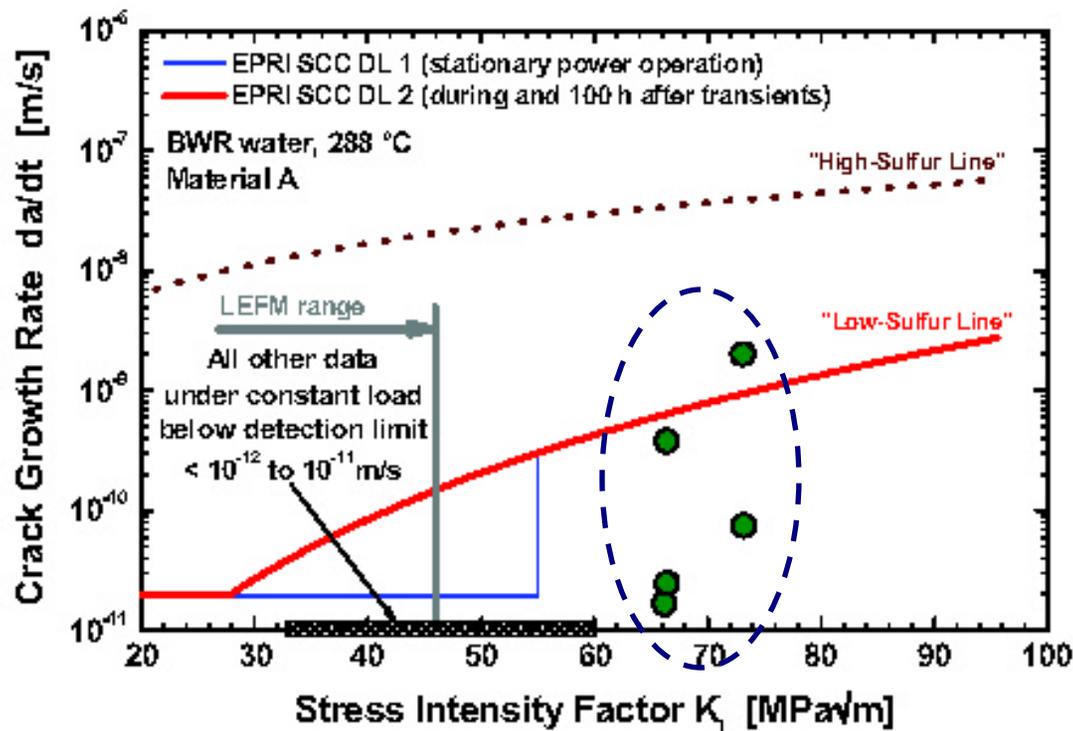
Target: Ni based alloy and Low alloy steel boundary region of the Shroud support/RPV weld



Background

Recent Test result

-Increase in CGR of SCC in Low alloy steel can be seen with high stress intensity factor (more than $60 \text{MPa}\sqrt{\text{m}}$)

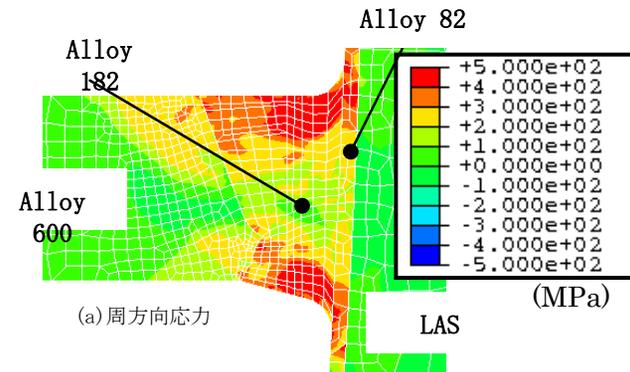
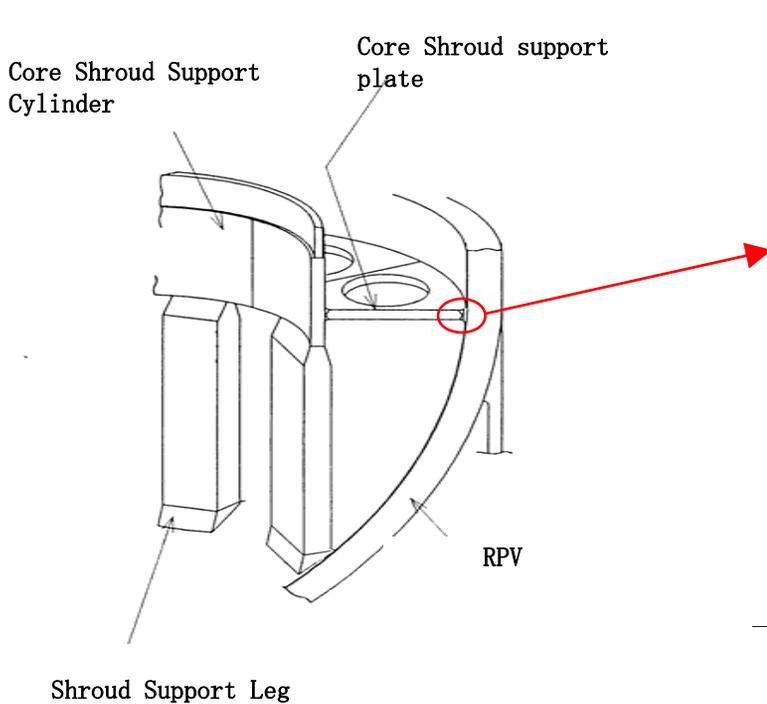


A.Roth et al., Proceedings of the 12th International Conference on Environmental Degradation of Materials in Nuclear Power System -Water Reactors-, TMS (2005).

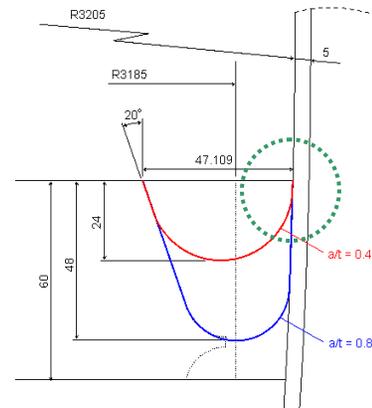
CGR of SCC in Low alloy steel (ASME SA508 Cr.3 Cl.1(0.015%S) vs Stress intensity factor

Background (Cont.)

JNES study showed that high stress (High stress intensity factor) can be seen in the transition area between Ni based alloy and low alloy steel.



Profile of circumferential residual stress at H9 weld



$a/t=0.4: K=60\text{MPa}\sqrt{\text{m}}$
 $a/t=0.8: K=72\text{MPa}\sqrt{\text{m}}$

Stress Intensity Factor

Objective

JNES will verify the adequacy SCC CGR criteria the industry group proposes. And to develop the guideline summarizing the regulatory requirement to make sure the structural Integrity.

Note: BWR group has been carrying out the research on SCC growth characteristic in Ni based alloy/Low alloy steel boundary region and structural Integrity, since 2008. The group plans to develop the SCC CGR criteria.

Research Schedule

	2009FY	2010FY	2011FY	2012FY	2013FY	2014FY
1. Planning						
2. Study on the crack growth behavior in Ni based alloy/Low alloy steel boundary region						
3. Residual stress measurement in dissimilar metal weld						
3. CGR simulation in Ni based alloy/Low alloy steel boundary region, and verification test						

Research Plan

Research contents and policy

■ SCC CGR test

- Ni base alloy is the first priority
- the plan for the Low alloy steel will be considered based on the industry's research result

■ Mock up test

- Preparing the test pieces simulating H9 and H11 welds
- Manufacturing the SCC specimens
- Residual stress measurement in the course of manufacturing the

TP

■ K Evaluation on mock up

- H9 and H11 weld will be considered
- Taking into account the operating condition

■ Study on SCC crack growth behavior

- CGR simulation in Ni based alloy/Low alloy steel boundary region, and verification test

Note: More specific plan will be established in this fiscal year

Thank you!