

# Management technology for prediction of SCC growth in the structural materials

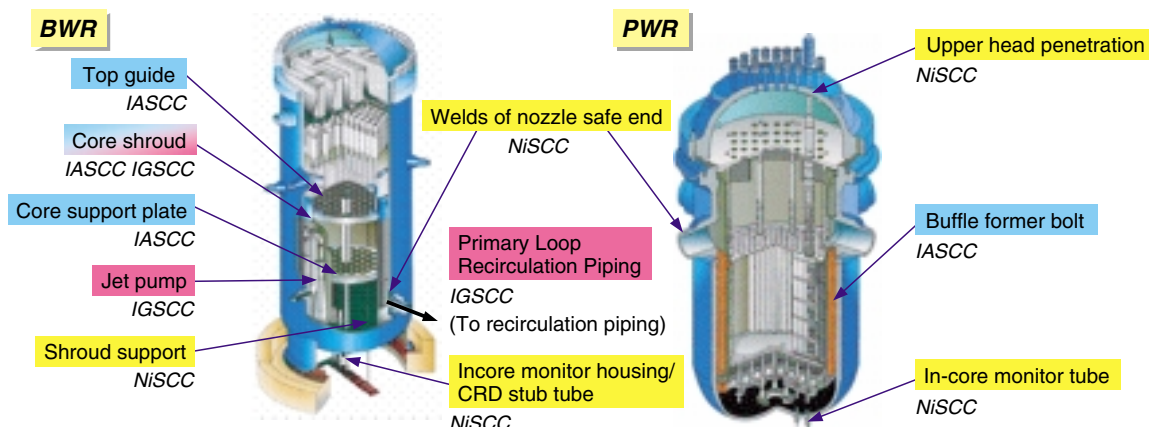
## Background and Objectives

Since the identification of SCC in stainless steels, it is recognized that a major cause of SCC in water environment at high temperature is sensitization due to welding heat of stainless steels. Many countermeasures for the SCC have been developed, however, recently we have experienced the new types of SCC such as neutron-irradiation assisted stress corrosion crack (IASCC), non-sensitized SCC (IGSCC) and SCC of nickel base alloy used in reactor pressure boundaries. The purpose of the project is to collect experimental crack growth data necessary to predict the crack size, to evaluate structural integrity to decide whether plant operation may be continued or not, when these SCC are observed in the components.

## Features

Now, three projects regarding SCC growth are in progress. In these SCC projects, SCC crack growth tests are conducted in the simulated commercial plant conditions, such as chemical contents and fabrication processes of materials, and water environmental conditions. Based on the results of the tests, the diagrams of SCC crack growth rate will be developed as a function of applied stress (stress intensity factor).

- Evaluation Technology for SCC Growth of Nickel Base Alloy [NiSCC Project]:  
To evaluate SCC growth behavior for nickel base alloy of components composing the pressure boundary
- Intergranular SCC in Nuclear Grade Stainless Steel [IGSCC Project]:  
To evaluate the crack growth behavior of SCC for core shroud and primary loop recirculation (PLR) piping of low carbon stainless steel
- Evaluation Technology for Irradiation Assisted SCC [IASCC Project]:  
To evaluate crack initiation and growth behavior of SCC for neutron irradiated stainless steel



Components for Evaluation

## Schedule and future development

Stress intensity factor vs SCC growth rate diagram will be developed, and the guideline for integrity assessment will be established and proposed promptly.

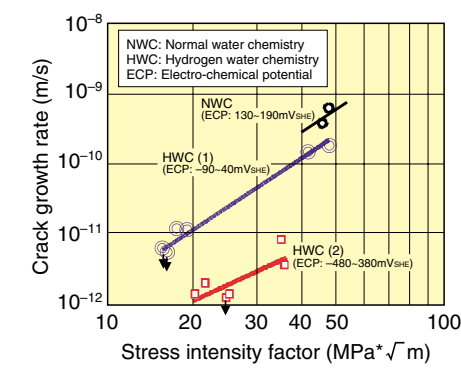
Fiscal year	2000	2001	2002	2003	2004	2005	2006	2007	2008
NiSCC					Proposal of an interim draft	Proposal of a final draft			
IGSCC					Proposal of an interim draft (Recirculation piping NWC)	Proposal of a final draft (Recirculation piping)			
IASCC					Proposal of an interim draft (Core shroud NWC)	Proposal of a final draft (Core shroud)	Proposal of an interim draft	Proposal of a final draft	

Schedule

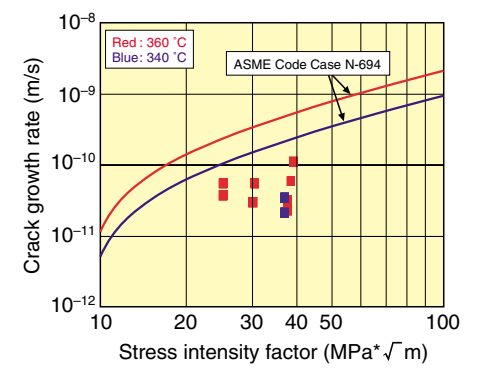
## Topics

### Evaluation of Crack Growth Rate for Nickel Base Alloy (NiSCC)

SCC tests using compact tension (CT) specimens are carried out for over 5000 hours under simulated BWR and PWR water chemistries, in order to clarify the relation between stress intensity factors and crack growth rates. The systematic data on weld metal have been obtained for the first time.



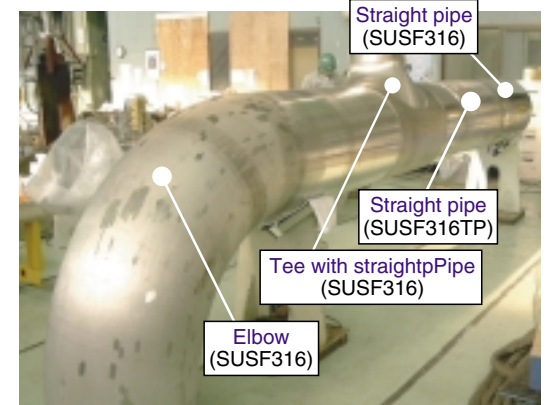
Results of SCC: Growth Test at Constant Load for BWR: 182 Alloys (shielded metal arc weld metal).



Results of SCC Growth Tests of PWR head penetration under Constant Load: Alloy 600 (base metal).

### Fabrication of Test Piece for Crack Growth of Low Carbon Stainless Steel (IGSCC)

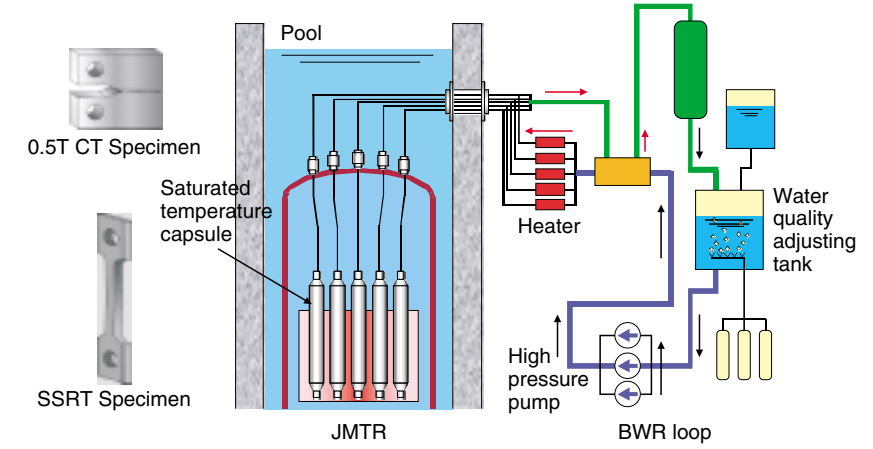
SCC of low carbon stainless steel was newly found in two or three years ago, and the cause has not been identified yet. Therefore, in order to carry out a test under the similar condition with that of commercial plants, test pieces for SCC crack growth tests were machined from full scale mock-up fabricated by the same welding method as those of the commercial plants.



Mock-up Test Piece of Recirculation Loop Piping (Approximately 600mm in diameter)

### Accelerated Irradiation Device under BWR Environment (IASCC)

In order to obtain the data on the growth of IASCC, test materials are required to be irradiated with neutrons up to equivalent fluence of aged plant materials. A device of an accelerated irradiation under simulating the BWR environment was installed in a material-testing reactor, JMTR. Using the device 60-year irradiation in commercial parts will be achieved only for 5 years.



BWR Environment Control Device Installed in JMTR