

Overview of Japanese R&D activities related to nuclear safety

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Abstract

An overview is given about currently on-going activities on nuclear structural components in Japan. The content comprises six national projects on R&D. Four movements of codes and standards and two replacement plans for nuclear components are introduced. © 2000 Elsevier Science S.A. All rights reserved.

1. Introduction

Fifty two commercial light water reactors (LWR) plants are operating in Japan. Twenty eight units are BWRs, 23 are PWRs and one unit is a gas cooled reactor (the gas cooled reactor was shut down in March 1998). The current nuclear power generation capacity is about 44 900 MWe. Steady supply of electric power is essential for nuclear power generation in Japan.

Nuclear power plants in Japan commissioned in the early period have now been in service for more than 25 years. The recent major concern is directed towards the reliability of aged plants, accompanying the increase of the number of aged plants.

From technical and social viewpoints, comprehensive technological tasks are brought up to maintain and improve the reliability of operating

nuclear plants. The present paper gives an overview of the following activities:

1. Activities of research and development (R&D).
2. Movement of codes and standards.
3. Replacement plans of nuclear components.

The author gives a brief introduction to the above items, i.e. the basic framework, current scope, some results and future developments.

2. R&D activities

Most parts of the national projects of R&D related to structural components are carried out in Japan, funded by the Ministry of International Trade and Industry (MITI). The projects in progress and recently completed are summarized in Table 1. The overview of the R&D activities of each project is described below.

2.1. Plant Life Extension (PLEX) Project

2.1.1. Background

To extend the life of aged nuclear plants, experimental data for aged materials are needed for the prognoses of life. On the other hand there are many components which are not easy to repair or replace in reality. These components require the development of maintenance technologies for plant life extension.

2.1.2. Scope

The project for plant life extension (PLEX) was started in 1987 and had completed in March 1997 (financial year 1996). The project was organized by the Japan Power Engineering and Inspection Corporation (JAPEIC) under the sponsorship of MITI. The objective of the project was to assess the aged components and to evaluate plant life extension technology.

The program is divided into three phases. Phase I is a world wide survey of the literature with respect to PLEX. Phase II is items of necessary researches as denoted in the phase I survey. Verification tests are ongoing with respect to the following items:

1. Material tests in a corrosive environment.
2. Thermal aging behavior on duplex cast stainless steel.
3. A fracture toughness characterization test for nuclear components.
4. The possibility of re-use of surveillance test specimens.
5. Development of inspection or repair/replacement technology of reactor pressure vessels and internals.

Phase III studies are to make an overall evaluation of the service life prediction in preparation for a scenario of plant life extension.

Table 1
Summary of Japanese R&D related to nuclear structural components^a

No.	Project	Contents	Period	Organization
1	Plant life extension (PLEX)	Operation	Fracture toughness/strength for aged materials. Assessment of aged components	1987–1996 JAPEIC
2	Structural assessment flawed equipment (SAF)	In-service inspection	Fatigue crack growth Ductile fracture for vessel with low upper shelf toughness Fatigue flaw growth in pipes for life	1991–2000 JAPEIC
3	Environmental fatigue test (EFT)	Design	Fatigue strength data Methodology of environmental fatigue strength evaluation	1994–2006 JAPEIC
4	Plant life management technology (PLIM)	Operation	Assessment of vessel embrittlement Toughness monitoring for vessel Thermal aging evaluation for cast stainless steel	1996–2005 JAPEIC
5	Plant maintenance technology (PMT)	Repair	Service modification technology for vessel internals	1996–2002 JAPEIC
6	Containment integrity test	Safety	Pressure-proof limit of reactor containment vessels	1990–2002 NUPEC

^a JAPEIC, Japan Power Engineering and Inspection Corporation; NUPEC, Nuclear Power Engineering Corporation

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