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NB

ENERGY INDUSTRY STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

NB/T 20013-2010

Structural integrity assessment for nuclear pressure-retaining components containing defects

含缺陷核承压设备完整性评定

Issued on: May 1, 2010 **Implemented on: October 1, 2010**

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Foreword

This document was issued on 1 May 2010 by the National Energy Administration of the PRC and takes effect on 1 October 2010.

It is a NB/T standard: recommended rather than compulsory, but it is the text a Chinese reviewer applies when assessing a submission.

It is classified under ICS 23.020.30, Chinese classification J 74.

This standard is drafted in accordance with the rules given in GB/T 1.1-2009.

This standard was proposed by the National Energy Administration.

This standard is under the jurisdiction of the Nuclear Industry Standardization Research Institute.

This standard was drafted under the responsibility of the Research Institute of Nuclear Power Operation. The organizations that took part in the drafting are: CNNC Wuhan Nuclear Power Operation Technology Co., Ltd., East China University of Science and Technology, Shanghai Nuclear Engineering Research and Design Institute, Hefei General Machinery Research Institute, Nanjing University of Technology, China Institute of Atomic Energy and Wuhan University.

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1 Scope

NB/T 20013-2010 sets out how a nuclear pressure-retaining component found to contain a defect is assessed for continued service. When an inspection reveals a crack, a lack of fusion or a wall loss in a reactor coolant pipe, a steam generator or a vessel nozzle, the question is not simply whether the flaw is acceptable against a workmanship standard, but whether the component still has adequate margin against fracture, plastic collapse and fatigue growth for the life ahead of it. That is a fitness-for-service calculation, and this standard is the Chinese procedure for it. It gives the scope of application and the full set of defined terms and symbols - the notation alone runs to about a hundred entries - then the general requirements: the assessment levels, the data needed on geometry, loading, material properties and defect size, and the safety factors applied at each level. Characterisation of planar defects comes next: how an indication reported by non-destructive examination is idealised into an analysable flaw, how flaws close together are combined, and how surface, embedded and through-wall cases are treated. The assessment methods follow, covering brittle fracture through the failure assessment

diagram, plastic collapse, fatigue crack growth, stress corrosion cracking, creep where temperature demands it, and the treatment of residual stresses. Material property determination, the appendices of stress intensity and reference stress solutions, and the reporting of the assessment close the document. It applies to nuclear pressure equipment in China.

This standard specifies the methods for the structural integrity assessment of in-service nuclear pressure-retaining components containing defects, including linear elastic fracture assessment, elastic-plastic fracture assessment, plastic collapse assessment and fatigue crack growth assessment.

This standard applies to the integrity assessment of in-service steel nuclear safety class 1 pressure-retaining components of pressurized water reactors. The integrity assessment of nuclear safety class 2 and class 3 pressure-retaining components may be carried out with reference to this standard.

For non-repairable defects found during pre-service inspection, assessment may be carried out with reference to this standard after the agreement of the owner and of the relevant departments.

This standard does not apply to the assessment of pumps and valves among nuclear pressure-retaining components, nor to newly manufactured nuclear pressure-retaining components accepted against manufacturing quality control standards.

2 Normative references

The following documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 228 Metallic materials - Tensile testing at ambient temperature.

GB/T 229-2007 Metallic materials - Charpy pendulum impact test method.

GB/T 4161 Metallic materials - Test method for plane-strain fracture toughness KIc.

GB/T 4338 Metallic materials - Tensile testing at elevated temperature.

GB/T 6398 Metallic materials - Test method for fatigue crack growth rate.

GB/T 6803 Test method for the nil-ductility transition temperature of ferritic steels - Drop weight test.

GB/T 12778 Method for the determination of the Charpy impact notch of metals.

GB/T 19744 Test method for the crack arrest fracture toughness KIa of ferritic steels under plane strain.

GB/T 21143 Metallic materials - Unified test method for quasi-static fracture toughness.