

ICS 27.120.20
CCS F 83

NB

**ENERGY INDUSTRY GUIDING TECHNICAL DOCUMENT OF THE
PEOPLE'S REPUBLIC OF CHINA**

NB/Z 20250-2013

**Guidance for the decision on modernization for instrumentation
and control system important to safety in nuclear power plants**

核电厂安全重要仪表和控制系统的更新改造决策指南

Issued on: June 8, 2013

Implemented on: October 1, 2013

Issued by: National Energy Administration of the PRC

Table of Contents

Foreword	3
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Abbreviations	3
5 Reasons for modernization	3
5.1 General	3
5.2 Economic reasons	3
5.3 Safety reasons	4
5.4 Summary report on the reasons for modernization	5
6 The modernization decision	5
6.1 The life cycle of I and C modernization	5
6.2 Long-term I and C strategy	6
6.3 Feasibility study	8
6.4 System tender specification and procurement	13
7 Considerations for modernization	15
7.1 General	15
7.2 Technical considerations	15
7.3 Economic considerations	16
7.4 Regulations and standards	16
7.5 Corporate policy and design standards	16
7.6 Modernization requirements	16
7.7 Reliability of the I and C system	18
7.8 Risk and benefit study	18
7.9 Safety classification	19
7.10 Equipment qualification requirements	19
7.11 Software qualification requirements	19
7.12 Physical constraints	20
7.13 Equipment availability (delivery and support)	20
7.14 Human factors	20
7.15 Defence in depth and diversity analysis	22
7.16 Isolation and protection against fire and flood	22

7.17 Uncertainty and setpoint calculation	22
7.18 Response time analysis	22
7.19 Test procedures	22
7.20 Document management	23
7.21 Updating of the technical documentation of the plant	23
7.22 Training and staff qualification	23
7.23 Project organisation	24
7.24 Configuration management	24
7.25 Interfaces with other existing systems	25
7.26 Standardisation	25
8 Implementation of the modernization	25
8.1 General	25
8.2 Target architecture	25
8.3 Sequence of the upgrade steps	26
9 Recommendations	28
Bibliography	29

Foreword

This document was issued on 8 June 2013 by the National Energy Administration of the PRC and takes effect on 1 October 2013.

It is a NB/Z guiding technical document: it does not oblige, it guides.

It is classified under ICS 27.120.20, Chinese classification F 83.

This guiding technical document was drafted in accordance with the rules given in GB/T 1.1-2009.

This guiding technical document is a modified adoption, by the redrafting method, of IEC/TR 62096:2009 Nuclear power plants - Instrumentation and control important to safety - Guidance for the decision on modernization.

Compared with IEC/TR 62096:2009 there is an adjustment of the text structure, reflected mainly in Clause 3: because former subclause 3.9 has been deleted, the former 3.10 and 3.11 have been renumbered 3.9 and 3.10.

The technical differences with respect to IEC/TR 62096:2009, and the reasons for them, are as follows: Figure 1 and the associated description have been deleted in order to satisfy the drafting requirements of Chinese standards; as regards the normative references, technically significant adjustments have been made in order to suit the drafting

requirements and the technical conditions of Chinese standards, the adjustments being concentrated in Clause 2.

The specific adjustments are: EJ/T 1143, a modified adoption of the international standard, replaces IEC 61839, see Clause 7; NB/T 20026, an identical adoption, replaces IEC 61513, see 6.4.2; NB/T 20027, an identical adoption, replaces IEC 62241, see 7.14; NB/T 20054, a modified adoption, replaces IEC 60880, see 6.4.2; NB/T 20060, a modified adoption, replaces IEC 60709, see Clauses 6 and 7; NB/T 20072, a modified adoption, replaces IEC 61888, see 7.17; references to EJ/T 529, GB/T 11684, GB/T 12727 and GB/T 13625 have been added, see 6.4.2; and the references to IEC 60050-191:1990, IEC 60300-3-3:2004, IAEA-TECDOC-1066:1999 and IAEA:2007 have been deleted.

The term nuclear safety and its definition, formerly 3.9, have been deleted in order to satisfy the drafting requirements of Chinese standards.

The Chinese documents having a corresponding relationship with the international documents normatively referenced in this guiding technical document are: EJ/T 529 Digital computers for systems important to safety in nuclear power plants (EJ/T 529-1990, IEC 60987:1989, eqv); EJ/T 799-2006 Determination and maintenance of trip setpoints for safety system instrumentation in nuclear power plants (IEC 61888:2002, EQV); EJ/T 1143-2002 Nuclear power plant control room design - Function analysis and assignment (IEC 61839:2000, MOD); GB/T 11684 Electromagnetic environmental conditions and test methods for nuclear instruments (GB/T 11684-2003, IEC 61000 series, NEQ); GB/T 12727 Quality qualification of electrical equipment of the safety system of nuclear power plants (GB/T 12727-2002, IEC 60780, MOD); GB/T 13625 Seismic qualification of electrical equipment of the safety system of nuclear power plants (GB/T 13625-1992, IEC 60980:1989, eqv); NB/T 20026-2010 General requirements for instrumentation and control systems important to safety in nuclear power plants (IEC 61513:2001, IDT); NB/T 20027-2010 Alarm functions and displays of the main control room of nuclear power plants (IEC 62241:2004, IDT); NB/T 20054-2011 Computer software performing category A functions in instrumentation and control systems important to safety in nuclear power plants (IEC 60880:2006, MOD).

This guiding technical document was proposed by the Nuclear Power Standardization Technical Committee of the Energy Industry.

This guiding technical document is under the administration of the Nuclear Industry Standardization Research Institute.

Drafting organizations of this guiding technical document: CGN Engineering Co., Ltd.; Shenzhen CGN Engineering Design Co., Ltd.; Nuclear Power Institute of China.

1 Scope

NB/Z 20250-2013 is the Chinese guiding technical document for deciding whether, and

how, to modernize the instrumentation and control systems important to safety in an operating nuclear power plant. It exists because of a mismatch of lifetimes: a reactor is built to run for sixty years, while the analogue cabinets, recorders and control computers installed with it become unsupportable in twenty. The trigger for replacing them is rarely the attraction of the new equipment; it is that spare parts for the old equipment have run out, that the vendor no longer exists, or that nobody left in the plant knows how to maintain it. But replacing the protection system of a running reactor is one of the most consequential projects a utility undertakes, because it touches the very systems that exist to make the plant safe, and because the analogue-to-digital move introduces failure modes the original design never contemplated, above all software common cause failure across redundant channels. This document is the framework for making that decision defensibly rather than by drift. Clause 5 separates the economic reasons from the safety reasons and requires them to be argued on a life cycle cost basis rather than on purchase price. Clause 6 sets out the decision process itself, from the long-term I and C strategy through the feasibility study to the tender specification and procurement, so that individual replacements add up to a coherent target architecture instead of a patchwork of vendors. Clause 7 is the substance: twenty-six considerations that a modernization has to answer, among them safety classification, equipment and software qualification, defence in depth and diversity analysis, reliability, human factors, isolation against fire and flood, setpoint and uncertainty recalculation, response time analysis, configuration management, interfaces with the systems that are not being replaced, and the retraining of the operators who will use the new interface. Clause 8 covers implementation and the sequencing of the upgrade steps, and Clause 9 gives the recommendations. The document is a modified adoption of IEC/TR 62096:2009, with the international normative references replaced by their Chinese equivalents. It was issued on 8 June 2013 by the National Energy Administration and took effect on 1 October 2013.

This guiding technical document provides guidance for making and preparing the decision to modernize all or part of the instrumentation and control (I and C) system of a nuclear power plant. Its content covers:

- the reasons for modernizing the I and C system;
- the main trade-offs to be considered between the different modernization options for the I and C system;
- the technical and economic principles for establishing a long-term I and C strategy;
- the main aspects to which a technical feasibility study has to pay attention.

This guiding technical document applies to the renewal or modification of all or part of the I and C system of a nuclear power plant, with the emphasis on improving the safety performance of the reactor and on improving the human-machine interface. It does not specify the design requirements of the I and C system.