

Nuclear reactor instrumentation — Pressurized light water reactors (PWR) — Monitoring adequate cooling within the core during cold shutdown

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Summary of pages

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Surveillance du refroidissement correct
du coeur au cours de l'arrêt à froid**

**Nuclear reactor instrumentation –
Pressurized light water reactors (PWR) –
Monitoring adequate cooling within the core
during cold shutdown**



Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**NUCLEAR REACTOR INSTRUMENTATION –
PRESSURIZED LIGHT WATER REACTORS (PWR) –
MONITORING ADEQUATE COOLING WITHIN THE CORE
DURING COLD SHUTDOWN**

FOREWORD

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International Standard IEC 62117 has been prepared by subcommittee 45A: Reactor instrumentation, of IEC technical committee 45: Nuclear instrumentation.

The text of this standard is based on the following documents:

FDIS	Report on voting
45A/362/FDIS	45A/367/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

Annexes A and B are for information only.

The committee has decided that this publication remains valid until 2004. At this date, in accordance with the committee's decision, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

INTRODUCTION

IEC 60911 was introduced in 1987 to address the general issue of measurements for monitoring adequate cooling within the core of pressurized light water reactors. That standard, focusing primarily upon the general issue, does not tackle special conditions, such as cold shutdown, during which existing systems, complying with the requirements of IEC 60911, have been found to be inadequate and misleading and during which some incidents have already occurred.

Therefore, after the publication of IEC 60911, it was decided that it would be useful to develop a similar standard to address the topic during cold shutdown in order to formulate specific requirements for instrumentation to assure that core cooling is maintained during the considered cold shutdown conditions when the reactor vessel water level is reduced for maintenance purposes. Thus, the current International Standard is to be considered in conjunction with IEC 60911 of which it extends the scope.

NUCLEAR REACTOR INSTRUMENTATION – PRESSURIZED LIGHT WATER REACTORS (PWR) – MONITORING ADEQUATE COOLING WITHIN THE CORE DURING COLD SHUTDOWN

1 Scope and object

This International Standard applies to pressurized water reactors (PWRs) with configurations similar to those shown in figures 1 and 2 and presents requirements for the monitoring of adequate cooling within the core during cold shutdown operations.

Adequate core cooling can be achieved only by providing sufficient coolant flow to the core to remove the heat. During cold shutdown operations, core cooling is provided by forced circulation with the residual heat removal system (RHRS). However, in certain shutdown operations when water level in the reactor pressure vessel (RPV) is reduced for maintenance operations, forced circulation may be interrupted, and the core may become overheated.

It is important that plant operators have reliable information to confirm that the temperature and flow of coolant circulated through the RPV is adequate to remove heat from the core. This information includes a reliable measurement of water level in the RPV outlet piping used for circulating the flow from the core to the RHRS, as well as measurements of temperature and flow of the coolant. An unreliable measurement of water level can result in interruption of coolant flow and overheating of the core, an event that has occurred at several PWRs. Annex A, which describes some of these events, identifies conditions which should be considered in the design of core cooling monitoring instrumentation.

Good international practices to be used when designing new or upgrading existing PWR core cooling monitors are summarized in this standard.

Requirements are given in this standard for instrumentation to monitor core cooling for safe operation of PWRs during cold shutdown operations when the coolant temperature is below 100 °C (212 °F). Requirements for core cooling monitoring during conditions beyond a design basis accident (DBA), which could be a specific national requirement or consideration, are not covered in this standard.

The core cooling monitoring instrumentation for cold shutdown functions when the reactor coolant system (RCS) is configured for cold shutdown maintenance or refuelling. The circumstances under which these measurement systems need to function are described in this standard. Descriptions of diverse measuring principles and suitable devices are given together with requirements for the following:

- operational conditions;
- installation;
- operator displays;
- testing, calibration and maintenance;
- equipment qualification;
- documentation.

Typical applications in operating power plants are also presented.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60050(393):1996, *International Electrotechnical Vocabulary (IEV) – Chapter 393: Nuclear instrumentation: Physical phenomena and basic concepts*

IEC 60737:1982, *In-core temperature or primary envelope temperature measurements in nuclear power reactors – Characteristics and test methods*

IEC 60770-1:1999, *Transmitters for use in industrial-process control systems – Part 1: Methods for performance evaluation*

IEC 60780:1998, *Nuclear power plants – Electrical equipment of the safety system – Qualification*

IEC 60880:1986, *Software for computers in the safety systems of nuclear power stations*

IEC 60911:1987, *Measurements for monitoring adequate cooling within the core of pressurized light water reactors*

IEC 60964:1989, *Design for control rooms of nuclear power plants*

IEC 60980:1989, *Recommended practices for seismic qualification of electrical equipment of the safety system for nuclear generating stations*

IEC 60987:1989, *Programmed digital computers important to safety for nuclear power stations*

IEC 61225:1993, *Nuclear power plants – Instrumentation and control systems important for safety – Requirements for electrical supplies*

IEC 61226:1993, *Nuclear power plants – Instrumentation and control systems important for safety – Classification*

IEC 61227:1993, *Nuclear power plants – Control rooms – Operator controls*

IEC 61343:1996, *Nuclear reactor instrumentation – Boiling light water reactors (BWR) – Measurements in the reactor vessel for monitoring adequate cooling within the core*

IAEA Safety Guide 50-SG-D8:1984, *Safety related instrumentation and control systems for nuclear power plants*