PART I  
TECHNICAL BID

Volume 8  
Technical description of I&C

08-02-15  
Power unit I&C subsystems  
Reactor vessel level indication system (RVLIS)

2022

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Abbreviations

| **Abbreviation** | **Meaning** |
| --- | --- |
| DiD | Defence-in-depth |
| ECR | Emergency control room |
| EP-ESFAS | Emergency protection – Engineered safety features actuation system |
| HTC | Heated level indication thermocouple |
| HTC | Heated level indication thermocouple |
| HW | Hardware |
| HWC | Hardware complex |
| I&C | Instrumentation and Control |
| ICDA | In-core detector assembly |
| LIE | Level indication equipment |
| LIEH | Level indicator electric heater |
| MCR | Main control room |
| NPP | Nuclear Power Plant |
| NTLIC | Neutron temperature and level instrumentation channel |
| OD | Operation documentation |
| PAMS | Accident and Post-Accident Monitoring System |
| PRT | Platinum resistance thermometer |
| PU | Power Unit |
| RC | Reactor core |
| RI | Reactor installation |
| RP | Reactor plant |
| RVLIS | Reactor vessel level indication system |
| SC | Operational supervisory control |
| SHT | Software and hardware tools |
| SPND | Self-powered neutron detector |
| SW | Software |
| TC | Unheated level indication thermocouple |
| UTC | Unheated level indication thermocouple |
| UULS | Upper Unit Level System |

References

| No. | Document No. | Document name |
| --- | --- | --- |
|  | GOST R IEC 61226-2011. | Nuclear power plants. Monitoring and control systems that are essential for safety. Classification of control and management functions. |
|  | GOST R IEC 60709-2011. | Nuclear power plants. Monitoring and control systems that are essential for safety. Separation |
|  | GOST 29075-91 | Nuclear instrumentation system for nuclear power plants. General requirements |
|  | GOST 32137-2013 | Electromagnetic compatibility of hardware facilities. Hardware facilities for nuclear power plants. Requirements and test methods. |
|  | GOST 14254-2015 | Degrees of protection provided by the shells (IP code) |
|  | ISO/IEC 9899-2011 | Information technology. Programming languages. C |
|  | NP-001-15 | Federal codes and regulations in the field of atomic energy use. General Provisions for Nuclear Power Plant Safety Assurance |
|  | NP-031-01 | Federal codes and regulations in the field of atomic energy use. Standards for Design of Seismic Resistant Nuclear Power Plants |

# Introduction

The introduction typically describes the scope of the document and gives a brief explanation or a summary of the document. It may also explain certain elements that are important to the document. The readers can thus have an idea about the following text before they actually start reading it.

**Table 1. Requirements of EUR rev. E considered in this document**

| **ID** | **Description** |
| --- | --- |
| 939 | Appropriate and reliable protection system as early as possible. |
| 633 | Due shall be preferred. |
| 634 | The should be avoided. |
| 782 | Instrumentation post-accident analysis. |
| 793 | Functions\* to be performed. |
| 733 | Safety itiating specific functions necessary to mitigate releases in the case of DEC or a defined site specific External Hazard\*. |
| 740 | The I&C systems shall be |
| 742 | • provide; |
| 804 | The that they can be used for:  • testing during plant commissioning;  • testing t transients (i.e. abnormal occurences the operation of the plant). |
| 806 | The following of permanent records |
| 810 | It shall allow the evaluation of algorithms such as the NSSS enthalpy balance. It shall also allow re-qualification of safety-related equipment. To this end, the following requirements shall apply: |

# System purpose

Purpose is the end for which something is done, created or for which it exists. It is part of the topic of intentionality and goal-seeking behavior.

# Basic design principles

## Safety and seismic resistance classification

The classification of RVLIS.

Table 2 Classification of RVLIS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Safety | Classificati | Seismic | Safety class |
| RVLIS | 1 | 2 | 3 | 3 |
| \* Classification is. | | | | |

The seismic resistance at the design stage.

## Defence-in-depth principle

RVLIS is

A principle is a proposition or value that is a guide for behavior or evaluation. In law, it is a rule that has to be or usually is to be followed.

## Independence, redundancy and diversity principles

When is applied:

* system;
* inlets;
* conditioning.

Description of the RVLIS.

When designing:

* Electrical:
* overcurrent;
* electrical;
* Communication:
* unified;
* galvanic;
* Physical:
* different rooms;
* different cabinets;
* Functional isolation (non-safety related functions do not affect RVLIS functions; independent power systems).

The principles of separation and insulation of RVLIS.

Diversity principles do not apply to RVLIS.

# System functions

of the following:

* Informational:
* coolant;
* alarming;
* Auxiliary:
* self;
* information;

Service function requirements are defined in the system requirements specification.

# System architecture

which incorporates:

* discrete
* LIE;

The RVLIS architecture is shown in Fig. 1.



Fig.1 RVLIS architecture

The list of

Table 3. Communication between systems

| System | Safety | DiD | System | Safety] | level | Interface |
| --- | --- | --- | --- | --- | --- | --- |
| where from | | | where to | | |  |
| RVLIS | 1 | 2 | 3 | 4 | 5 | 6 |
| RVLIS | 7 | 8 | 9 | 10 | 11 | 12 |
| IP EP-ESFAS | 13 | 14 | 15 | 16 | 17 | 18 |
| PAMS | 19 | 20 | 21 | 22 | 23 | 24 |

# HWC description

## General information

Information is an abstract concept that refers to that which has the power to inform. At the most fundamental level information pertains to the interpretation of that which may be sensed. Any natural process that is not completely random, and any observable pattern in any medium can be said to convey some amount of information. Whereas digital signals and other data use discrete signs to convey information, other phenomena and artifacts such as analog signals, poems, pictures, music or other sounds, and currents convey information in a more continuous form.[1] Information is not knowledge itself, but the meaning that may be derived from a representation through interpretation.

**Table 4 The main technical specifications of RVLIS**

## NTLIC ICDA

NTLIC ICDA incorporates seven SPND for energy release control, a thermocouple for temperature monitoring at the RC outlet Cable loop (ShT-1) and cable track (TK-1)

Cable loop (ShT-1) is designed to transmit electrical signals from the ICDA within the RI containment in the section from the ICDA electrical connector to the electrical connector of the cable route at the reactor shaft.

Cable route (TK-1) is designed to transmit electrical signals from the ICDA within the RI containment in the section from the electrical connector of the cable loop at the reactor shaft to the sealed passage.

## Level indication equipment (LIE)

LIE constitutes an electronic product

* ".

# Software description

includes:

* SW;
* SW
* SW.

The functions:

* conversion;
* self;
* LIEH;

The diagnostic SW.

# Protection of hardware facilities from internal and external impacting factors

## NPNTC ICDA, ShT-1, TK-1

Table 5 Factors

|  |  |
| --- | --- |
| Impacting factor | 1 |
| Coolant speed, m/s | 2 |
| Coolant temperature, °C | 3 |
| Maximum concentration of boric acid, g/kg | 4 |
| Operating pressure of coolant, MPa | 5 |
| Test pressure in the first circuit (1 time in 4 years), MPa | 6 |
| Maximum thermal neutron flux density, cm-2×s-1 | 7 |
| Maximum thermal fast neutron flux (energy 1 MeV, min), cm-2×s-1 | 8 |
| Absorbed dose rate of gamma radiation, Gy/s | 9 |
| Fluence of thermal neutrons, cm-2 | 0 |
| Fluence of fast neutrons (1 MeV, min), cm-2 | 1 |
| Seismic impact causing oscillations with acceleration (the installation height mark is above 20 m) | 2 |
| Resistance to sinusoidal vibration in accordance with GOST 29075 [3] | 3 |

channel remains

## LIE

A lie is an assertion that is believed to be false, typically used with the purpose of deceiving or misleading someone.[1][2][3][4] The practice of communicating lies is called lying. A person who communicates a lie may be termed a liar. Lies can be interpreted as deliberately false statements or misleading statements. Lies may also serve a variety of instrumental, interpersonal, or psychological functions for the individuals who use them.

# Power supply and grounding

Description

# Self-diagnostic and periodic testing

# Maintenance and repair

maintain (third-person singular simple present maintains, present participle maintaining, simple past and past participle maintained):

* convenience
* replacement.

The monitoring