Institute of Physics ASCR, v. v. i.
Na Slovance 2
182 21 Prague 8
eli-cz@fzu.cz
www.eli-beams.eu

Annex No. 4 Technical Specifications
Preliminary information

ELI Beamlines monitoring system

(Software for monitoring system of ionizing radiation, gases and clean areas)

1. Introduction

This technical summary document describes the monitoring system in the research centre ELI Beamlines, located in Dolní Břežany, the Czech Republic, further on referred to as "facility".

1.1. Purpose

This document, being a part of project documentation, lists the technical requirements and constraints on the monitoring system for the facility.

1.2. Scope

This document contains top level functional, safety, operational, design, quality and installation requirements for the monitoring system software of the facility.

1.3. Definitions

For the purpose of this document, the following definitions apply:

Definitions	Meaning
Personal dose	A general term for the quantities characterising a measure of external and internal exposures of individuals, especially effective dose, committed effective dose and committed equivalent dose in individual organs and tissues; personal doses are measured by personal dosimeters.
Legal dosimetry	Measurement system approved for usage in recording personnel dose for regulatory purposes.
Dose rate	It is defined as a quantity of radiation absorbed per time unit.

1.4. Non-exhaustive overview of applicable standards and regulations

Act No. 18/1997 Coll., on Peaceful Utilisation of Nuclear Energy and Ionising Radiation (the Atomic Act) and on Amendments and Alterations to Some Acts (Atomic Act).
Decree No. 307/2002 Coll., on radiation protection, as amended by the decree No. 499/2005 Coll.

Decree No. 132/2008 Coll., on Quality Assurance System in Performing and Ensuring Activities Related to the Utilisation of Nuclear Energy and Radiation Activities, and on Quality Assurance of Selected Equipment with Regard to their Ranking into Safety Classes.
Act No. 258/2000 Coll., on protection of the public health and on amendment to some related laws.
Decree No. 6/2003 Coll., establishing hygienic limits of chemical, physical and biological indicators for the internal environment of residential rooms in some buildings.
Act No. 350/2011 Coll., on chemical substances and mixtures, and amending certain acts.

Applicable Czech technical standards (ČSN) and European standards (EN):

ČSN 33 2000-4-41 ed.2	Low voltage electrical installations - Part 4- 41: Protection for safety - Protection against electric shock
ČSN 33 2000-5-51 ed.3	Electrical installations of buildings – Part 5-51: Selection and erection of electrical equipment – Common rules
ČSN EN 61000-1-2	Electromagnetic compatibility (EMC) - Part 1-2: General - Methodology for the achievement of the functional safety of electrical and electronic equipment with regard to electromagnetic phenomena
ČSN EN 61000-6-2	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
ČSN EN 61000-6-4	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments
ČSN EN 60846	Radiation protection instrumentation - Ambient and/or directional dose equivalent (rate) meters and/or monitors for beta, X and gamma radiation
ČSN EN 60761-1	Equipment for continuous monitoring of radioactivity in gaseous effluents - Part 1: General requirements
ČSN EN 50402	Electrical apparatus for the detection and measurement of combustible or toxic gases or vapour or of oxygen - Requirements on the functional safety of fixed gas detection systems
ČSN 07 8304	Pressure vessels for gases – operating rules
ČSN EN 60079-29-2	Explosive atmospheres - Part 29-2: Gas detectors - Selection, installation, use and maintenance of detectors for flammable gases and oxygen

2. FUNCTIONAL REQUIREMENTS ON MONITORING SYSTEM

The monitoring system of ELI Beamlines research centre shall be used for monitoring of quantities and parameters that have impact on radiation safety and radiation protection, technical gas leakage protection and clean areas status.
Monitoring system will enable the user to have an overview of the overall situation in the facility, including movement of personnel in the controlled areas and current state of their dose account. The monitoring system shall contain dose rates monitoring, surface contamination of

personnel, personal dosimetry, gas leakage monitoring, and indication of clean areas conditions.

2.1. Radiation monitoring

Ionizing radiation sources used in the facility emit electrons, protons, heavy ions, and photons. Due to the high energies of primary particles, secondary particles are produced, in particular neutrons, positrons, and muons.
The beam divergence of the primary particles is relatively low; most primary particles hit the beam dump, where they are slowed down or stopped. Considering the experimental geometry and operational regime, monitoring of heavy particles will not be implemented.
In terms of radiation protection, the main contribution to the dose accrual comes from neutrons; in some cases from photons.
Monitoring of the radiation produced within the facility shall be provided by stationary instruments suitable for detection in pulsed fields (measuring contribution of neutrons, gammas and muons). Four possible states were identified: Routine operation, Alarm, Failure, and Intentional turn-off.
For operational monitoring, portable (hand-held) instruments for detection of β and γ radiation and surface contamination measurement shall be used.
Additionally, passive detection system will be implemented in the facility for environment, cooling water and aerosols monitoring.
The personal dosimetry system used for monitoring and evaluation of personal dose accrual will implement both legal dosimeters as well as electronic dosimeters.

2.2. Industrial gases monitoring

In frame of the monitoring system, the industrial gases and cryogenic system shall be monitored.
All gases will be stored in pressure bottles, with the exception of N_2 that is distributed by pipes to individual workplaces. Similarly, cryogenic system provides liquid cooling media to different places in the building.

2.3. Clean areas monitoring

Clean areas monitoring shall collect and evaluate measured data from clean areas devices (particle counters and overpressure probes).

2.4. General

Communication among individual parts of the monitoring system shall be divided into several levels in order to ensure reliable communication taking into account the significance of information transferred.
The supplier shall define the procedures for maintenance and testing of the system (HW and SW) and commissioning requirements in the user documentation.
The HW components that reached end of their lifetime shall be disposed of according to the valid legislation – Waste Act.
Any requirements related to a decommissioning of the system, especially related to archiving of radiation workers data in accordance with valid legislation, shall be defined in the user's documentation by the supplier.

3. SOFTWARE PART

Monitoring information system (MIS) shall provide monitoring of quantities and parameters necessary to ensure radiation protection, provide gases and clean areas monitoring, and personal dosimetry management including communication with personal dosimetry terminal and agenda of activated material storage.
In the high level architecture diagram of the MIS system (see the Figure 1) the components are marked in blue, while the interfaces are in red.

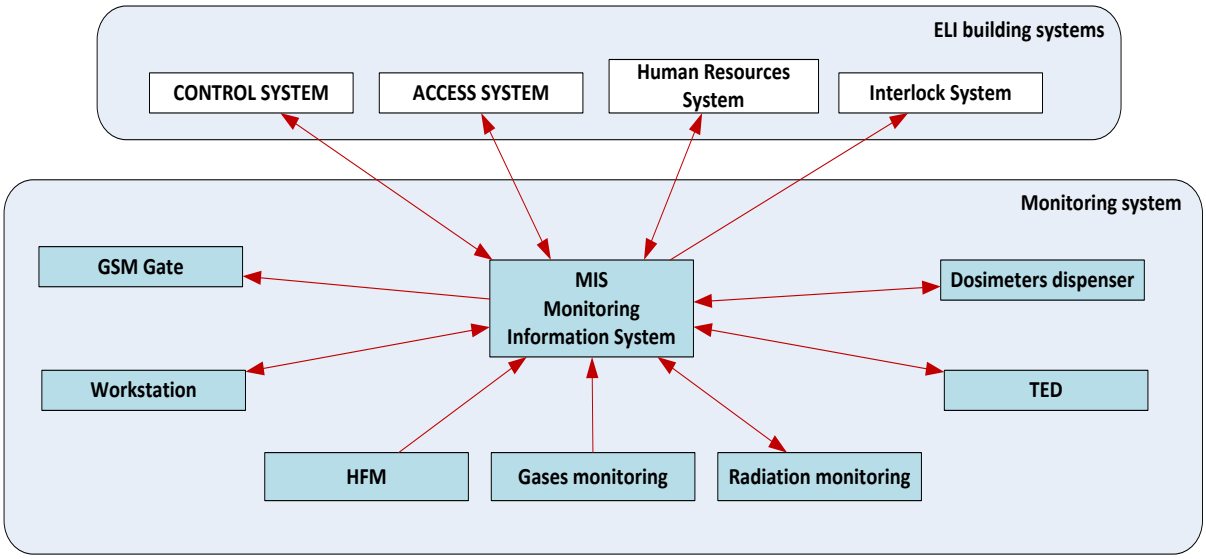

Figure 1: High level architecture diagram.

The MIS application logic shall contain a service that shall provide communication with the following facility systems: Control system, INTERLOCK system, the Human Resources system, and the Access system.
Some HW components shall enable direct communication with web services of the MIS application layer.

3.1. Application architecture

The MIS shall be for security reasons developed in Linux open source environment (preferably in LAMP - Linux/Apache/MySQL/PHP software bundle).
The MIS shall consist of the following basic parts:

- Data layer – database;
- Application layer;
- Presentation layer;
- Supporting interfaces layer.

NOTE: The Figure 2 displays basic parts of the monitoring information system.

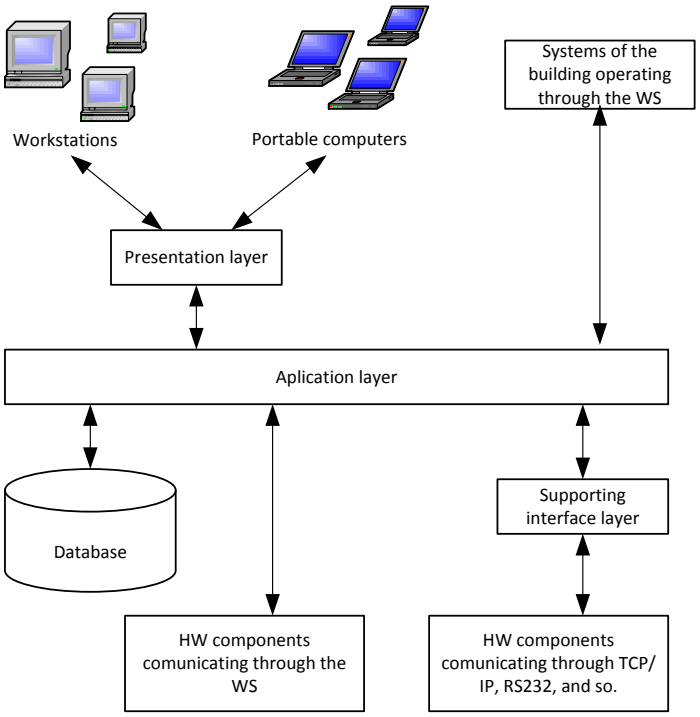

Figure 2: Application architecture of the MIS system.

Data layer shall serve exclusively as data storage and shall not contain any application logic. The application layer shall contain most of the "business logic" of the system (part of the logic shall be contained in a layer that forms interface with the follow-up systems or HW). Presentation layer shall be W3C compliant and shall not be developed using Flash, as Flash does not meet the necessary security standards. The MIS system shall communicate with different types of HW components that have pre-defined communication interface (TCP/IP, RS232, etc.) and shall contain the so called supporting interfaces layer. Building-technical solution interface shall provide relevant data for other building system's needs (control system, interlock, etc.).

3.2. Functional requirements on software part

3.2.1. Database

The database shall contain following information:

- Tables with measured data (current and archived);
- Configuration and logging tables;
- Registers of personnel, doses obtained, dosimeters, measurement nodes, measurement instruments, measurement channels, schemes, and activated material.

3.2.2. Personal dosimetry

The data from legal dosimetry service shall be imported to the MIS using a CSV file format.

Regular evaluation of received dose, and comparison received cumulative dose with legal limits (one year and five years limits) is to be executed for each monitored person.

Each person is obliged to take a personal and electronic dosimeter from the automatic dispenser and register the electronic dosimeter before entering the Radiation controlled area, which s/he will return on her/his exit from the controlled area.

3.2.3. General

Communication services of the support interfaces layer shall serve for reading data from instruments.
All data that are important for radiation protection shall be immediately transmitted (delay shall be maximally few seconds) for archiving to the central MIS database, which shall serve as an archive for the whole lifetime of the application.
All data inserted to the MIS shall be backed up for the whole lifetime of the system.
Data important for radiation protection (given by the legislation) shall be periodically exported in CSV format.
Web application shall allow displaying of various ad hoc information entered into the system by authorized person.

3.3. Web application

Web application shall be used for presentation of measured data, for interaction of the system with the user, and as a tool for administration of the system.

3.3.1. Modules

Presentation and administrative layer of the monitoring system shall be provided by the web application MIS – Monitoring information system that consists of six modules, see Figure 3:

- General;
- Personal dosimetry;
- Measurement (gases, ionizing radiation, clean areas);
- Schemes;
- Clean areas monitoring;
- Activated material storage room.

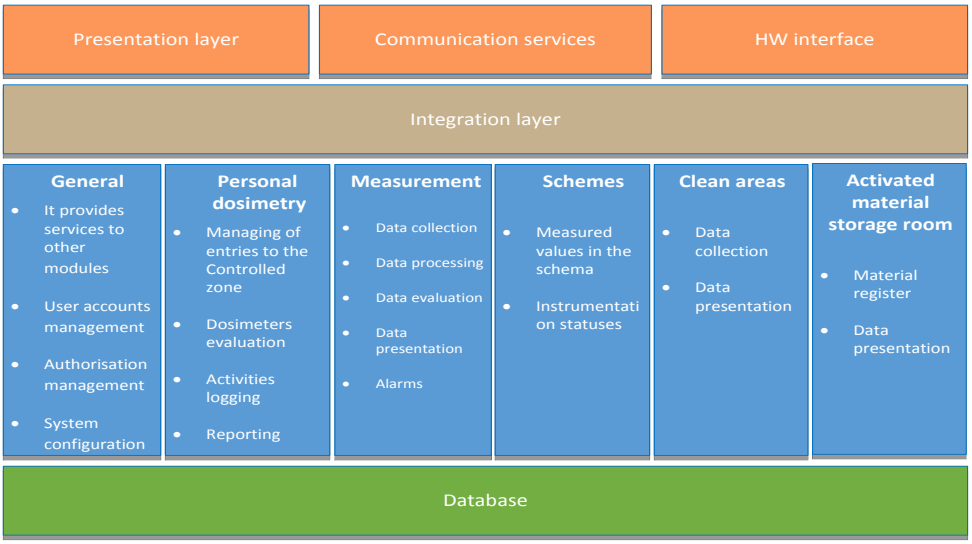

Figure 3: Logical structure of the MIS application.

3.3.2. User interface

From the user's point of view, data views in the MIS application shall have standard controls.
Data views in the MIS application shall enable the following basic operations:

- Record entry, edit, and validity cancellation;
- Table settings;
- Paging;
- Filtering;
- Sorting of records;
- Data export.

NOTE: Usage of some functions can be limited to an authorized user only.

3.3.3. Other

The MIS application shall log all changes performed in the application, i.e. records entry, edit and cancelling.
If the MIS system registers any nonstandard state (e.g. unauthorised entry, etc.), such a state shall be recorded. A table of all nonstandard states shall be displayed online to the authorised person.
Presentation layer of the system shall be developed as a multi-language (Czech and English).

4. Security

Security solution for the MIS shall comply with the information security systems state of the art.