CLS Lockup PLC
Technical Specification, Rev. 0

7.4.37.1

Date: 2001-07-12

Canadian Light Source
107 North Road
University of Saskatchewan
Saskatoon, Saskatchewan Canada

	Signature	Date
	Original on File – Signed by:	
Author	E. Matias	
Reviewer #1	N. Johnson	
Reviewer #2	M. Benmerrouche	
Approver	M. de Jong	

REVISION HISTORY

Revision	*Date*	*Description*	*Author*
A	2001-05-29	Original Draft	E. Matias
B	2001-06-11	Incorporated comments. Used for initial procurement and vendor selection.	E. Matias
C	2001-06-12	Updated distance between stations and added document number.	E. Matias
0	2001-07-12	Issued.	E. Matias

TABLE OF CONTENTS

1. INTRODUCTION

1.1 PURPOSE

This document defines the requirements for the CLS Lockup System PLC Hardware and System Software.

1.2 SCOPE

The scope of this specification covers only the “generic” PLC hardware and software. This manual excludes the CLS specific configuration of this equipment and the application software. Consult the CLS Lock-Up System manual for additional information.

1.3 BACKGROUND

See CLS Lock-up System Component Manual.

1.4 DEFINITIONS AND ABBREVIATIONS

Certified – A recognised, independent testing laboratory has issued a certification of compliance against the specified standard. In the case of IEC 61508, TÜV and Factory Mutual are generally accepted as suitable certification bodies. In the case of CSA standards, the CSA is generally regarded as a suitable certification body.

Failure – A change in the characteristics of a component or system such that the component or system is unable to carry out its specified function.

Fail-Safe – The characteristic exhibited by a component, piece of equipment, or a system that results in the nuclear facility being put in the preferred state in terms of public safety following the failure of the component, equipment or system. Such fail-safe characteristics are not universal, but are dependant upon the failure mode postulated.

2. REQUIREMENTS

2.1 Functions

2.1.1 General Requirements

The computer (PLC) controlled chain is in parallel to a relay-based chain, therefore the IO configuration will be SIL 2 configuration.

a) All components certified for use in a IEC 61508 SIL 3 demand application.
b) The configuration shall consist of non-redundant IO with diagnostics.
c) One processor with diagnostics and a second either hot-standby processor or off-line processor module.
d) Programming shall be performed using IEC 61131-3 Function blocks.

e) The configuration below represents the initial configuration of the system. The system shall be able to accommodate future expansion of the number of IO by up to 150% (excluding wired spares).

2.1.2 Cabling

a) All bus cabling will be run in a conduit outside of radiation areas
b) Marshalled Cable Assemblies shall be included in the scope of supply so that the PLC can be mounted in the front of the rack and the cabling can be mounted on the back of the rack.
c) The quote shall include all bus cabling, connectors and mounting hardware including DIN rails if required.
d) The quote shall include redundant 24V field power supplies (certified for use in SIL 3 applications).

2.1.3 Inputs

a) Doors: 34 dry contacts
b) Gates: 38 dry contacts (5 in booster, 9 for storage ring, 4 roof and 20 beamlines)
c) Interface Ports: 6 dry contacts
d) Areas Radiation Monitors: 12 Analogue Inputs
e) Oxygen monitors 5 Analogue and 5 dry contacts
f) Ozone monitors 5 Analogue and 5 dry contacts
g) Emergency Off Buttons: 45 dry contacts
h) Beamline openings: 20 dry contacts
i) The supplier shall identify if the equipment quoted supports the use of sensing resistors for line breaks.

Total Inputs: 153 dry contacts; 22 Analogue inputs

2.1.4 Outputs

a) Flashing lights: 30 - relay outputs (250 mA 24V)
b) Horns: 16 - relay outputs, solid state (250 mA 24 V)
c) Interlocks: 5 - 24V outputs
d) Interlocks: 5 relay outputs (250 mA, 24V)

Total Outputs: 56 - 24V outputs or relay output;

2.1.5 General IO

a) 15% installed spare channels shall be added to preceding count
b) An additional 10% spare components shall be included in the quote.
c) All IO hardware shall meet the requirements of IEC 61131-2.

2.1.6 Additional Items To be Included

a) All run-time software licenses and media.

b) Three copies of all documentation, identify if provided on CD-ROM or in printed format
c) IEC 61131-3 programming software for Windows 2000, Solaris or Linux, one seat.
d) Recommended (non-conventional) installation tools, and maintenance kits.
e) Any special IO cards required for the development station.
f) Special DIN rails, mounting equipment.
g) Shipping and Handling Charges.
h) GST and PST.

2.1.7 Internal Communication

a) Internal system communication formats and protocols between distributed components shall be based on proven data transmission techniques. Documentation shall be available on transmission techniques for the support of licensing related activities for the CNSC.
b) This proposed communication technique shall be consistent with IEC 61508 certification.

2.1.8 General Facility Distributed Control System

The CLS facility distributed control system is made up of PLC hardware, embedded single board computers and VME hardware using the Experimental Physics and Industrial Control System (EPICS) Channel Access communication protocol and operator interface.

a) A means of communication with the main facility control system shall be supplied. Connecting and disconnecting the main control system shall not cause any erroneous actions to be taken by the lockup system. Communication shall be in one direction only (from the lockup system to the main facility control system).
b) Communication with the main control system shall be over a Profibus, Modbus Plus, RS232 or other equivalent data-link that is compatible with the equipment SIL 3 certification. The system being supplied shall reference a relevant standard, or include a definition of the protocol being supplied.

2.1.9 Excluded Items

a) CLS will provide 19inch racks with 50 to 60 cm depth to hold the equipment.
b) CLS will perform installation, programming and commissioning of the system.
c) CLS will provide all field cabling.
d) CLS will provide a conventional PC or Sun Sparc workstation for configuration software.

2.2 Performance

The system must be able to scan all inputs perform basic comparisons on the scanned inputs and write the outputs within 40ms.

2.3 Safety and Environmental

a) Each processor shall incorporate a mechanism that disables changes to its application software unless specifically enabled.
b) Safety-related output signals shall be fail-safe; capable of being set to the power-off state within a period of 1 s if they are not updated with valid data or system (or modules) diagnostics detect a fault.
c) The design of individual modules shall make use of diagnostics to detect internal faults in the system. These shall include but not be limited to watchdogs, input and output electronics checks.

d) Detected faults and data error shall allow a pre-detected control action to be taken and shall provide an output to the facility control system for annunciation to the operator.
e) The product must meet all Canadian electrical and conventional safety standards with CSA certification for sale in Canada.

2.4 Applicable Codes, Standards and Procedures

a) CAN/CSA-Z234.1-89 (R1995) Canadian Metric Practices Guide.

   - *Documentation shall be in compliance with Canadian National Standards for the use of System International (Metric System) units.*

b) IEC 1131-2 (61131-2) Programmable Controllers – Part 2: Equipment Requirements and Tests

   - *The system shall meet the equipment requirements of IEC 1131-2. The supplier shall identify any deviations from IEC 1131-2.*

c) IEC 1131-3 (61131-3) Programmable Controllers – Part 3: Programming Languages

   - *The system must support Function Blocks and Structured Text Languages. Support for other languages defined by IEC 1131 is desirable but not required.*

d) IEC 61508-2 Functional Safety of electrical/electronic/programmable electronic systems, Part 2: Hardware Requirements and IEC 61508-3 Functional Safety of electrical/electronic/programmable electronic systems, Part 3: Software Requirements.

   - *Hardware, Firmware, and operating system (if applicable) must be certified in compliance with IEC 61131-2 and 3 for use in a SIL 3 application.*

e) ISO 9001 Quality Systems – Model for quality assurance in design, development, production installation and servicing.

   - *Equivalent national standards may be substituted in place of ISO 9001, subject to CLS acceptance. CAN3-Z299.2-85, Quality Assurance Program – Category 2 requirements, can be used in place of ISO 9001.*

2.5 Quality Assurance

The system shall satisfy the quality assurance requirements of ISO 9001.

2.6 Inspection, Testing and Commissioning

This equipment will be subject to standard CLS receiving inspection. This equipment will be integrated into the CLS lockup system and subject to integrated testing and commissioning. No specific testing and commissioning of the hardware (not part of the general system integration and testing) is anticipated.

2.7 Reliability and Maintainability

The system must provide a high level of availability as per IEC 61508. The system shall be designed to minimize time to repair to the greatest extent feasible.

2.8 Layout

a) The system shall contain the ability to geographically distribute IO modules.
    i. Four racks will be located in a circle, approximately 45 m from each other.
    ii. The fifth rack will be located in the control room approximately 80 m from the ring.

2.9 Vibration and Acoustic Noise

This equipment should not be the source of noticeable vibration or acoustic noise.

2.10 Services

Standard 120 V AC power will be provided to the equipment. No special cooling requirements are anticipated.

2.11 Other Requirements and Constraints

None.

3. REFERENCES

None.