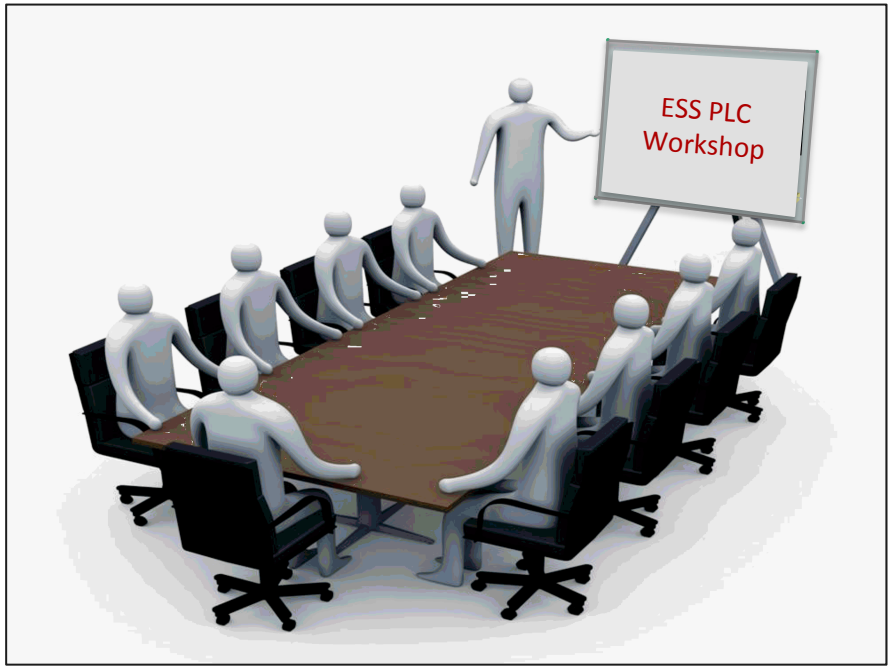
Workshop on PLC based interlock systems for accelerators and other large research installations



Started out with a small "Mini" Workshop

Ended up with a "not-so-Mini" Workshop

Introduction

- ESS is entering into the club of major research facilities based on accelerators
- ESS is challenging, with 5 MW average beam power on target (more that a factor of 5 compared to SNS)
- Protection of personnel, environment and equipment has to be considered
- Last year, a workshop on Machine Protection on Linear Colliders was organised at CERN – with a general view on aspects of machine protection

- PLC and other fast interlock systems play a major role in the protection and safety systems. PLCs are also widely deployed for other control functions. How far can on go by using PLCs?

- This year's workshop is dedicated to the technical aspects of PLC based system, and options for fast interlock systems will also be discussed.

PLC based interlock systems as used for Machine Protection and Personnel Safety / Access Systems

Organising Committee of the Scientific Programme

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Workshop on PLC based interlock systems for accelerators and other large research installations

- Programmable Logic Controllers (PLCs) are widely used in industry, and since some years in many accelerators and other large research installations
  - No development of hardware required, easy purchase and exchange, no local stock needed.
  - Easy to connect to a host computer or network.
  - High level of connectivity. Manage a large number of signals in different flavours.
  - Meets the requirements of high EM anti-disturbance taking into account industrial conditions.
  - Easy to integrate PLCs in different SCADA systems, as well as EPICS.
  - Stability, reliability, fast response (in general, down to 1 ms), compact, modular, easy to install and easy to maintain.
  - Standardized for general purpose, large range of available commercial products, both for hardware and software.
- The experience at several labs from using PLCs in interlock systems is excellent
- Safety and protection systems, and many other systems use PLCs, with very good experience
  - CERN examples: Cryogenics, vacuum, beam dumping system, magnet protection systems, access system, safety systems for experiments

Scope

Main focus will be on PLC based interlock systems, however there is also one session on fast FPGA based interlock systems (to better understand the areas of application for PLC / fast systems)

- Machine Protection Systems
- Access Systems
- Magnet Powering Systems
- Target Safety Systems
- Detector safety systems
- PLCs for vacuum systems, cryogenics, …
- Different PLC architectures (how safe, how fast, how complex)
- Different PLC types (experience with vendors, future trends)
- Fieldbus technologies
- PLC test benches
- Operational experience (radiation issues, availability, reliability, process safety, etc.)
- Interfaces to control systems
- Services (logging, archiving, post mortem, clock synchronization)

Objectives and questions

- What are the requirements for Machine Protection Systems and Personnel Protection Systems ?
  - Safety level (is a PLC based access system without hardware wires acceptable?)
  - Availability
  - Response time
  - Number of input / output signals to be handled
  - Algorithms required for logic decision
  - What can be done with PLCs, what requires other hardware systems?
  - Electrical main failures – recovery UPS required?

Objectives and questions

- What performance can be achieved, depending on the type of PLC?
  - Safety level and Availability
  - Response time (cycle time), as function of the number of input / output signals
  - Number of signals to be treated
  - Algorithms required for decision
  - Management of PLC firmware
  - Fast processors in PLC based systems

- What is the experience using PLCs in existing systems?
  - Experience from operation
  - How much effort in the development and commissioning phases?
  - How much effort in the operation and maintenance phase?
  - Pitfalls and risks – near misses

- What architectures for PLC based interlock systems are proposed/used?
  - Ring, tree, how many crates, …
  - Buses: Profibus, Profisafe, Profinet, others

Objectives and questions

- How to connect PLC input and output signals to external systems?
  - Direct inputs, inputs via electronic boards, others?
  - Outputs – how to connect PLCs in a dependable (=reliable, available and safe) way to actuators ?
  - Redundancy (1oo2, 2oo2, 2oo3, …)
  - Connectivity (cables, optical, copper wires, connector types, …)

- Testing and verification of the system
  - What are the essential ingrediants to build a successful test stand (PLC lab)?
  - How to make sure that the system does what is intended?
  - How to ensure that the correct program is loaded in the PLC?
  - Start sequences for processes
  - Transition test – operation - tests during the operational phase
  - Disabling inputs

Objectives and questions

- Interface to the controls system
  - Configuration and its management, databases, access, software updates
  - Drivers
  - EPICS, JAVA based systems, SCADA systems, ...
  - Synchronisation between PLCs and an external clock (~1 ms required)
  - What programming languages?
  - How to download programs?
  - System updates and connection to networks
  - Security: how to avoid problems with hackers?
  - Completely isolate critical systems from the outside world?

- PLCs from different vendors
  - What PLCs are being used?
  - What is the experience with PLC from different vendors?
  - How is the support?
  - How many different types of PLC in one lab – what is acceptable?

Objectives and questions

- Other questions
  - Simulations of safety systems
  - From requirements to PLC program - the development cycle
  - To build and operate a PLC based interlock system, what profile for engineers and technicians is required?
  - What can be outsourced, what should be done in the lab? During design, commissioning and operation…
  - What standards?

Workshop spirit

- This is a workshop, and discussions are strongly encouraged.
- The objective is to discuss between experts from different labs.
- Is there is a common view for PLC based systems for large research installations?

Sessions

1. Introduction
2. Machine protection and interlock systems at different labs
3. PLC for protection and safety systems
4. Operational experience
5. Machine protection and fast interlock systems
6. Discussion session

You are invited to contribute with your slides, in particular in the discussion sessions

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