	Projects available for the Internships at the Engineering Support for the MPD Installation Sector		
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Distribution list						
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Prepared	**Controlled**	**Verified**	**Verified**	**Verified**	**Approved**	**Date**

Contents

Automation of cryogenic system for superconductive magnet – M. Kutyła

Topic**: Automation of cryogenic system for superconductive magnet**

Supervisor: **Monika Kutyła (kutyla@jinr.ru)**

Purpose and objectives of the project

A superconducting magnet was designed and manufactured for the NICA (Nuclotron-based Ion Collider fAcility) MPD (Multi-Purpose Detector) experiment. For its proper functioning, it is required to cool it down to the temperature of liquid helium. For this purpose, a specialized cooling system was designed, consisting of three main subsystems: MFS (Magnet Flushing Station), Control Cryostat, Satellite Refrigerator. The auxiliary system necessary to maintain the desired temperature is the Vacuum System. Each of these systems requires an appropriate control system to allow the cooling procedure to be carried out following the assumed algorithm. Moreover, the subsystems mentioned above are interdependent, which means that they must cooperate closely with each other. For the operator to carry out the magnet cooling process and monitor the correctness of its course, it is necessary to visualize the process in SCADA (Supervisory Control And Data Acquisition).

Control system for the MFS.

Supervisor: **Monika Kutyła (kutyla@jinr.ru)**

Tasks for student:

A student that will be responsible for this project should prepare a proposition of the control system that requires to do:

a. Reading existing documentation for the subsystem
b. A brief description of the operating principle of the subsystem (e.g. Word)
c. Identification of devices and signals in the system (e.g. Excel)
d. Selection of appropriate PLC modules
e. Electrical connection diagram (e.g. AutoCAD)
f. Preparation of the control algorithm
g. Preparation of the software (e.g. TIA Portal)
h. Preparation of SCADA (e.g. TIA Portal)
i. Preparation of the documentation (e.g. Word)

Satellite Refrigerator.

Supervisor: **Monika Kutyła (kutyla@jinr.ru)**

Tasks for student:

A student that will be responsible for this project should prepare a proposition of the control system that requires to do:

a. Reading existing documentation for the subsystem
b. A brief description of the operating principle of the subsystem (e.g. Word)
c. Identification of devices and signals in the system (e.g. Excel)
d. Selection of appropriate PLC modules
e. Electrical connection diagram (e.g. AutoCAD)
f. Preparation of the control algorithm
g. Preparation of the software (e.g. TIA Portal)
h. Preparation of SCADA (e.g. TIA Portal)
i. Preparation of the documentation (e.g. Word)

Control Cryostat.

Supervisor: **Monika Kutyła (kutyla@jinr.ru)**

Tasks for student:

A student that will be responsible for this project should prepare a proposition of the control system that requires to do:

a. Reading existing documentation for the subsystem
b. A brief description of the operating principle of the subsystem (e.g. Word)
c. Identification of devices and signals in the system (e.g. Excel)
d. Selection of appropriate PLC modules
e. Electrical connection diagram (e.g. AutoCAD)
f. Preparation of the control algorithm (e.g. Word)
g. Preparation of the software (e.g. TIA Portal)
h. Preparation of SCADA (e.g. TIA Portal)
i. Preparation of the documentation (e.g. Word)

Vacuum System.

Supervisor: **Monika Kutyła (kutyla@jinr.ru)**

Tasks for student:

A student that will be responsible for this project should prepare a proposition of the control system that requires to do:

a. Reading existing documentation for the subsystem
b. A brief description of the operating principle of the subsystem (e.g. Word)
c. Identification of devices and signals in the system (e.g. Excel)
d. Selection of appropriate PLC modules
e. Electrical connection diagram (e.g. AutoCAD)
f. Preparation of the control algorithm
g. Preparation of the software (TIA Portal)
h. Preparation of SCADA (SIMATIC WinCC)
i. Preparation of the documentation (e.g. Word)

Thermal stabilization systems M. Czarnynoga (1 person per project)

Topic: **Thermal stabilization systems**

Supervisor: **Maciej Czarnynoga (czarnynoga@jinr.ru)**

Purpose and objectives of the project:

Each electronic device generates heat. Usually, about 95% of the electrical power supply is converted into heat. In the case of electronic equipment, this heat must be removed to provide correct working conditions. The most significant hazard is overheating, which can permanently damage the device. However, in the detectors, such as MPD, high-temperature gradients can affect the physical results produced. Due to this fact, some detectors have a cooling system as well as a thermal stabilization system.

Each project in this topic is related to cooling systems or thermal stabilization systems. The subject is aimed to prepare a set of tools necessary to design, build, and prototype one of the heat management systems.

Project: Thermal measurement station

Supervisor: **Maciej Czarnynoga (czarnynoga@jinr.ru)**

The thermal measurement station will allow conducting the measurements of the thermal properties of the materials.

Based on the general layout of the thermal measurements station, the student will prepare the executive project, collect all components, and build such a stand.

Tasks for the student:

a) The conception of the design of the stand (e.g., AutoCAD, Word)
b) Choosing components (research work)
c) The executive project of the stand (e.g., Inventor Word)
d) Assembly of the stand (manual work, 3D printing)
e) Programming readout electronics (e.g., LabVIEW)
f) Preparation of the documentation (e.g., Word)

Project: Chiller loop for the mobile cooling system

Supervisor: **Maciej Czarnynoga (czarnynoga@jinr.ru)**

The flexibility given by the mobile cooling system will allow providing a quick cooling solution for the experimental stand. In addition, parts of this system can be used in prototyping MPD detectors.

Tasks for the student:

a) Design of the mobile chiller loop (e.g., Inventor, Word)
b) Production of the elements of the system (3D printing, manual work)
c) Choosing sensors (research work)
d) Programming of the readout electronics (e.g., LabVIEW)
e) Testing of the system
f) Preparation of the manual (e.g., Word)

Project: Secondary loop of the cooling system

Supervisor: **Maciej Czarnynoga (czarnynoga@jinr.ru)**

The flexibility given by the mobile cooling system will allow providing a quick cooling solution for the experimental stand. In addition, parts of this system can be used in prototyping MPD detectors.

Tasks for the student:

a) Designing of the loop (e.g., Inventor, Word)
b) Manufacturing elements of the system (3D printing, manual work)
c) Choosing sensors (research work)
d) Programming of the readout electronics (e.g., LabVIEW)
e) Testing the system (research work)
f) Preparing the manual (e.g., Word)

Project: Cooling of the MPD-TOF detector

Supervisor: **Maciej Czarnynoga (czarnynoga@jinr.ru)**

The Time Of Flight system (TOF) is one of the primary detectors in the MPD experimental stand. During the testing, the first signs of overheating have appeared. To prevent future problems cooling system is needed.

Tasks for the student:

a. Understand principles of operating TOF detector (research work)
b. The conception of the design of the cooling system (e.g., Inventor, Word)
c. Simulating the effectiveness of the cooling system (e.g., Inventor, CFD)
d. Designing prototyping stand for cooling system (e.g., Inventor)
e. Building prototype stand (3D printing, manual work)
f. Preparation of the documentation (e.g., Word)

Automatization of the designing process M. Czarnynoga (1 person per project)

Topic: **Automatization of the designing process**

Supervisor: **Maciej Czarnynoga (czarnynoga@jinr.ru)**

Purpose and objectives of the project:

During the designing process, repetitive tasks are made. In some situations, we can automatize parts of the process. Moreover, each project, or its technical documentation, should comply with standards and norms.

Project: Automatization of the space management system inside of the NICA-MPD-Platform's Rack cabinets

Supervisor: **Maciej Czarnynoga (czarnynoga@jinr.ru)**

Space inside the rack cabinets on the NMP is limited. The racks must contain all the equipment needed to operate the MPD experimental setup safely. Moreover, some unstandardized devices will be mounted on the NMP. Due to these facts, space management is an essential part of the design of the NMP.

Tasks for the student:

a. Preparing excel sheet template to collect data about the equipment (Excel)
b. Preparing the manual (e.g., Word)
c. Finding the optimal way to transfer data (research work)
d. Connecting data from the sheet with the 3D model (Inventor, iLogic)
e. Preparation of the documentation (e.g., Inventor, Word)

Project: Creating the standards and templates for technical documentation

Supervisor: **Maciej Czarnynoga (czarnynoga@jinr.ru)**

To avoid misunderstandings, documentation of the whole project must be produced by the same standards.

Tasks for the student:

a. Finding suitable norms and standards (research work)
b. Preparing template for Inventor and AutoCAD (Inventor, AutoCAD)
c. Preparing the documentation (e.g., Word)
d. Preparing conception of the naming of the documents (research work)

Preparation of the RACK cabinet – M. Czarnynoga, M. Kutyła

Project: Radio-Frequency Identification of the cable connection (1 person)

Supervisor: **Maciej Czarnynoga (czarnynoga@jinr.ru)**

Purpose and objectives of the project

In huge project, such as the MPD experiment, thousands of cable connections must be made. Error in cable connections can cause incorrect operation of the whole system. To avoid such problems, RFID should be implemented in the IT structure of the project.

Tasks for the student:

a) Understanding the principles of RFID system operating (research work)
b) Setting up RFID equipment in the rack cabinet (manual work)
c) Filling RFID database (RFID software)
d) System testing (research work)
e) Preparing the manual of system operating (e.g. Word)

Project: Installation of the cooling system inside a rack cabinet (1 person)

Supervisor: **Maciej Czarnynoga (czarnynoga@jinr.ru)**

Purpose and objectives of the project

To provide the correct working conditions for the equipment mounted inside the rack cabinet cooling system is required. The conception of such systems already exists. However, the system must be installed and tested.

Tasks for student:

a) Understanding the working principles of cooling system (research work)
b) Installation of the system (manual work)
c) Adjusting of the system (e.g., LabVIEW)
d) Conduct tests (e.g., Excel)
e) Preparing operating manual of the system (e.g. Word)

a. Cooling system
b. Intelligent Power Distributor
c. Dosimetry system
d. Magnetic field measurements
e. Visualization of the process

Automation of RACK cabinet – M. Kutyła (1 person)

Project: **Automation of the auxiliary systems mounted inside the RACK cabinet.**

Supervisor: **Monika Kutyła (kutyla@jinr.ru)**

Purpose and objectives of the project

Some parameters inside RACK cabinets should be monitored because each of the devices installed inside have specific working conditions that should be maintained for their correct operation. Such parameters are e.g. temperature, humidity, radiation, magnetic field. For this, various types of transducers are required, combined into one measurement system. The monitored values should be transferred to the SCADA, which is responsible for the acquisition and allows the operator to control the process.

Tasks for student:

A student that will be responsible for this project should prepare a proposition of the monitoring system that requires to do:

a. Conception of the device connections (e.g. AutoCAD)
b. The conception of the cover box for the device (e.g. Inventor)
c. Preparation of the cover box for the device (e.g. 3D printers)
d. Arrangement of devices inside the RACK (manual work)
e. Preparation of electrical connections (manual work)
f. Preparation of the software (e.g. TIA Portal)
g. Preparation of the visualization (e.g. TIA Portal)
h. Preparation of the documentation (e.g. Word)

Integration of the RACK cabinet auxiliary systems.

Supervisor: **Monika Kutyła (kutyla@jinr.ru)**

Purpose and objectives of the project

Inside the RACK cabinet, many auxiliary systems are mounted. Due to the fact that a variety of companies supplied the system mounted in RACKs, there is a problem with their integration. There is a need to create one supervisory system for all of them.

Tasks for student:

A student that will be responsible for this project should integrate auxiliary systems inside the RACK cabinet that requires to do:

a) Getting familiar with SIMATIC WinCC (e.g. TIA Portal)
b) Review of possible supervisory system architectures (e.g. Word)
c) Finding a solution for interconnecting non-SIMATIC systems with SIMATIC WinCC
d) Integration of auxiliary systems inside the RACK cabinet (e.g. TIA Portal)
e) Preparation of the documentation (e.g. Word)

EqDb database – F. Protoklitow

Project: **EqDb User Guide and GUI improvement**

Supervisor: **Filip Protoklitow (protoklitow@jinr.ru)**

Purpose and objectives of the project

During this practice, the student will learn what EqDb (Equipment Database) is, its role in the NICA project, and how it works. It will be a hands-on experience and a chance to improve the existing database structure. The result of this practice will be new chapters in the current User Guide as well as changes in the GUI which will enhance the user experience. Changes in the manual will be done in LaTeX. The basic knowledge of this language will be advantageous.

English, at least at the B2 level, is required because the database itself and its documentation are in English.

Tasks for student:

A student that will be responsible for this project should perform the following tasks:

j. Familiarize with existing EqDb documentation (Adobe Acrobat Reader)
k. Familiarize with operating EqDb, actions such as adding new: elements, invoices, institutions, etc. (EqDb data editor)
l. Prepare the list of improvements for the GUI (EqDb data editor and text editor, e.g., Word)
m. Prepare the list of bugs of the GUI (EqDb data editor and text editor, e.g., Word)
n. Write new chapters for the User Guide (LaTeX)
o. Extend the User Guide glossary (LaTex)
p. Prepare the *examples* appendix for the User Guide (EqDb data editor and LaTeX)

Pressure sensor calibration system – I. Shmyrev

Project: **Pressure sensor calibration system**

Supervisor: **Ilia Shmyrev (shmyrev@jinr.ru)**

Purpose and objectives of the project

Calibration is one of the key conditions for effective quality assurance. Calibrated sensors are a prerequisite for accurate, reliable and reproducible measurements. The accuracy of measuring instruments can be reduced due to wear, aging and environmental influences. Therefore, measuring instruments must be periodically calibrated. During the calibration process, the accuracy of measuring instruments, in particular sensors and measuring systems, is checked, as well as the reproducibility of measurement results.

Tasks for student:

The student who will be responsible for this project have to create a calibration system stand for calibrating and testing various types of sensors, which will require:

q. Conception of the calibration system (e.g. Word)
r. Selection of the necessary components for the calibration system (sensors for reference measurements, pumps, heaters etc.) (research work)
s. Development of the calibration system stand layout (e.g. AutoCAD)
t. Assembly of the mechanical part of the stand (manual work)
u. Preparation of the documentation (e.g. Word)

Cable tester – K. Rosłon (1 person)

Project: **Universal cable tester based on NI modules.**

Supervisor: **Krystian Rosłon (roslon@jinr.ru)**

Purpose and objectives of the project

When working with electronic equipment, trivial errors related to, for example, connection, can take many hours of work devoted to finding the cause of the incorrect operation of the system. The aim of the project is to create and program a Universal cable tester based on NI modules. The assumption is to use the NI modules (e.g., myRIO, myDAQ) as a system for recording high states on appropriate outputs and as a system for reading high states from appropriate inputs.

Tasks for student:

A student that will be responsible for this project should build a universal tester that requires to do:

v. Conception of the device connections (e.g. AutoCAD)
w. Conception of the cover box for the device (e.g. Inventor)
x. Conception of the connections any connector to the device (e.g. Word)
y. Preparation of the prototype board of the device (manual work)
z. Testing the prototype (LabVIEW)
aa. Preparation the cover box for the device (manual work, 3D printing)
bb. Mounting the device inside the cover box (manual work)
cc. Preparation of the documentation (e.g. Word)

FIRESI extinguishing module F. Protoklitow

Project: **Connecting FRS-RACK 2 extinguishing panel to the SCADA system**

Supervisor: **Filip Protoklitow (protoklitow@jinr.ru)**

Purpose and objectives of the project

FRS-RACK 2 is currently working as a standalone device with the possibility to connect the device with installed LabVIEW and monitor its' parameters. This topic aims to connect FRS-RACK2 to the SIMATIC S7-1200 CPU, acquire data from the device using SNMP protocol, visualize and monitor the received data using SIMATIC WinCC. Also, the list of possible states of the FRS-RACK2 needs to be prepared as well as alarms connected with them.

Knowledge of SIMATIC WinCC, TIA Portal, or programming PLCs would be advantageous.

Tasks for student:

A student that will be responsible for this project should build a ready to use SCADA by fulfilling the following:

a. Familiarize with the documentation of the FRS-RACK2 and the LabVIEW software (Adobe Acrobat Reader, LabVIEW)
b. Connect FRS-RACK 2 to the S7-1200 CPU (manual work and TIA Portal)
c. Acquire the data using SNMP protocol (TIA Portal)
d. Prepare the finite state machine algorithm-based (graph editor, e.g., yEd)
e. Implement the states based on the prepared algorithm (TIA Portal)
f. Prepare the SCADA system for the acquired data (SIMATIC WinCC)
g. Prepare the documentation of the project (text editor, e.g., Word)

Integration of automation systems – M. Kutyła

Integration of the Cryogenic subsystems.

Supervisor: **Monika Kutyła (kutyla@jinr.ru)**

Purpose and objectives of the project

Since the cryogenic system described in point 1 consists of several subsystems that must work closely together, there is a need to integrate them. When different contractors prepare subsystems, the task of combining them into one system is not trivial.

Tasks for student:

A student that will be responsible for this project should integrate cryogenic subsystem that requires to do:

a) Getting familiar with SIMATIC WinCC (e.g. TIA Portal)
b) Review of possible supervisory system architectures (e.g. Word)
c) Integration of systems that are being created under point 1. (e.g. TIA Portal)
d) Preparation of the documentation (e.g. Word)

Integration of the Cryogenic Platform and Nitrogen Factory.

Supervisor: **Monika Kutyła (kutyla@jinr.ru)**

Purpose and objectives of the project

Some auxiliary systems necessary for the proper functioning of the cryogenic system were built earlier and have their independent software. A solution must be found to integrate these existing systems with the control system being developed for cryogenics.

Tasks for student:

A student that will be responsible for this project should prepare proposition of integration auxiliary system into cryogenic platform that requires to do:

a) Getting familiar with SIMATIC WinCC (e.g. TIA Portal)
b) Review of possible supervisory system architectures (e.g. Word)
c) Prepare a plan of integration auxiliary system into the cryogenic platform (e.g. Word)
d) Preparation of the documentation (e.g. Word)

Android mobile applications – K. Rosłon (1 person)

Project: **Android mobile applications**

Supervisor: **Krystian Rosłon (roslon@jinr.ru)**

1. Purpose and objectives of the project

   In an experiment as large as MPD, many parameters must be monitored and controlled. SCADA is usually used for this purpose. However, the data visualization can be transferred to the browser or directly to the mobile application. The aim of the project is to write an application that allows monitoring of certain data from the Slow Control system for the NICA experiment.

2. Tasks for student:

   A student that will be responsible for this project should build a universal tester that requires to do:

   a. Conception of the algorithm (e.g. Flow Chart Maker)
   b. Connection to the data base (e.g. JAVA)
   c. Programming the algorithm for the Android (e.g. JAVA)
   d. Preparation of the documentation (e.g. Word)