Engineering Support for MPD – NICA

TDR Technical Design Report NICA-MPD PLATFORM

Technical Design Report: Requirements & System Description

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3 ACRONYMS and ABBREVIATIONS

Table 1; Acronyms and Abbreviations

(H)	Horizontal Measurement
(V)	Vertical Measurement
A	Ampere
Å	Angstrom
AC	Alternating Current
ACS	Access Control System
ADC	Analog to Digital Converter
ADT	Array Display Tool
ANSI	American National Standards Institute
APPS	Accelerator Personnel Protection System
ASIC	Application-Specific Integrated Circuit
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWG	American Wire Gauge
BAG	Bayard-Alpert Gauge
BBA	Beam Based Alignment
BCJINR	Building Code of JINR
BDA	Beam Defining Aperture
BLM	Beam Loss Monitor
BM	Bending Magnet
BPM	Beam Position Monitor
B–SR	Booster-to-Storage Ring
BT	Beamline Team
CA	Channel Access
CAD	Computer Aided Design
CAMAC	Computer Automated Measurement And Control
CCAS	Cable Connection Authorization System
CCG	Cold Cathode Gauge
CCTV	Closed Circuit TeleVision
CPU	Central Processing Unit
c-RIO	Compact RIO
CRWS	Cable Race Way System
DAC	Digital to Analog Converter
DC	Direct Current
DIAMOND	British National Synchrotron
DMM	Digital Multi Meters
DP	Display Page
DSP	Digital Signal Processor
EqDb	Equipment Database
ESD	Emergency Shutdown
ESH	Environmental Safety and Health
ESRF	European Synchrotron Radiation Facility
EUV	Extreme Ultraviolet
FAS	Fire Alarm System
FFT	Fast Fourier Transform
FOC	Fiber-Optic Cables
FPGA	Field Programmable Gate Array
FTIR	Fourier Transform InfraRed
GbE	Gigabit Ethernet
GHe	Gaseous Helium
GPIB	General Purpose Interface Bus
GSS	Gas Supply System
GUI	Graphical User Interface
GV	Gas Valve
Gy	Gray, a unit for measuring radiation
H	Henry, a measure of inductance
HMI	HuMan Interface
HP	High Pressure, high purity, horse power
HPS	Hazardous Production MaterialS
HQS	High Quality Service
HTSC	High Temperature SuperConductor
HVAC	Heating Ventilating and Air Conditioning
IOC	Input Output Controller

IOT	Inductive Output Tube
IPD	Intelligent Power Distributor
ISO	International Organization for Standardization
IT	Information Technology
LEED	Leadership in Energy and Environmental Design
JINR	Joint Instituute of Nuclear Research
LHe	Liquid Helium
LID	Long Insertion Device
Linac	Linear Accelerator
LLRF	Low Level Radio Frequency
LN_2	Liquid Nitrogen
LoI	Letters of Intent
LPG	Low Pressure Gas
LTS	Low Temperature Superconductor
m	meter, or mill, if a Prefix
M	Million, or Mega
mA	miliAmps
MCL	Multichannel Line
MPD	Multi-Purpose Detector
MRAM	Magnetic Random-Access Memory
n	nano, 1×10^{-9}
nC	Nano Coulomb (Measure of Electrical Charge)
NFPA	National Fire Protection Administration
NICA	Nuclotron-based Ion Collider fAcility
ODH	Oxygen Deficiency Hazard
OPI	Operator Interface
ОИЯИ	Объединенный институт ядерных исследований
ph/s	photons per second
PID	Proportional Integral Derivative
PLC	Programmable Logic Controller
PLS	Power Line Switch
PM	Permanent Magnet
PMS	Position Monitoring System
PPM	Pure Permanent Magnet
PPMS	Physical Properties Measurement System
PPS	Personnel Protection Service
PRF	Pulse Repetition Frequency
ps	picosecond
Psf	pounds per sq ft
Rad	Radian
RF	Radio Frequency
RFI	Radio Frequency Interference
RGA	Residual Gas Analyzer
RS-232	Recommended Standard 232 (serial interface)
RS-485	Recommended Standard 485 (serial interface)
RTOS	Real-Time Operating System
SAS	Sound Alert System
SCADA	Supervisory Control And Data Acquisition
SCS	Slow Control System
SNR	Signal-to-Noise Ratio
SPring-8	Japanese National Synchrotron
STS	Suggested Technical Solution
TC	ThermoCouples
THz	TerraHertz
UBPM	User Beam Position Monitors
UHR	Ultra-High Resolution
UHV	Ultra-High Vacuum
UPS	Uninterruptible Power Supply
USB	Universal Serial Bus
UV	UltraViolet
VLS	Variable Line Spacing
VMEbus	Versa Module Europa bus
VUV	Vacuum UltraViolet
WUT	Warsaw University of Technology

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7 INTRODUCTION

At **JINR J**oint **I**nstitute for **N**uclear **R**esearch in Dubna, a project called **NICA N**uclotron-based **I**on **C**ollider f**A**cility, (NICA is the JINR flagship project for the next decade), is being implemented to create an ionic collider based on the Nuclotron as part of a program to study nuclear matter in a hot and dense state. The main objectives of the program: the creation of an accelerator complex of ions with high luminosity in the energy range up to 11 GeV/nucleon and a modern multi-functional detector for the study of heavy ion collisions.

The collider has two meeting points for the beams, which makes it possible to install two detectors and simultaneously carry out two experiments.

One of the detectors, the **MPD M**ulti-**P**urpose **D**etector, is planned to study the properties of hot and dense nuclear matter formed during collisions of high-energy heavy ions, in particular, to search for effects associated with deconfiguration and/or restoration of chiral symmetry, to study the properties of phase transitions and mixed hadron and quark-gluon phases.

The planned accelerator-accumulative complex will open up new great opportunities for carrying out applied programs at JINR in the fields of radiation technology, biology and medicine.

As a first step, it was decided to modernize the current accelerator of Nuclotron ions. The implementation of these ambitious tasks is associated with plans to build an NICA accelerator-storage complex for ion collisions in a wide range of atomic masses and collision energies (up to $\sqrt{S_{NN}}$ = 11 GeV) based on the Nuclotron. The accelerator will have a very high luminosity, $L=10^{27} cm^{-2}s^{-1}$. For proton beams, the luminosity should be at the level $L = 10^{31}\ cm^{-2}s^{-1}$, and the collision energy is E_{lab} = 12,6 GeV.

In addition to basic research on the beams of the NICA complex, applied work can also be carried out. In particular, JINR has extensive experience in carrying out biomedical research in the field of hadron radiation therapy.

The NICA complex includes various types of accelerators: a linear accelerator, an intermediate energy storage accelerator (booster), the Nuclotron and a collider. These accelerators provide beams in the energy range E_{lab} = 1 – 4,5 AGeV and are required in many applied research programs. The planned accelerator-accumulative complex will open up new great opportunities for carrying out applied programs, radiation technologies, biology and medicine at JINR.

An important goal of the NICA project is to provide users with a research machine that will allow them to acquire new scientific knowledge, research and understand the physical properties of a substance at an early stage of its occurrence.

This extraordinary research tools.

7.1 Scope

The multi-functional detector MPD is an advanced technical device with many parameters and features that require constant monitoring and control in on-line mode.

Therefore, the MPD construction requires designing and execution of dedicated technical installations using advanced technologies that will meet the task.

In Figure 7-1, the main MPD technical module with the basic infrastructure is shown.

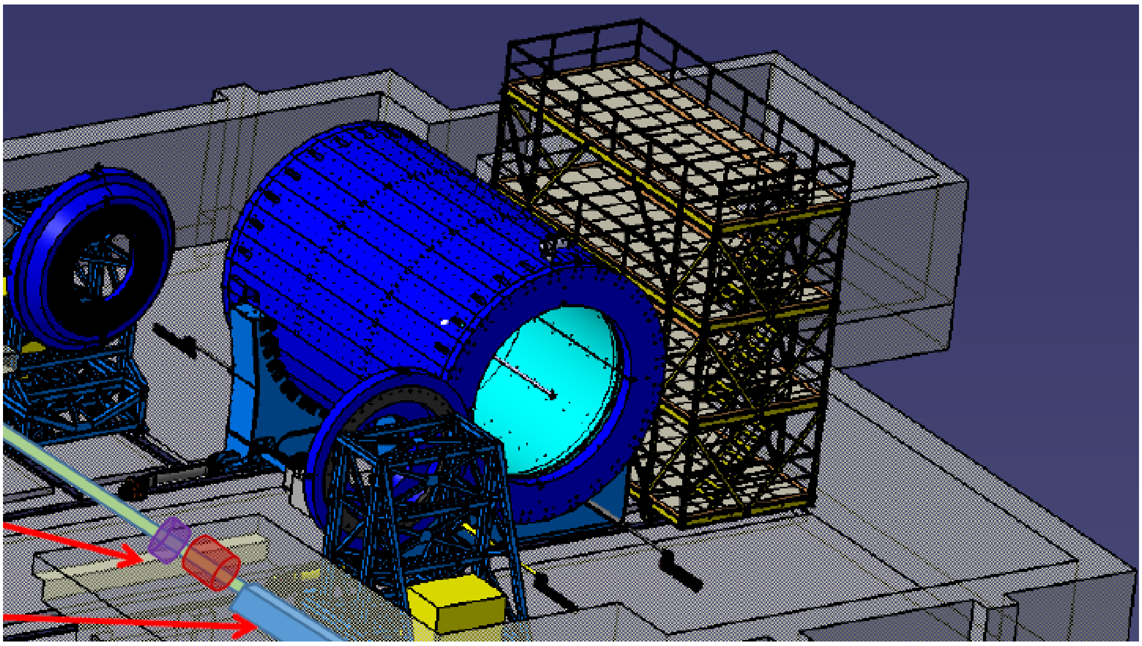


Figure 7—1; PLATFORM MPD-NICA and MPD, Mechanical Design.

Service requirements for MPD, made it an integrated structure placed on the wagon, allowing the entire module to be moved within 11 meters for service purposes. Many transmission paths, a high data rate required, limits the installation space. Therefore, the MPD control room will be placed on a special mechanical structure in four floors. This mechanical block is referred to as the Mechanical Platform. In this design, we will install the MPD infrastructure at 32 RACKs.

In the further part of this document: Technical Design Report **NICA-MPD-PLATFORM**, we will describe the designed solutions and the way of their implementation.

NICA-MPD-PLATFORM is designed as a mobile device integrated with MPD. The expected weight of the wagon is about 150 t.

The MPD-NICA platform has 4 floors. The lowest, LEVEL 1, is intended for power equipment, supplying MPD and the Platform itself.

The next three LEVELs (2, 3, 4) are for the SSC Slow Control System and DCS Detector Control System, for the MPD-NICA project.

The scope of the NICA-MPD-PLATFORM project described in the TDR covers the design, production, installation and commissioning of the required infrastructure and MPD-NICA PLATFORM.

A separate Technical Project will be created, in which there will be technical diagrams, solutions, routes of cable routes, structural elements, quality requirements of electric cables, FOC Fiber Optic Cables, GSS Gas Supply Systems and all.

7.2 Basic assumptions

NICA-MPD-PLATFORM is a displaceable structure coupled with MPD.

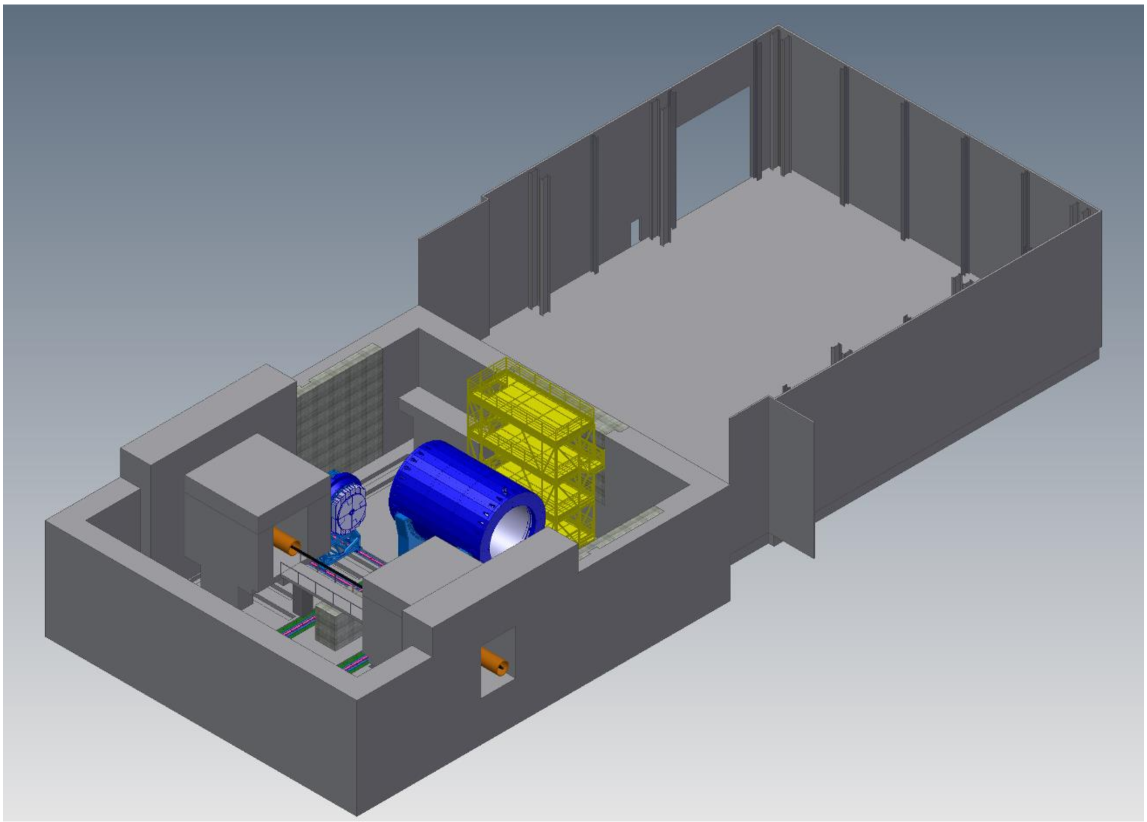


Figure 7—2; PLATFORM MPD-NICA, MPD ROOM

Main features of the structure:

a) Safe Operation
b) Standard 19 "Apparatus
c) Open Mechanical and Electronic Structure
d) Structure Management via WinCC SIEMENS SCADA
e) Operation Data Registration: EqDb Equipment Database ORACLE
f) Cable Routes for Optical and Communication IT Cables,
   Control and Power Supply and other MPD Media
g) Cable Available Interfaces: Ethernet, RS-485, RS-232, USB ...
h) Service Infrastructure (Wi-Fi service only, IT, lighting, CCTV)
i) PLSD Power Line Switch Distributor, two lines 3 x 380 V, 50 Hz, 400 A
j) IPD Intelligent Power Distributor,
k) VAC Ventilating and Air Conditioning,
l) CRWS Cable Race Way System,
m) CCAS Cable Connection Authorization System (InteliPhy),
n) NICA-MPD-PLATFORM Assembly Capacity:
   FS36U Free Space 36U / per RACK, 4 x 8 x 32 RACK's, (32 x 36 U = 1 152 U)
o) Dimensions: (12 000 x 3 700 x 8 6403) mm, number of levels 4,
p) FAS Fire Alarm System,
q) ACS Access Control System,
r) CCTV Closed Circuit TeleVision,
s) SAS Sound Alert System,

t) SES Smoke Extraction System,
u) ES Engineering Support,

7.3 Basic concept.

The project defines the main components of the PALTFORM mechanical structure:

a) RACK
b) AUXILIARY RACK – (COOLING UNIT)
c) UNIT
d) CONTAINER
e) PLATFORM

The project defines the main components of the PLATFORM logical structure:

a) CLUSTER

The project defines the main components of the PLATFORM infrastructure:

a) Structure Management via WinCC SIEMENS SCADA
b) Operation Data Registration: EqDb Equipment Database ORACLE
c) Cable Routes for Optical and Communication IT Cables,
d) Control and Power Supply and other MPD Media
e) Available Interfaces: Ethernet, RS-485, RS-232, USB ...
f) PLSD Power Line Switch Distributor, two lines 3 x 380 V, 50 Hz, 400 A
g) IPD Intelligent Power Distributor,
h) VAC Ventilating and Air Conditioning,
i) CRWS Cable Race Way System,
j) CCAS Cable Connection Authorization System (InteliPhy),
k) NICA-MPD-PLATFORM Assembly Capacity:
l) FS36U Free Space 36U / per RACK, 4 x 8 x 32 RACK's, (32 x 36 U = 1 152 U) Dimensions: (12 000 x 3 700 x 8 6403) mm, number of levels 4,
m) FAS Fire Alarm System,
n) ACS Access Control System,
o) CCTV Closed Circuit TeleVision,
p) SAS Sound Alert System,
q) SES Smoke Extraction System,

Unified elements of the MPD-NICA PLATFORM infrastructure are an important feature of the Project. They are also important to ensure a high level of personnel safety during the work of MPD.

Cables, pipes and other components of the system must be manufactured in accordance with the design requirements. This is a basic condition for achieving the expected high parameters of the MPD-NICA PLATFORM and the entire system.

The implementation of the designed system will take place in advanced laboratories in Poland in conditions of high technological purity. Subsequent tests under conditions of high electrical load and a large amount of data transfer will be performed already at JINR.

The most important NICA-MPD-PLATFORM modules: switch power lines 400 kW PLSD, SCS Slow Control System and DCS Detector Control System.

The PLATFORMS MPD-NICA modules will be prepared for road transport to the place of installation in V & BLHEP Veksler & Baldin Laboratory High Energy Physics JINR in Dubna, then installed on the mechanical PLATFORM structure in MPD ROOM.

The proposed system architecture has a clear division into mechanical, electrical and logical parts. This is the basic concept of the designed system.

8 Project NICA-MPD-PLATFORM

8.1 Architecture

Figure 8-1 shows a Block Diagram of the NICA-MPD-PLATFORM. The smallest - the main ingredient - RACK.

- **RACK**: the basic object of the NICA-MPD-PLATFORM
- **AUXILIARY RACK - COOLING UNIT:** five units per CONTAINER
- **UNIT**: four RACK's
- **CONTAINERS**: two UNIT's, eight RACKs
- **PLATFORM**: four LEVEL's, eight UNIT's, thirty-two RACK's
- **CLUSTER**: logical virtual groups RACK

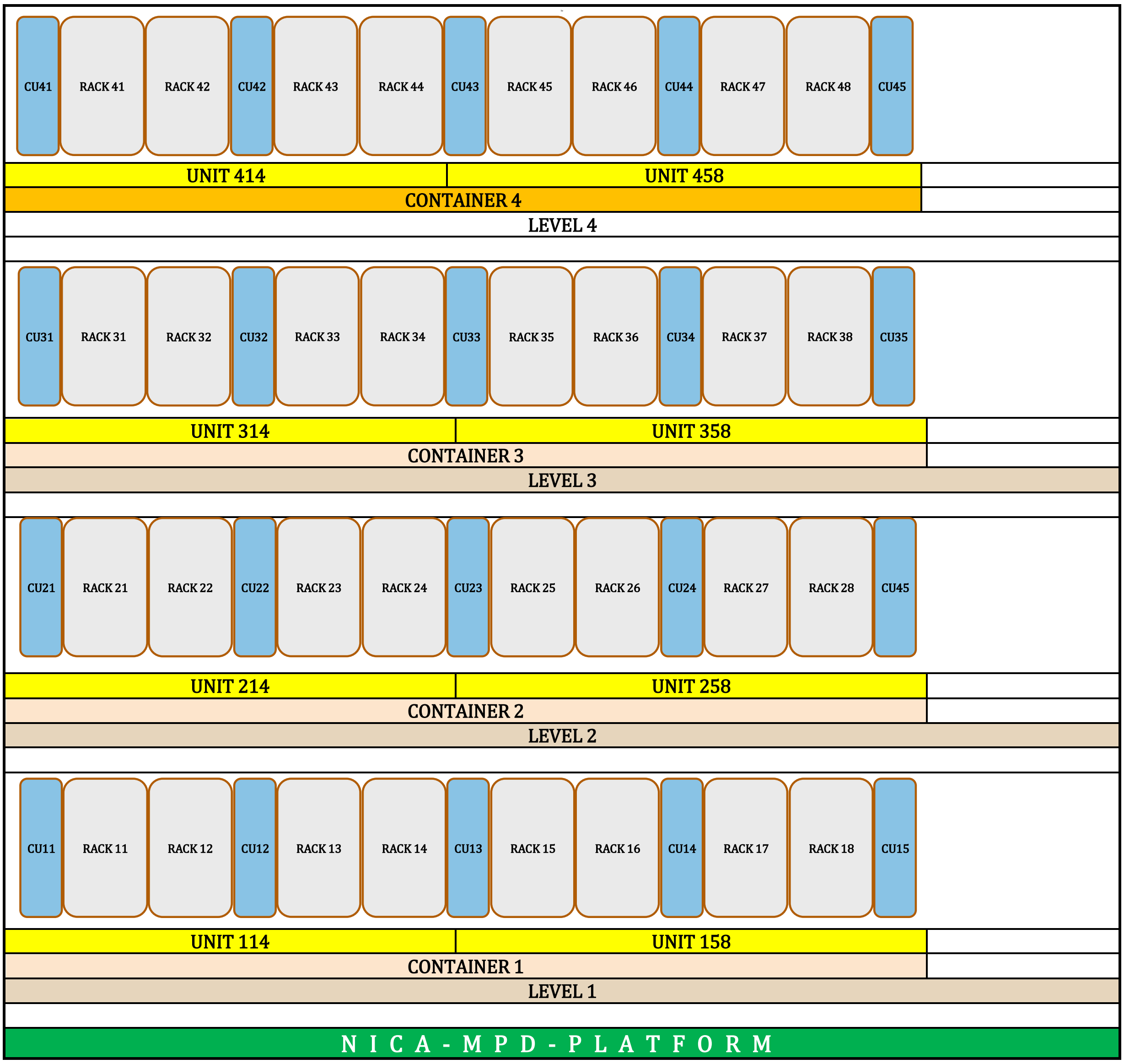


Figure 8—1; PLATFORM MPD-NICA Architecture

8.2 Structure

The “PLATFORM” consists of two parts: Mechanical Support Structure for RACK's, which is the construction structure shown in the Figure 8-2, and NICA-MPD-PLATFORM Project, which is the infrastructure for the Slow Control System, Detector Control System and EqDb Equipment Database for Multi-Purpose Detector in the NICA Project.

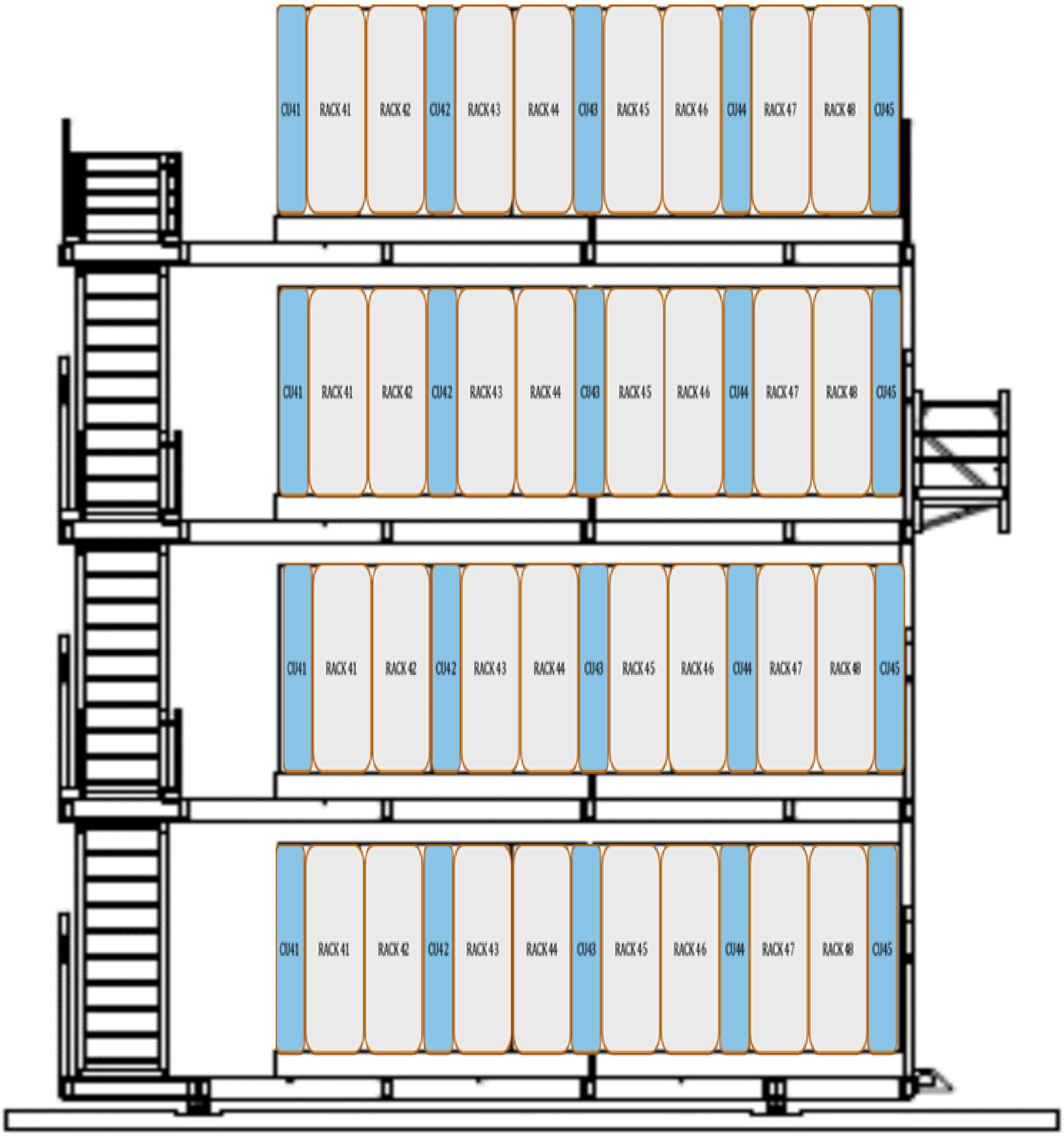


Figure 8—2; PLATFORM MPD-NICA Mechanical Support Structure with RACK’s.

Creating the layout and interconnections of real components that make up the expected whole, the following structural components of the NICA-MPD-PLATFORM Project are proposed:

a) Mechanical Structure
b) Hierarchical Structure
c) Logical Structure
d) Management Structure

8.2.1 NICA-MPD-PLATFORM Mechanical Structure

…is the basic object of the NICA-MPD-PLATFORM

- **RACK**: is the Main Module of the Mechanical Structure,
- **AUXILIARY RACK - COOLING UNIT:** five units per CONTAINER
- **UNIT**: four RACKs
- **CONTAINERS**: two UNITs, eight RACKs
- **PLATFORM**: four LEVELs, eight UNITs, thirty-two RACKs, a set of CONTAINERS, in a specific location.

8.2.1.1 RACK

… is the basic mechanical construction of the PLATFORM NICA-MPD Project.

A 600x1200x2200 RACK was selected with a usable height of 47U (1U = 1,75 inches). RACK is supported by a 300x1200x47U construction in auxiliary systems, COOLING UNIT such as **VAC**, **V**entilating and **A**ir **C**onditioning, as well as other required ones.

Therefore, the real dimensions of a single RACK are 900x1200x47U. Some supporting modules can support two RACKs. In such cases, the dimensions should be estimated individually.

Each RACK has its own required infrastructure.

Electronic equipment of sub-detectors In RACK, we install mechanical standards in cassettes of specific standards:

RACK may contain energy, electronic and other devices. They use their own infrastructure to support their work.

- **FRAME**
- **CHASSIS**
- **CASSETTE (PXI, c-RIO, VME, CAMAC itd.)**
- **GAS INSTALATION FRAME**

8.2.1.2 AUXILIARY RACK - COOLING UNIT

…five units per CONTAINER

AUXILIARY RACK - COOLING UNIT: such as VAC, Ventilating and Air Conditioning, as well as other required ones

8.2.1.3 UNIT

… four RACKs and two or three AUXILIARY RACK - COOLING UNIT.

The NICA-MPD-PLATFORM implementation technology forced the maximum assembly module for RACK as UNIT consisting of four full RACKs. Such a previously completely assembled module will be installed on the mechanical platform structure in MPD ROOM in a given order and at a given level.

UNIT is a mechanical structure consisting of four completely standard RACKs and necessary AUXILIARY RACK - COOLING UNIT: such as VAC, Ventilating and Air Conditioning, as well as other required ones.

8.2.1.4 CONTAINER

… are eight RACKs (two UNITs).

The mechanical construction of NICA-MPD-PLATFORM is forced by many factors. One of them (available space in MPD ROOM) forces its dimensions, especially the height allowing installation of equipment up to a height of 12 meters. Hence the division of the PLATFORM into four Floors with specific dimensions. Each Floor can accommodate 8 RACKs. On each Floor, we assemble up to eight RACKs. We define such a structural module as CONTAINER. Therefore, CONTAINER is two UNITs. Each LEVEL (the platform is built by two UNITs or CONTAINER).

The CONTAINER is two UNITs or eight RACKs and five AUXILIARY RACK - COOLING UNIT.

8.2.1.5 PLATFORM

... is four CONTAINER (LEVEL), eight UNITs, thirty-two RACKs and twenty AUXILIARY RACK - COOLING UNIT.

8.2.1.5.1 Mechanical Structure NICA-MPD-PLATFORM.

The platform is a mechanical construction designed for building electronic devices supporting MPD.

In the Project, we define PLATFORM as a mechanical structure on which dedicated 19-inch RACKS intended for mounting MPD control equipment will be mounted. This part of the project describing the building and mechanical and electronic construction for SCS and DCS: MPD, in the Project is called NICA-MPD-PLATFORM. We assume that most of the installed equipment is made in the 19-inch RACK standard, which will allow the use of typical 19-inch RACKs.

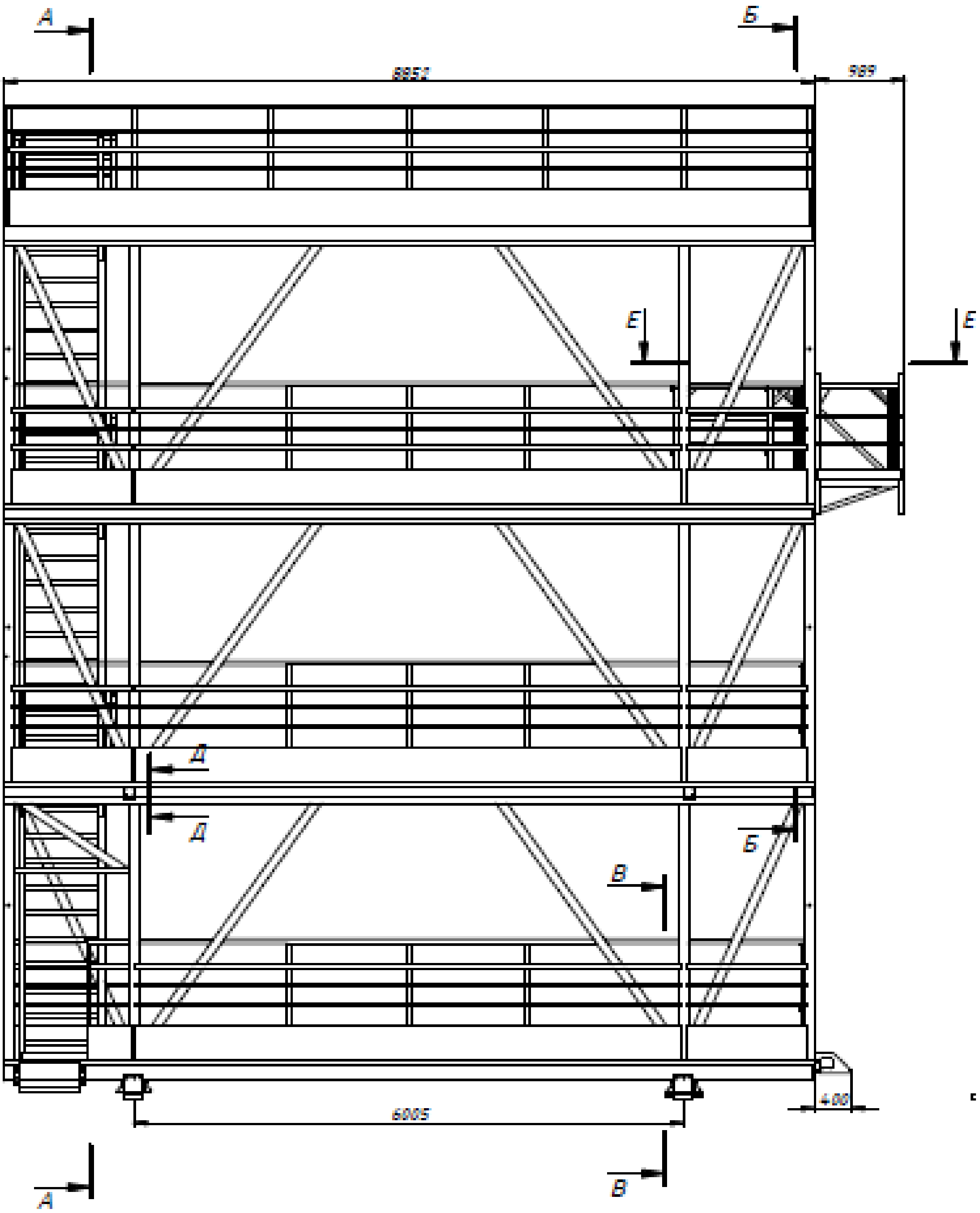


Figure 8—3; PLATFORM Mechanical construction.

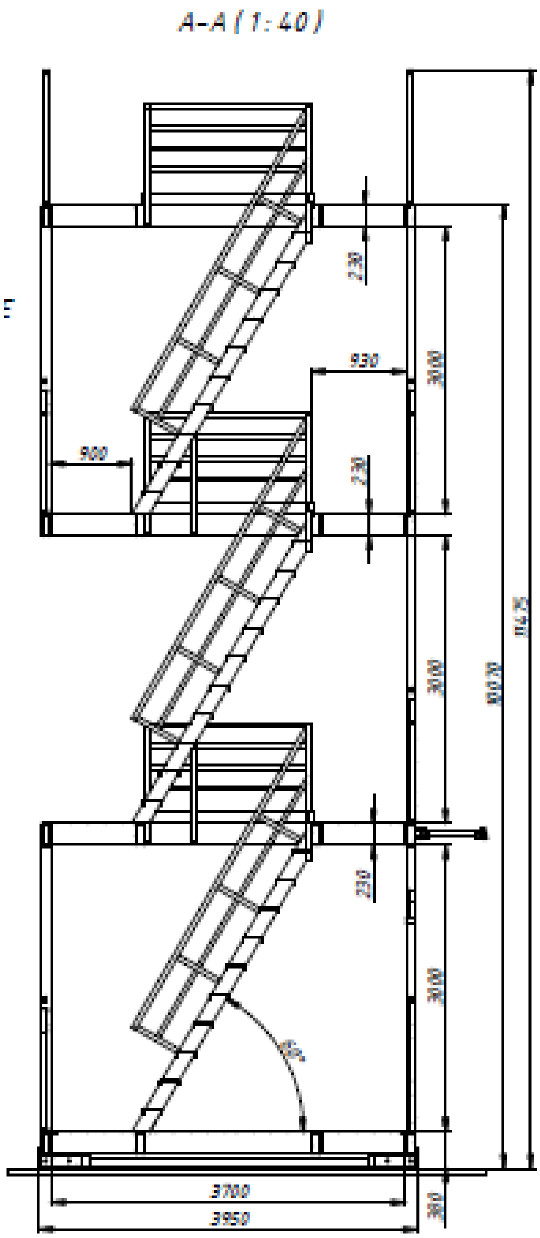


Figure 8—4; PLATFORM Mechanical Construction.
A-A segment.

The platform will be equipped with its own infrastructure, which will be described later in the Project NICA-MPD-PLATFORM.

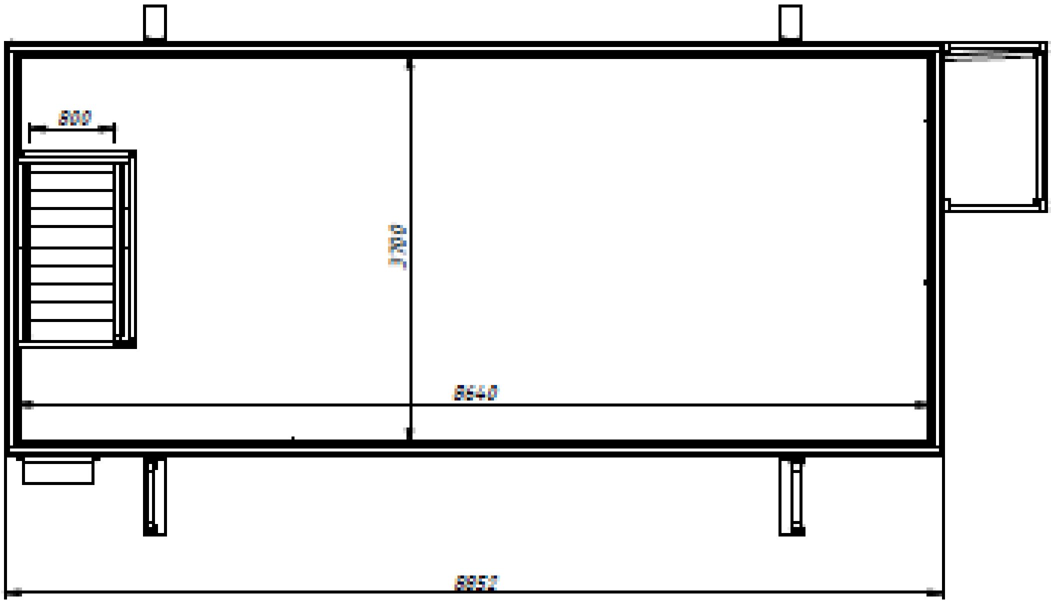


Figure 8—5; PLATFORM Mechanical construction, LEVEL Top of View

8.2.2 PALTFORM MPD-NICA Hierarchical Structure

The mechanical structure of the NICA-MPD-PLATFORM project presented above requires an appropriate Hierarchical Structure and Software. The expected functionality is achieved by highlighting the set RACK as MASTER RACK or SLAVE RACK and SCADA software.

Creating the layout and mutual hierarchical relations of the components that form the expected functional whole, we propose the following hierarchical structure of the MPD-NICA PLATFORM project:

a) MASTER RACK
b) SLAVE RACK

MASTER RACK manages a group consisting of SLAVE RACK.

8.2.3 PALTFORM MPD-NICA Logical Structure

Further devices mounted in the NICA-MPD-PLATFORM area can be dispersed and not ordered. Therefore, a system for marking and grouping devices was introduced.

We call this virtual group CLUSTER.

CLUSTER creates RACKs, devices or other mechanical structures of the Project that we want to group together.

8.2.4 PALTFORM MPD-NICA Management Structure

Management Structure NICA-MPD-PLATFORM will be carried out in the SIEMENS SCADA WinCC environment.

9 RACK Technical Description

RACK is a steel structure designed to assemble elements of a system for any purpose.

9.1 RACK Mechanical Construction

Figure 9—1; RACK 600x1200x47U.

Figure 9—2; RACK for PLATFORM MPD-NICA - Example

9.2 RACK Manufacturer's Options

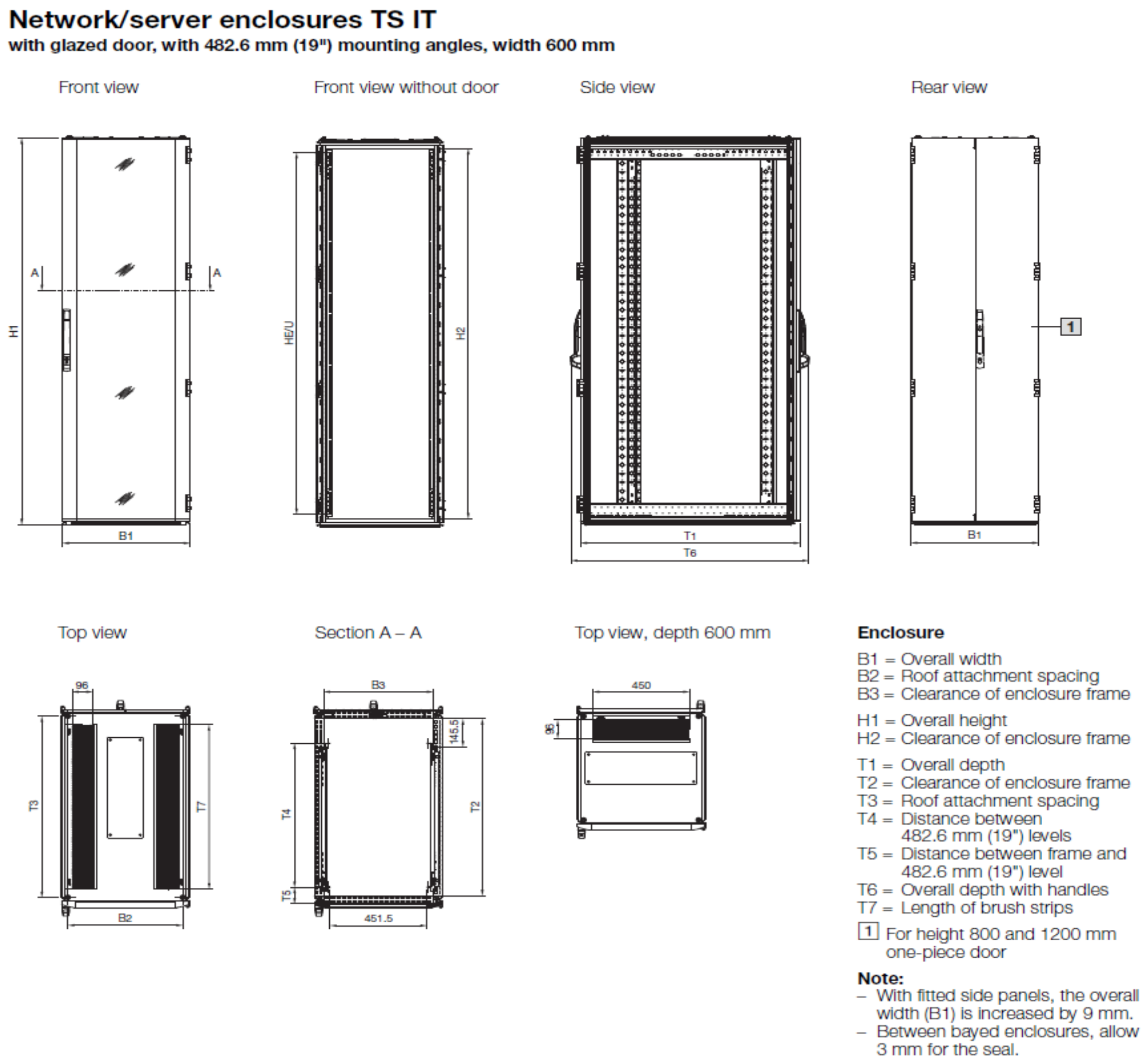


Figure 9—3; RACK Platform NICA - MPD, Dimensions and construction

9.3 RACK Design and Dimensions

Model No. DK	U	Width dimensions mm			Height dimensions mm		Depth dimensions mm						
		B1	B2	B3	H1	H2	T1	T2	T3	T4	T5	T6	T7
5508.120	42	597	535	512	1998.5	1912	1024	912	935	745	84	1111	850
5510.120	42	597	535	512	1998.5	1912	1224	1112	1135	745	144	1311	1050
5513.120	47	597	535	512	2198.5	2112	1024	912	935	745	84	1111	850
5515.120	47	597	535	512	2198.5	2112	1224	1112	1135	745	144	1311	1050
5525.120	15	597	535	512	798.5	712	624	512	535	345	84	711	–
5526.120	24	597	535	512	1198.5	1112	624	512	535	345	84	711	–
5527.120	38	597	535	512	1798.5	1712	624	512	535	345	84	711	–
5528.120	38	597	535	512	1798.5	1712	824	712	735	545	84	911	650
5529.120	42	597	535	512	1998.5	1912	624	512	535	345	84	711	–
5530.120	42	597	535	512	1998.5	1912	824	712	735	545	84	911	650
5531.120	47	597	535	512	2198.5	2112	824	712	735	545	84	911	650

Figure 9—4; RACK Table of dimensions.

The selected version of the RACK 19" 47U is shown in Figure 9-3. In the next part of the Project, we will call such an object RACK.

The mechanical design of the RACK is collapsible and open. When ordering RACK from the manufacturer, we can request various versions of the RACK. You can determine the dimensions, types of doors, internal and external equipment, the method of connecting the RACK to larger blocks, the colour of the RACK, etc.

The RACK is made of steel. It has two doors for opening (Front and Rear), easily removed from the hinges. The door is equipped with an electric and mechanical lock that can be opened by an application from a smartphone or a mechanical key.

The RACK allows to install devices up to 47U in size. The total mass of the structure with embedded devices should not exceed 1 500 kg. All movable elements of the RACK, (opening doors) are connected by protective conductor PE Protective Earth or Protective Conductor, to the mechanical structure of the RACK and grounded by additional flexible PE conductor. In Figure 9-3 and Figure 9-4, the available options offered by the manufacturer are shown. An algorithm is also provided for creating the requested RACK co-collection.

Figure 9—5; RACK the Main Module of the Mechanical Structure,
AUXILIARY RACK - COOLING UNIT

9.4 RACK Front View

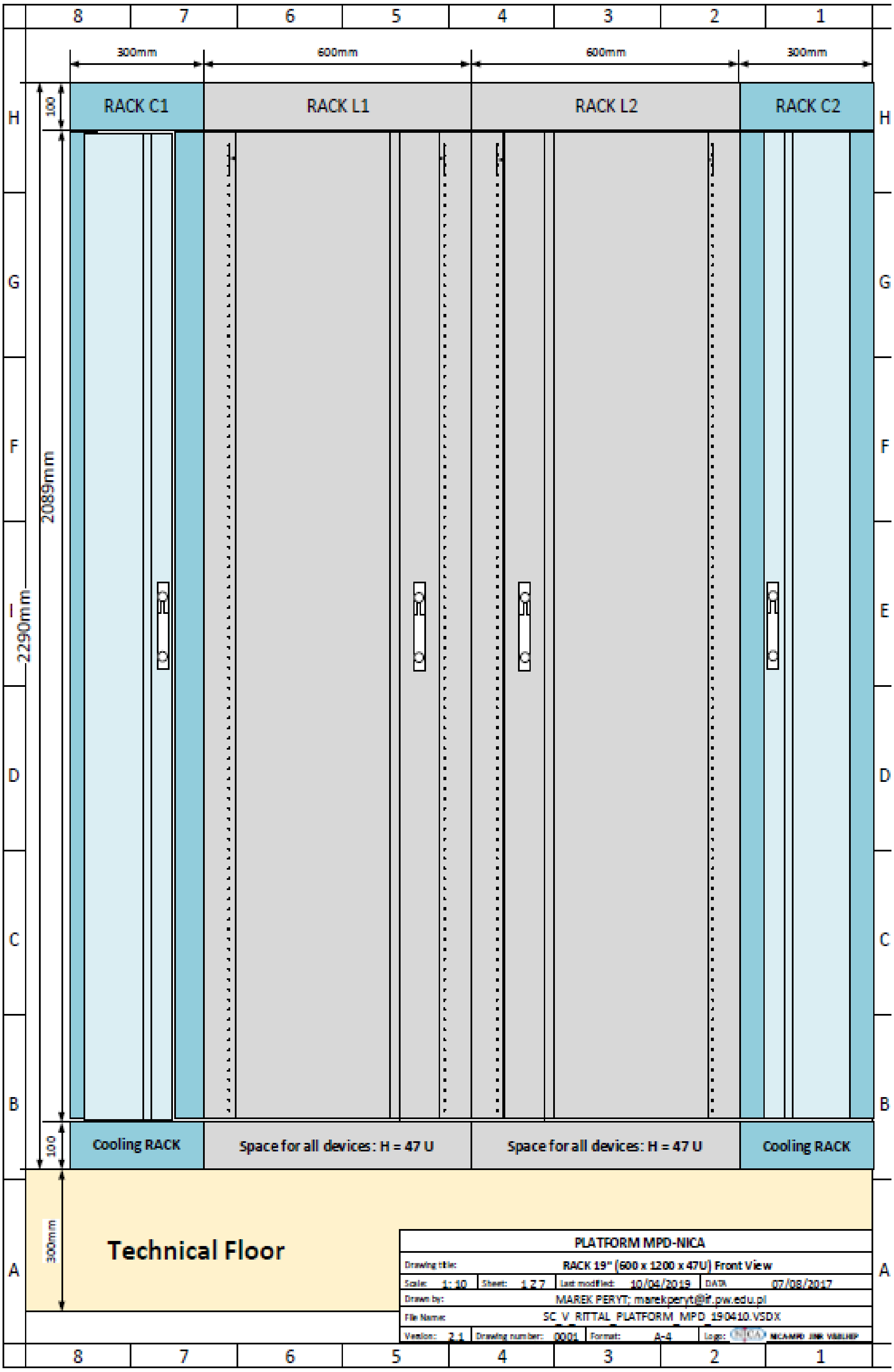


Figure 9—6; RACK - Front View, (300+600+600+300) x 1200 x 2200 (47 U).

9.5 RACK Technical Features

The main physical characteristics of the RACK are:

a) Steel construction, painted
b) Dimensions (600x1200 x 2200) mm 47U
c) Distance between mounting rails 19 "
d) Construction height 47U (1U = 1,75 inches)
e) Cascade design, possibility of grouping
f) Glazed or perforated doors, removable
g) Removable or lowered sidewalls
h) Electronic front door lock with ACS
i) Cable routes
j) Local liquid and air-cooling system, global cooling system
k) Standard equipment - described below in the Project

9.6 RACK Standard Equipment

List of standard equipment RACKS:

a) **FAS F**ire **A**larm **S**ystem,
b) **PMS NICA-MPD-PLATFORM M**anagement **S**ystem
c) **IPD I**ntelligent **P**ower **D**istributor,
d) **VAC V**entilating and **A**ir **C**onditioning,
e) **CCAS C**able **C**onnection **A**uthorization **S**ystem,
f) **ACS A**ccess **C**ontrol **S**ystem,
g) **SES S**moke **E**xtraction **S**ystem,
h) **FSM Free Space M**inimum 36U,
i) **ES E**ngineering **S**upport.

9.7 RACK Options Equipments

a) **CCTV C**losed **C**ircuit **T**ele**V**ision,
b) **SAS S**ound **A**lert **S**ystem,

9.8 RACK Standard Equipment – Visualization

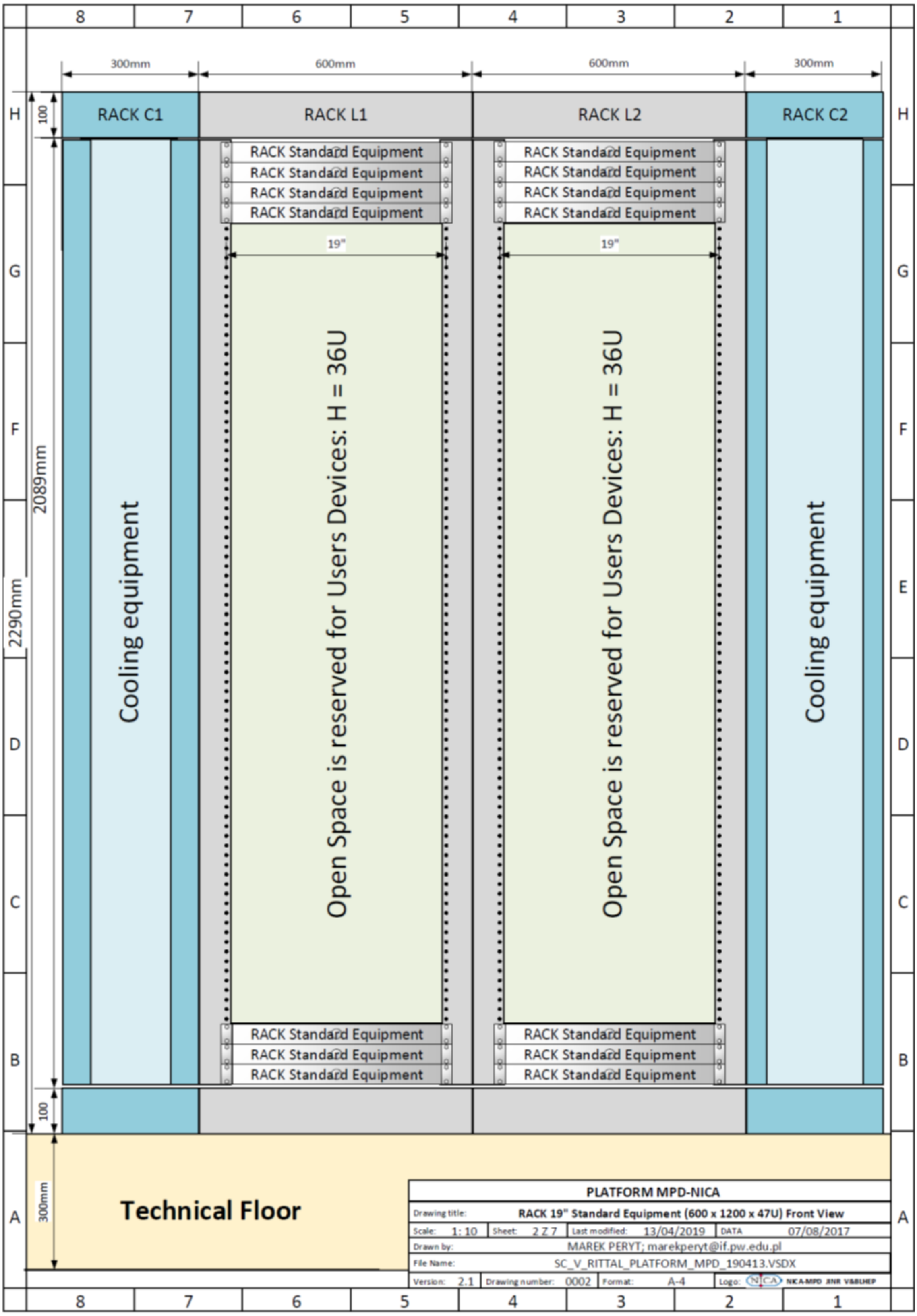


Figure 9—7; RACK Front View, (300+600+600+300) x 1200 x 2200 (47 U).
Standard Equipment - Visualization.

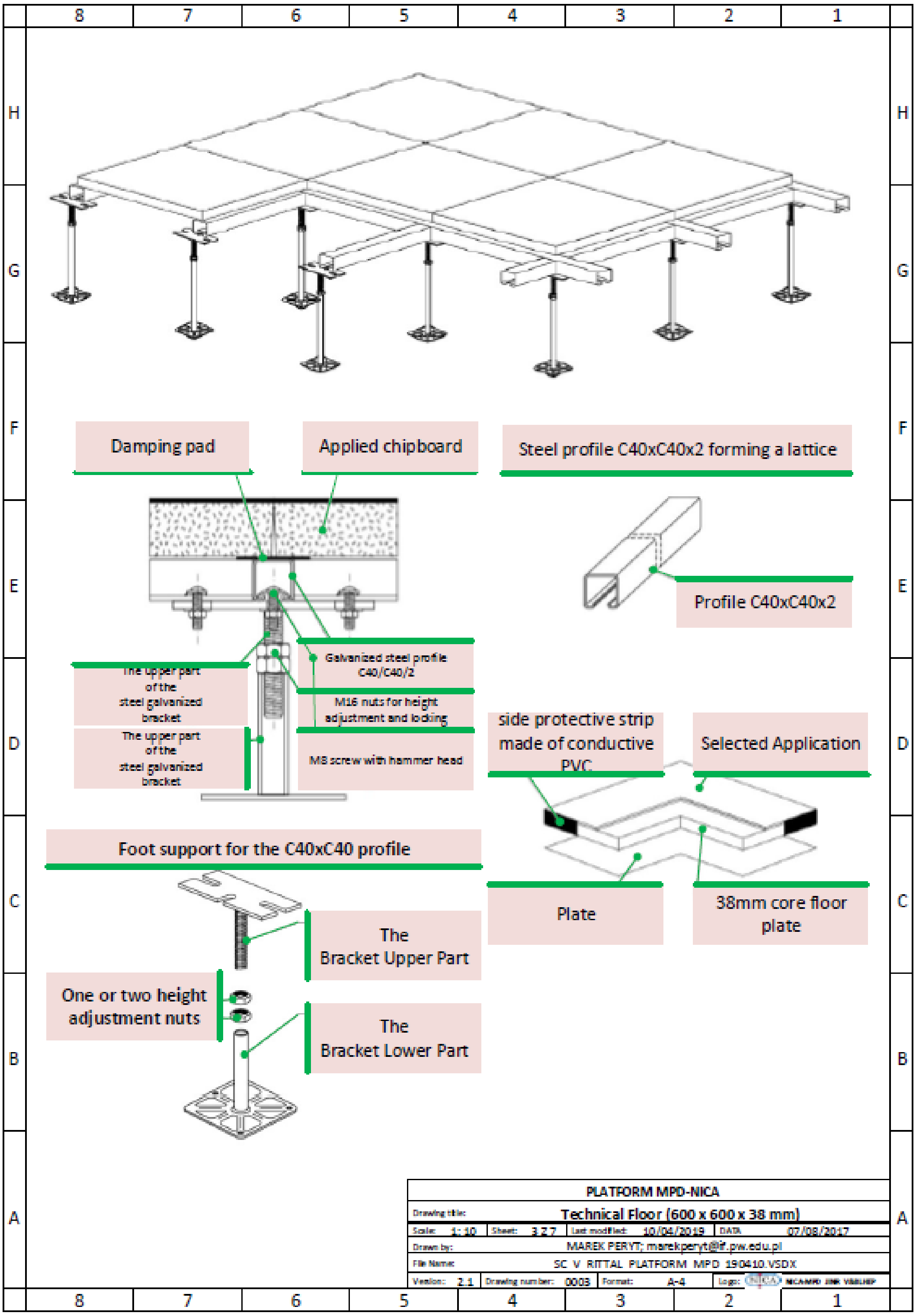


Figure 9—8; PLARTORF MPD-NICA, Technical Floor.

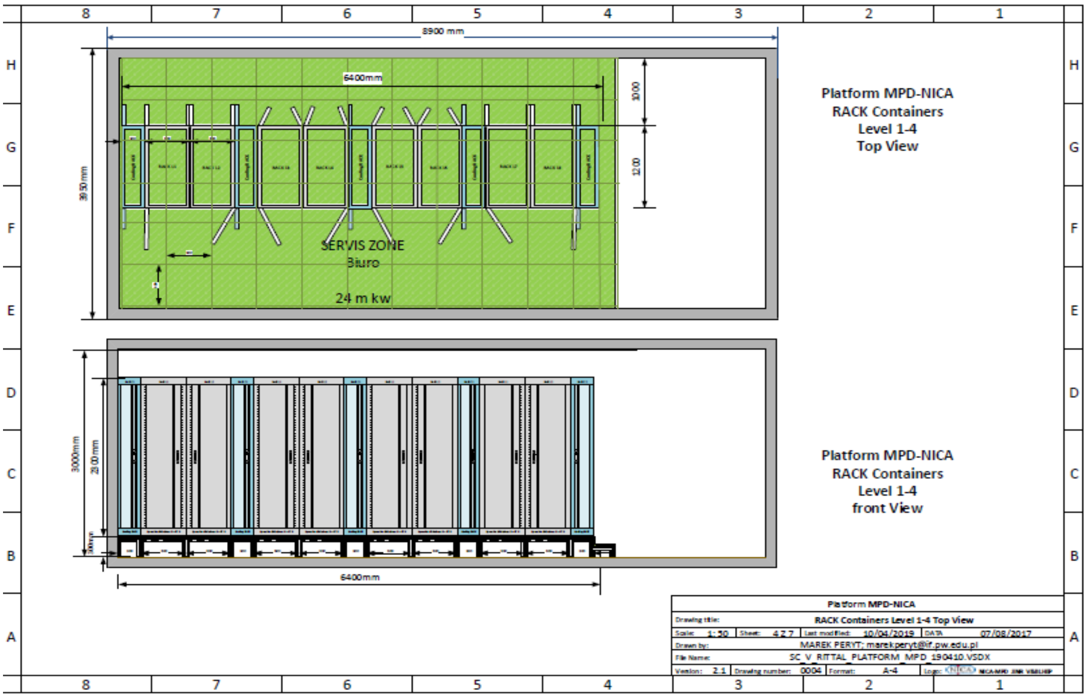


Figure 9—9; CONTAINERS LEVEL's 2-4, Top View and Front.

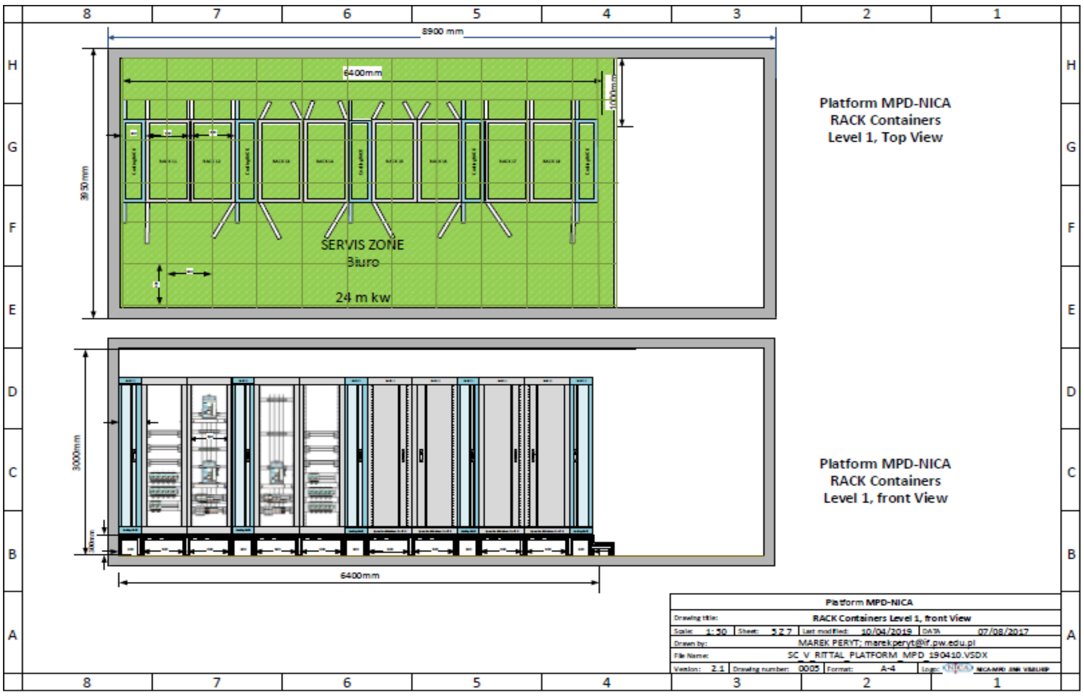


Figure 9—10; CONTAINERS LEVEL's 1, Top and Front View.

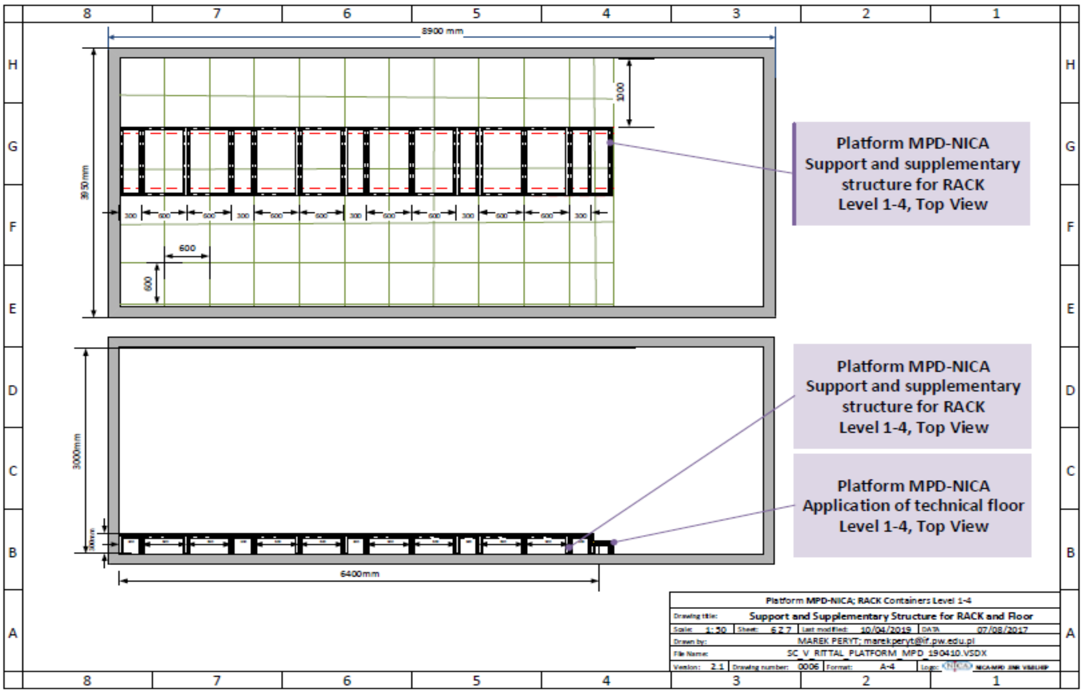


Figure 9—11; Support and Supplementary Structure for LEVEL's 1-4.

Figure 9—12; PLATFORM MPD-NICA, All RACK's

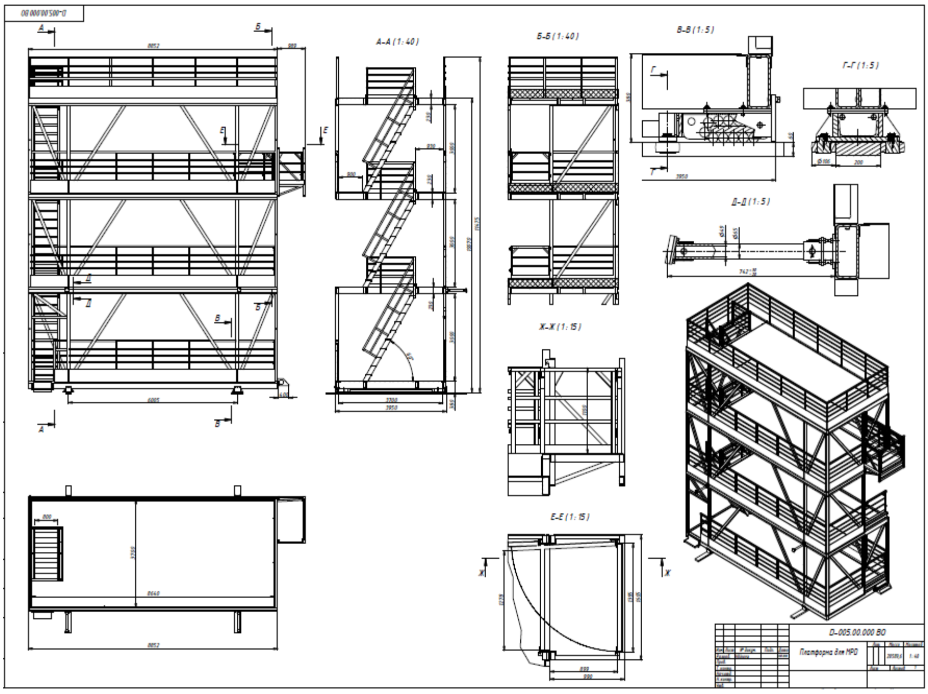


Figure 9—13; PLATFORM, Parts and Components (1)

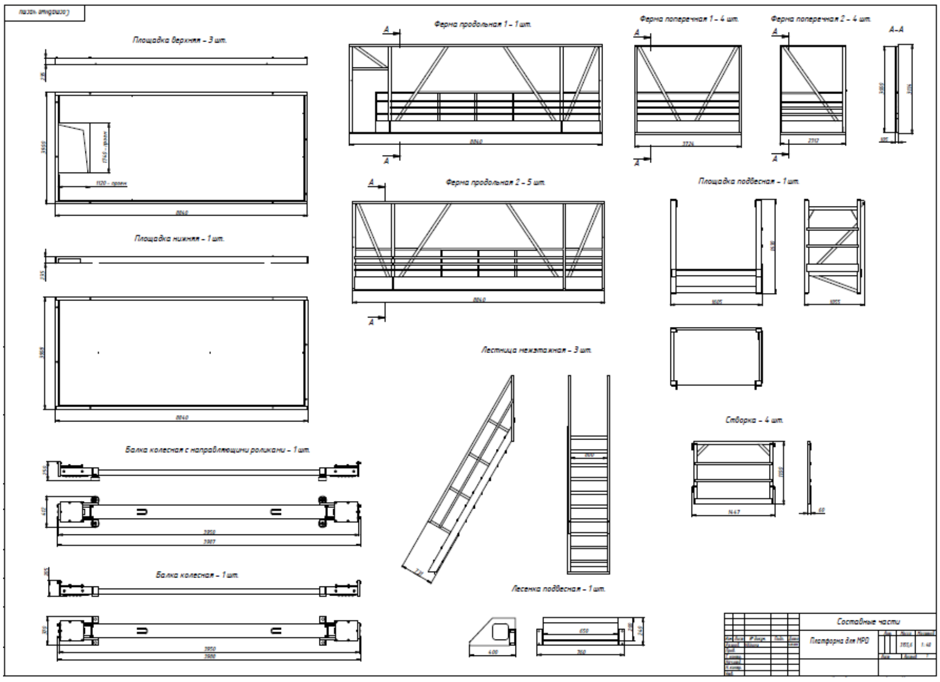


Figure 9—14; PLATFORM, Parts and Components (2)

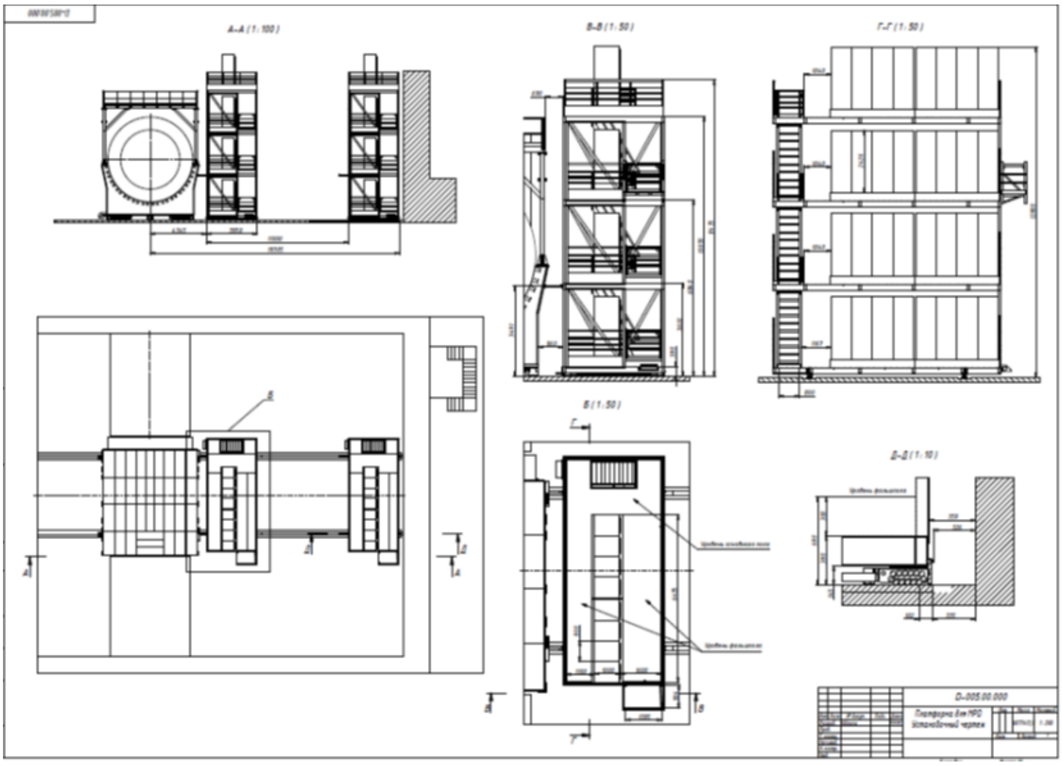


Figure 9—15; PLATFORM MPD-NICA and MPD, mutual position and assembly.

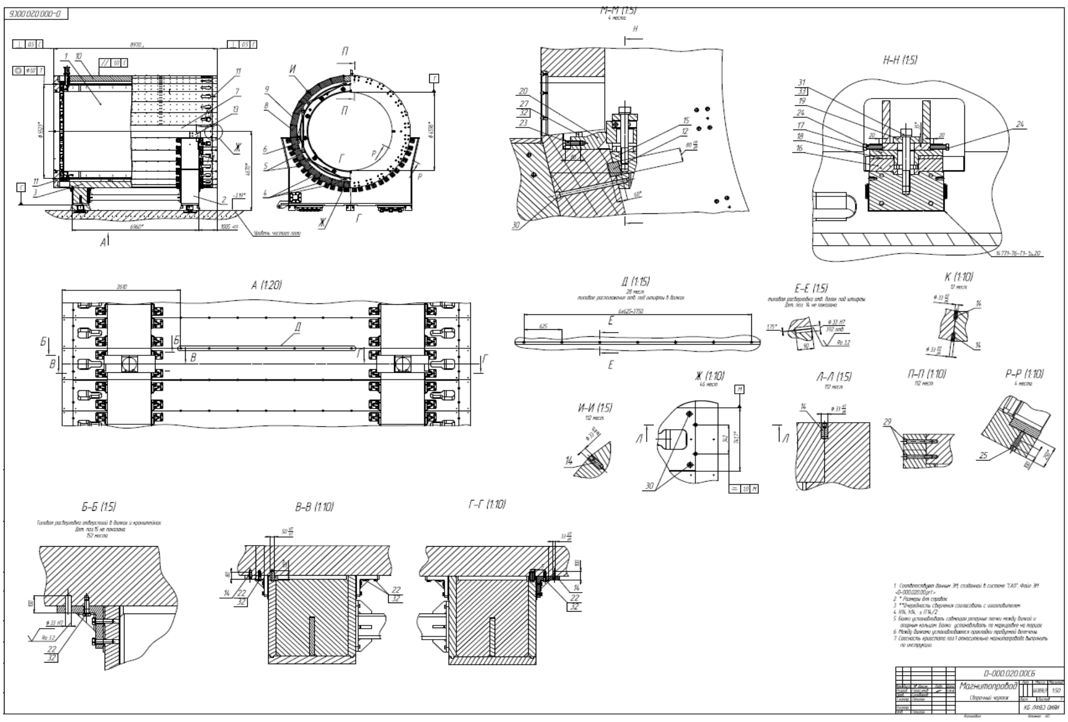


Figure 9—16; Magnet: Details of Workmanship.

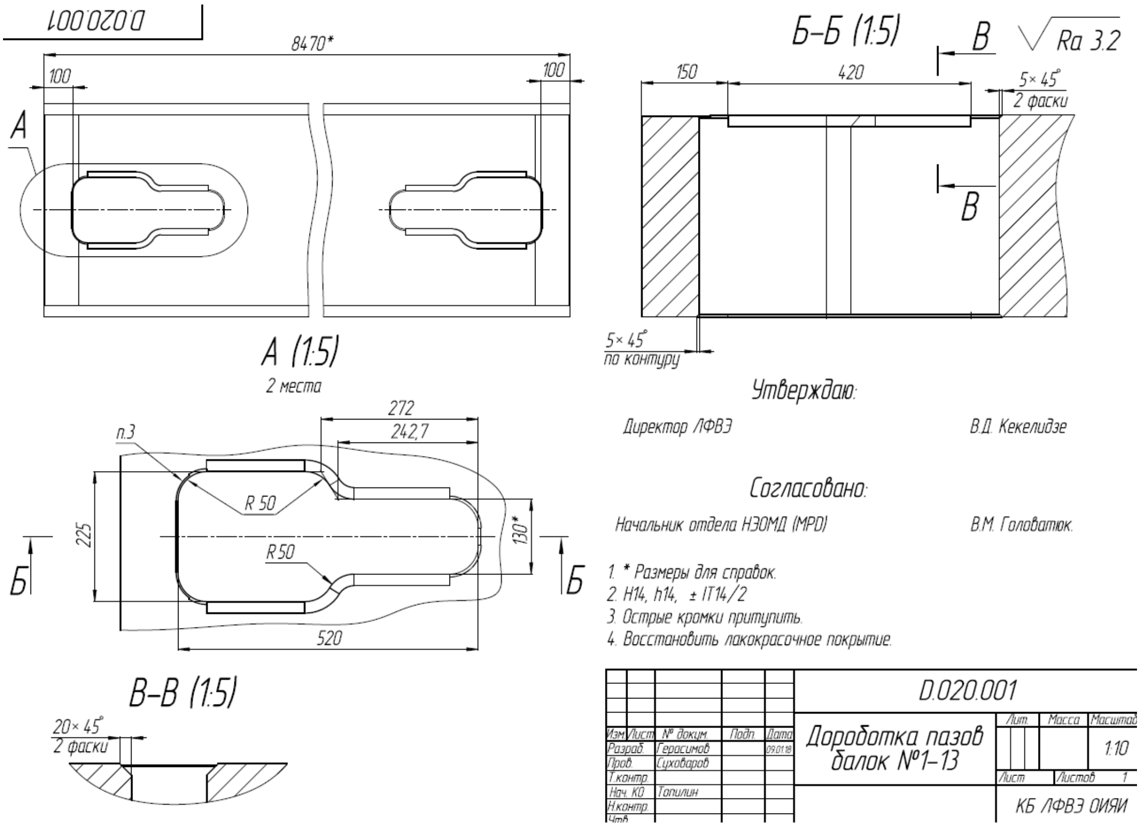


Figure 9—17; Cable Glands in a MAGNET.

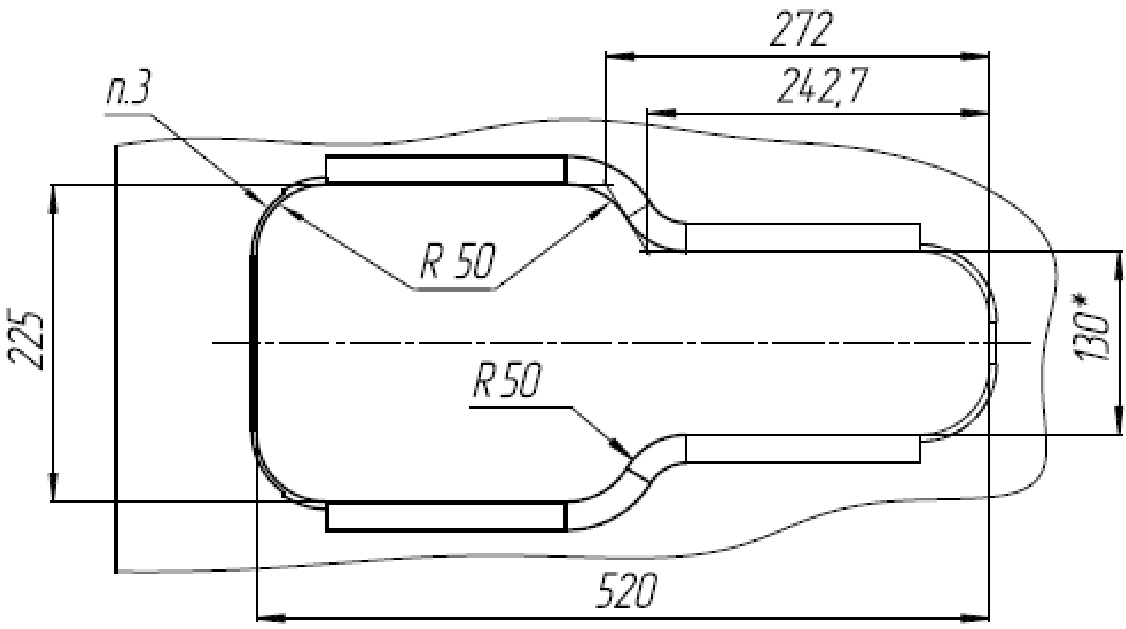


Figure 9—18; Cable Gland, details.

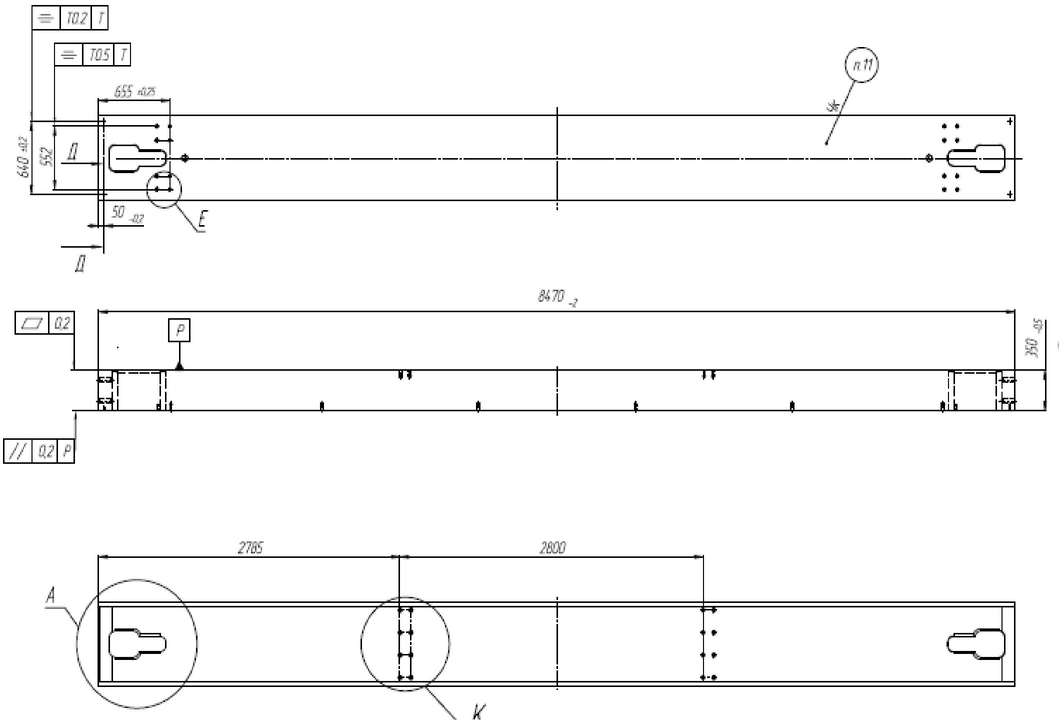


Figure 9—19; Cable entries, at the bottom of the MAGNET, details of the implementation.

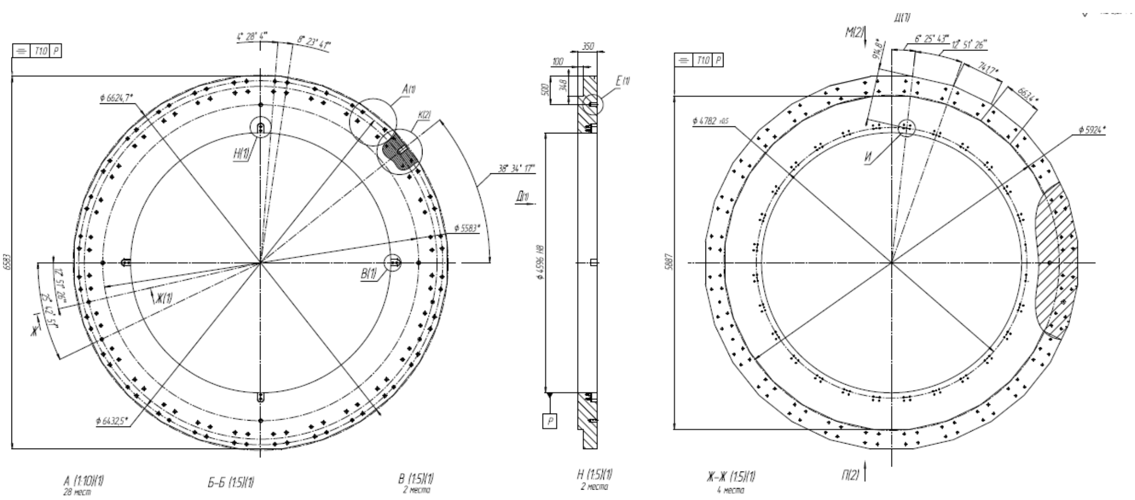


Figure 9—20; Magnet shield for cable ducts.

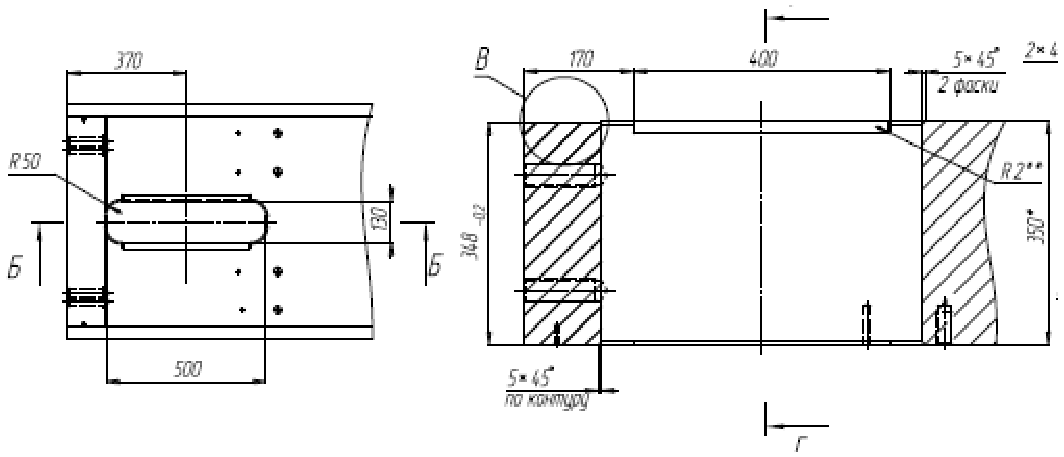


Figure 9—21; Cable entries, at the bottom of the magnet, details of the implementation, supplement

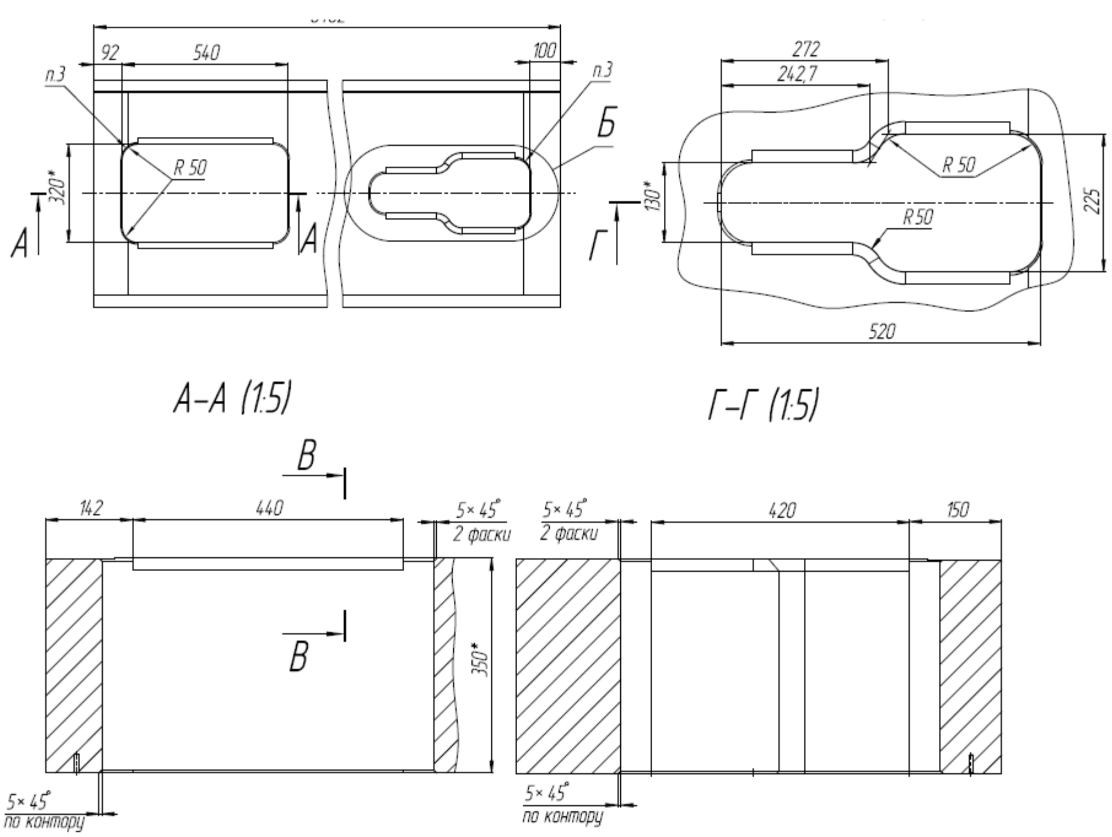


Figure 9—22; Cable entries, at the bottom of the magnet, details of the implementation, supplement.

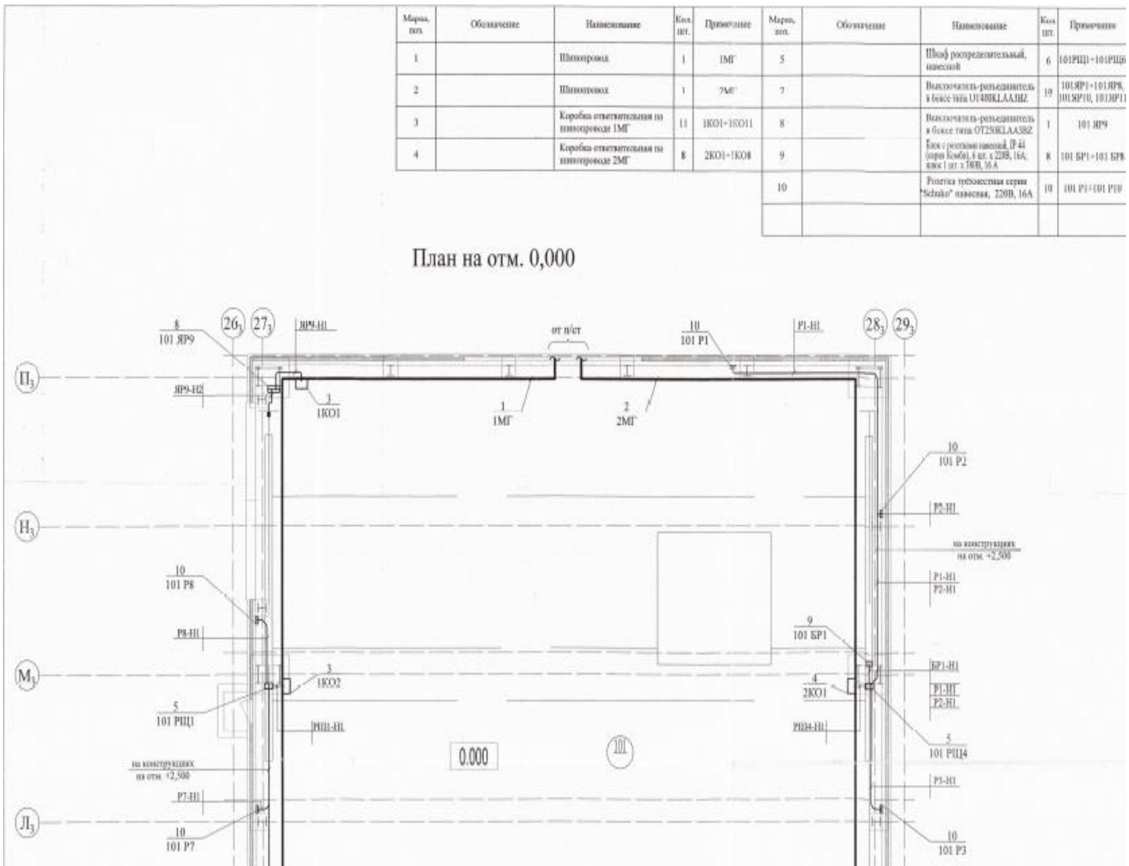


Figure 9—23; Plan PLATFORM MPD-NICA connections

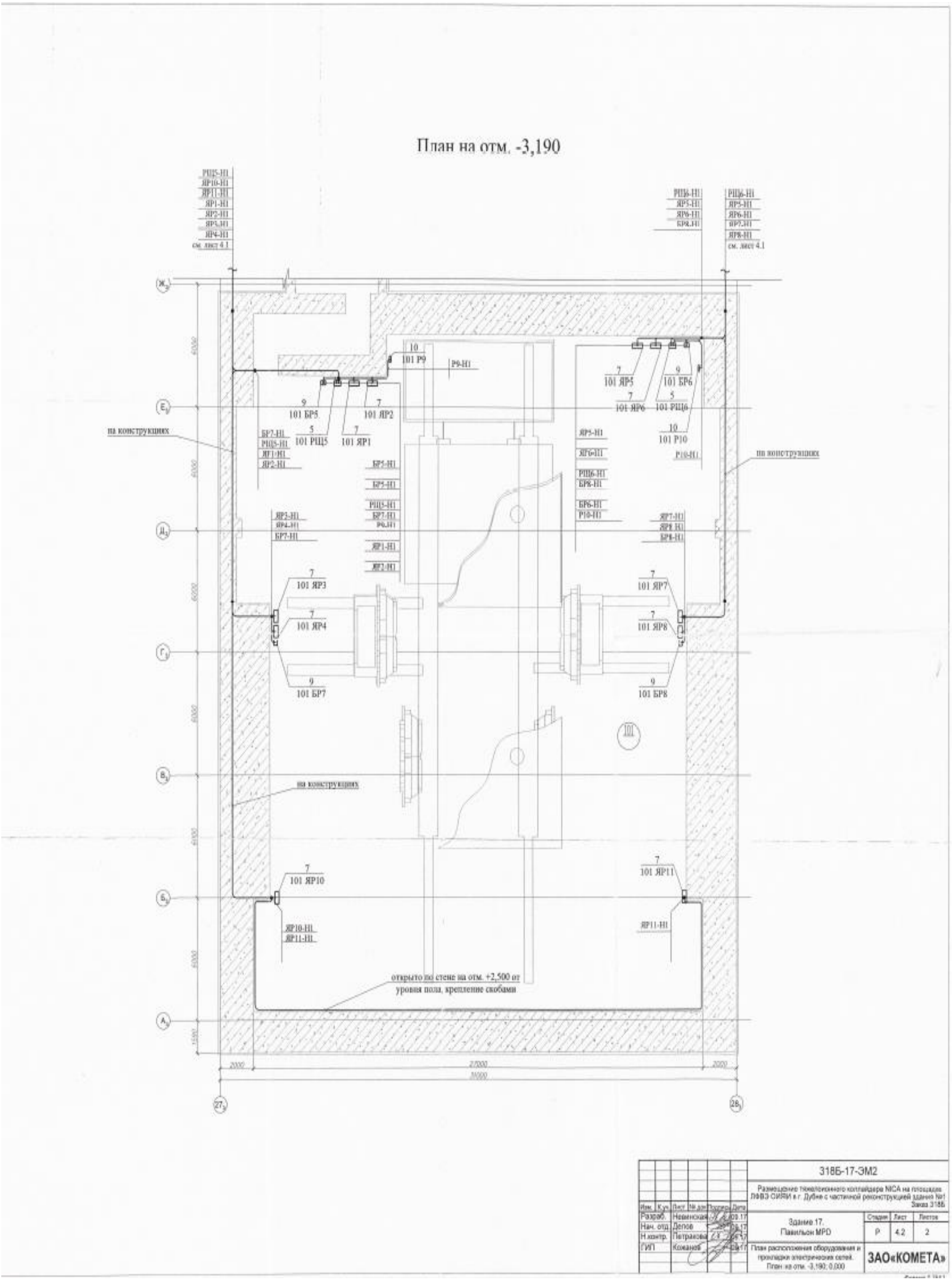


Figure 9—24; Plan PLATFORM MPD NICA connections, LEVEL A

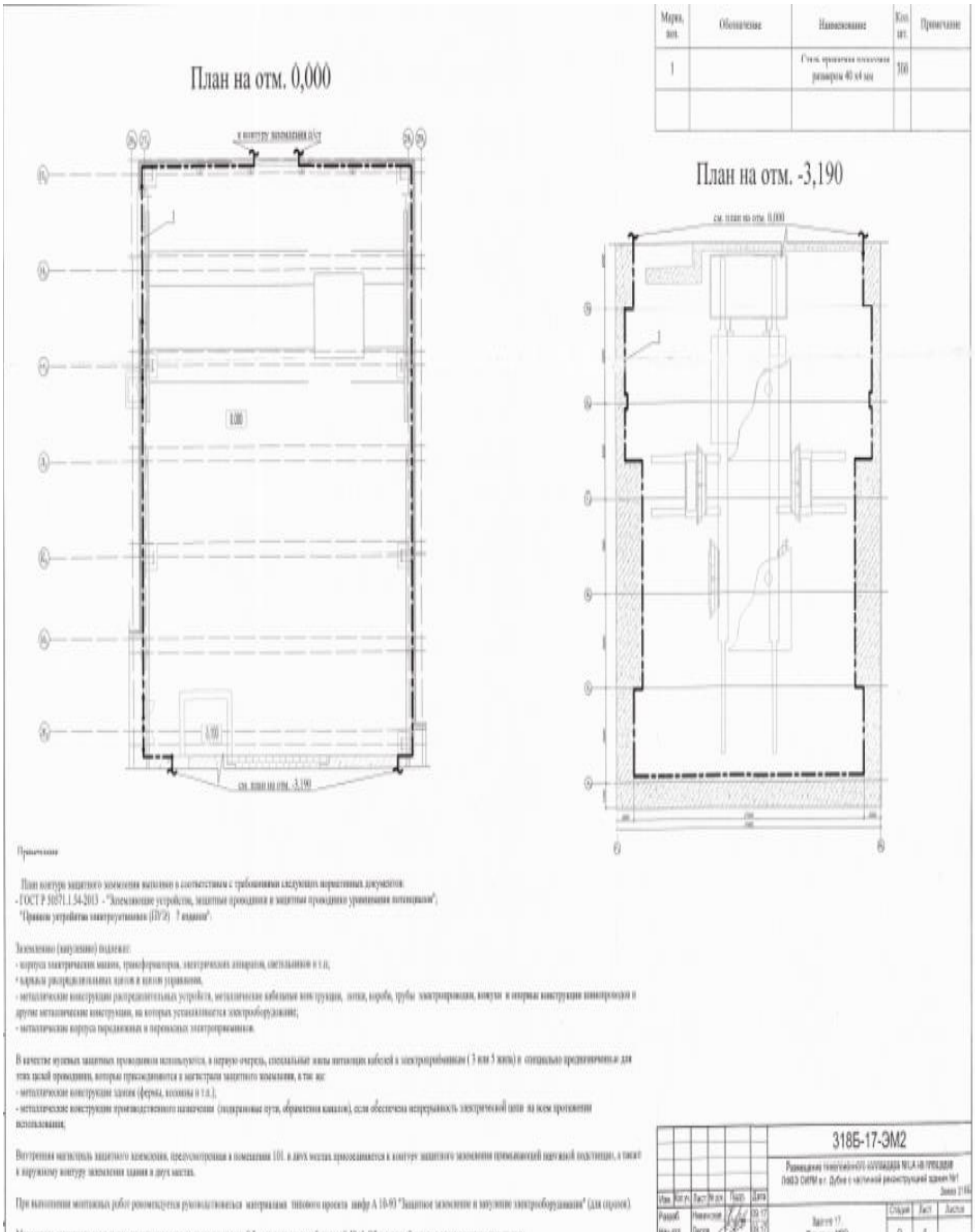


Figure 9—25; Plan PLATFORM MPD NICA ROOM

9.9 RACK for NICA-MPD-PLATFORM: Suggested Technical Solution

The following is a description of each sub-system of standard equipment RACK in accordance with the tasks.

9.9.1 FAS Fire Alarm System

9.9.1.1 FAS The goal of the proposed solutions

The aim of FAS is to ensure early detection of fire hazards in RACK and to neutralize this threat as soon as possible.

9.9.1.2 FAS Scope of Work

The MPD-NICA project is very saturated with electronic devices for different users, therefore reliable fire protection is necessary. To this end, each RACK will have its own automatic system for fire hazard detection and appropriate response.

9.9.1.3 FAS Proposed solution and Design description

A large amount of equipment and a wide area of its installation make it necessary to identify threats as precisely as possible and to concentrate protective measures in a specific place. Therefore, a solution was chosen for the fire detection and accurate location of fire hazard at RACK level, which allows local fire extinguishing. The proposed solution is more efficient and cheaper than fire extinguishing in huge halls due to a minor electrical failure and local ignition, which can turn into larger ones if instantaneous fire prevention measures are not taken.

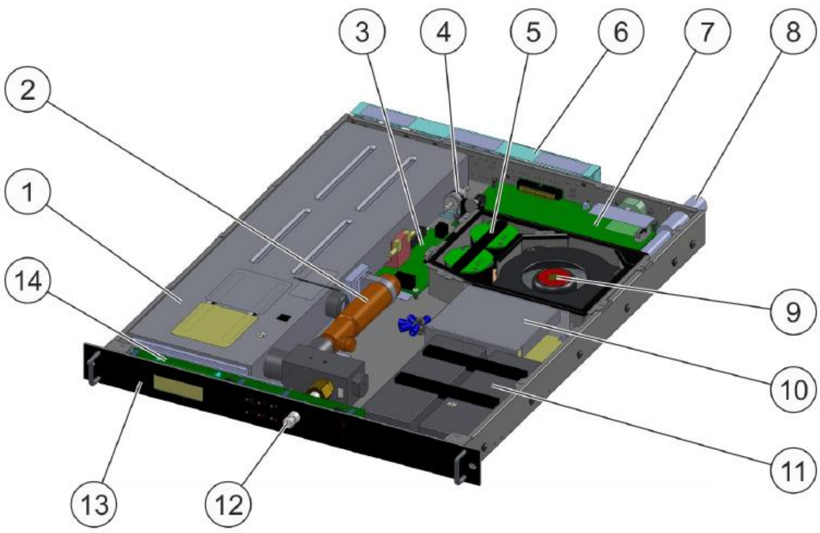


Figure 9—26; FAS, Fire Alarm System,
Extinguisher Structure of the FAS Fire Alarm System - Master Module

[1]. Tank (extinguishing agent container) with fill level monitoring and release device
[2]. Propellant Cartridge
[3]. Detector Interface
[4]. Air Flow Monitoring Filter
[5]. Fire Detectors
[6]. Connection Strip (connection technology card / network interface card)
[7]. Control Card CPU3
[8]. Suction Pipe Connection
[9]. Fan
[10]. Discharge Nozzle
[11]. Front Panel with Display and Control Panel
[12]. Control Panel Card BT3
[13]. Power Supply
[14]. Emergency Power Supply (batteries)

9.9.2 RACK PMS Platform Management System

9.9.2.1 PMS The goal of the proposed solutions

The purpose of this system is to manage the MPD-NICA PLATFORM resources. The system allows remote switching of installed devices, implements the set sequences of switching the system on and off. Where it has been provided, it provides a gentle start of power to not overload the power lines. Works with all Slow Control and Detector Control systems for MPD.

9.9.2.2 PMS Scope of Work

The structure, defined functionalities subject to management will be designed. The proposed solutions will determine the hardware and software requirements. Requirements for other design industries related to the MPD-NICA PLATFORM management structure and its functionality will be defined.

9.9.2.3 PMS Proposed solution and Design description

The research shows that a lot of different solutions should be used in this area. As the main software platform integrating all systems, we accept the same as in CERN SCADA WinCC SIEMENS. This solution will allow for a good integration of various existing subsystems, at least until their better versions.

The diversity of equipment both in terms of standards and their manufacturers means that at the management level we accept solutions within the PXI-e National Instruments standards, the Real-Time c-RIO system also NI (both in FPGA technology) and SIEMENS controllers and industrial automation systems.

It is proposed to use external servers of current time value transmitters to synchronize the entire system.

9.9.3 RACK IPD Intelligent Power Distributor

9.9.3.1 IPD The goal of the proposed solutions

The purpose of this system is to guarantee the Power Supply of devices installed in RACK, NICA-MPD-PLATFORM. The system provides two important technical requirements:

a) **PPS P**ersonnel **P**rotection **S**ervice
b) **HQS H**igh **Q**uality **S**ervice

The first postulate, **PPS** Personnel Protection **S**ervice (security of people serving the system), will be implemented with the Personnel **ACS A**ccess **C**ontrol **S**ystem, a high level of system automation and the possibility of full remote maintenance.

The second postulate, **HQS** High Quality Service, ensured by the design of a reliable and functional Electrical **IPD I**ntelligent **P**ower **D**istributor.

9.9.3.2 IPD Scope of Work

In the NICA Project many electrical measurement and control systems will be implemented. Majority of the measuring equipment is sensitive to noise in power supply. It results in decreased measurement accuracy and errors. Electrical noise can be reduced by balancing of electrical network.

All devices will operate under high radiation conditions what arises an issue of providing high reliability of power supply system and demand of remote control of all devices to avoid necessity of human actions in radiated area.

According to the scale of experiment, it is important to protect all devices, monitor state of each electrical subsystem, detect failures in its operation and avoid influence of failed devices on remaining systems.

General design requirements and corresponding functionalities of the power supply system are as follows:

a) Delivering Power Supply from Three-Phase Network to several devices;
b) Monitoring and Balancing the network loading;
c) Electrical Protection of all connected devices;
d) Failures Detection and recognition of failed devices;
e) Soft Start of the entire system;
f) Remote Control of individual power delivery to each device;
g) Compact solution compatible with 19” RACK,
h) Cooperate with EqDb.

9.9.3.3 IPD Proposed solution and Design description

The requirements presented in previous section were addressed by the design of the IPD Intelligent Power Distribution, which is a device delivering the power supply for electrical devices mounted in each rack. It connects a few devices to a three-phase electrical network and perform a balance loading of this network. In order to ensure possibly symmetric loading of the network

Figure 9—27; Visualization of the IPD without cover housing – Front View.

the automatic measurements of the individual power consumption of each connected device are performed. A dedicated relay system provides safe connection of devices to each phase and reconfiguration of the power scheme. The control system, which is based on the NI c-RIO, performs the optimization of phase loading, provide overcurrent and electrical shock protection, detect short circuits, automatically switch-on and switch-off power of the devices. System provide remote control mode.

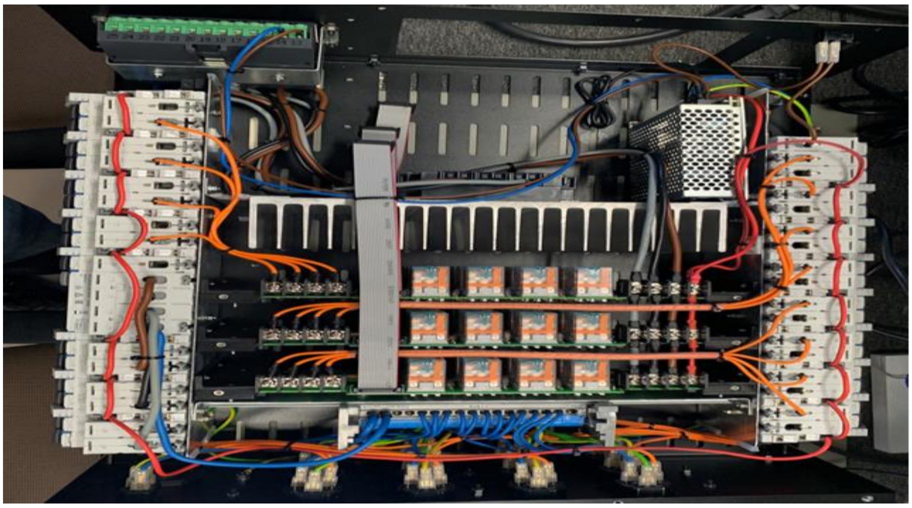


Figure 9—29; IPD without cover housing – Top View (A)

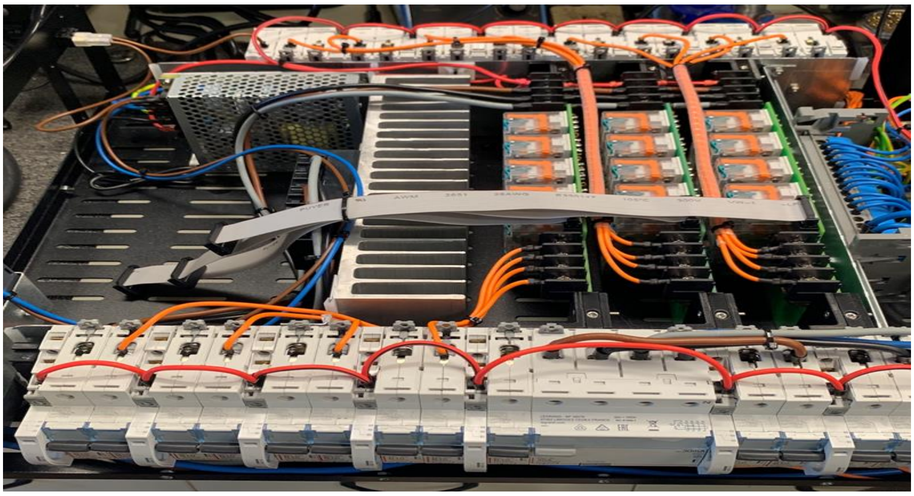


Figure 9—28; IPD without cover housing – Top View (B)

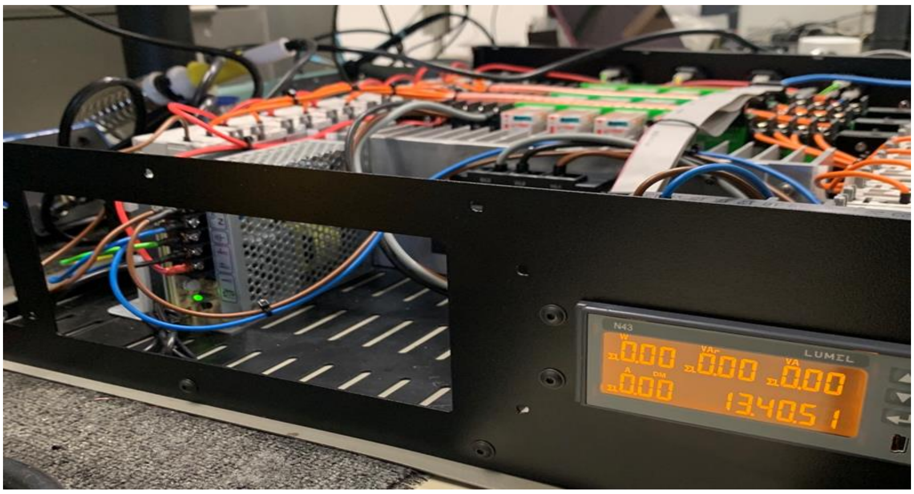


Figure 9—30; IPD without cover housing – Front View

9.9.4 RACK VAC Ventilating and Air Conditioning

9.9.4.1 VAC The goal of the proposed solutions

The aim of the system is to provide individual ventilation and cooling equipment installed in each RACK PALTFORM MPD-NICA.

9.9.4.2 VAC Scope of Work

The system ensures the sterility of the coolant (air in the closed circuit) and facilitates the location and neutralization of the fire hazard. This solution significantly reduces the cost of servicing the entire system.

For the MPD-NICA Project, local climate stabilization systems are offered, designed for individual RACK. Local cooling systems will be combined with the MPD-NICA global air conditioning system.

Figure 9—31; RACK 19"
VAC Ventilating and Air Conditioning

9.9.4.3 VAC Proposed solution and Design description

The main refrigerant in the RACK is air. It is planned to use the system for a long time, so it is necessary to consider the need to replace air purification filters, which cools the equipment in RACKS. This service is time consuming and difficult, since many of the RACKS are in the presence of ionizing radiation harmful to humans.

Maintenance of air filters requires the frequent presence of maintenance technicians in ionizing radiation zones. Therefore, a technical solution is proposed that will reduce this risk and inconvenience. We design a closed circuit of cooling air in RACKS.

The excess heat energy stored in STOCKX will be removed with the help of a fluid that cools the circulating air in STOCKX. Such a solution would improve the management of the cooling systems of the system and reduce the access of dust to the air for delicate electronic equipment.

The racks will be equipped with a circulating liquid air cooler in a closed loop for the Racks. Each such system will be connected to the central “icy liquid-glycol” at a temperature of 8° C to 12° C. The liquid will be cooled in the external circuit of the cold generator. The “cooling generator” can also supply cold air to the RACKS if there is a need for air cooling, for example, due to a failure. Each RACK has an electronic and mechanical system that allows such switching of cooling circuits (water or air).

Moreover, the system should meet all global safety standards.

The designed system should have closed air circulation in each cabinet (or in each set of cabinets). This requires sealing all the gaps through which dust can get inside the cabinets.

At the bottom and the top of the cabinets, fans should be installed to force the air flow inside the cabinet. These fans should be covered with covers and the air should be led out through pipes placed vertically inside the cabinet. The top fans are used to pump out hot air, which is afterwards pumped to the bottom of the cabinet and pumped into it using the bottom fans. Inside the pipes the VAV valves should be installed to open or close the loop with the air flow.

9.9.5 RACK AIM Automated Infrastructure Management, CCAS Cable Connection Authorization System

9.9.5.1 AIM The goal of the proposed solutions

The purpose of this solution is to guarantee the use of cables of the required technical quality, technology of performance that guarantees the safety of people, topology and quality of cable connections.

9.9.5.2 AIM Scope of Work

The cables will be labelled with micro RFID elements. In each RFID tag, the cable identifier will be saved. Detailed data describing the cable will be saved in EqDb and related to the required devices.

The system will monitor the connection topology so that unauthorized situations are not allowed by the constructors.

9.9.5.3 AIM Automated Infrastructure Management, Proposed solution and Design description

AIM (Automated Infrastructure Management) InteliPhy Monitor and InteliPhy Manage are the two pillars of the AIM (Automated Infrastructure Management) solution. InteliPhy Monitor consists of a small number of components that can be retrofitted: RFID tags for patch cord connectors, SensorBars for patch panels and Analyser’s for the network cabinets. InteliPhy Manage is the client-server solution with a central database installed on a Server in the LAN or available as a cloud-based service with numerous automating functions, routing, and planning tools and extensive component libraries.

That is all a company needs to manage the passive infrastructure of a DataCentre or corporate network from any location. And InteliPhy grows with a company's needs. Users have the flexibility to choose which part of their infrastructure they want to automate and when.

9.9.6 RACK ACS Access Control System w systemie

9.9.6.1 ACS The goal of the proposed solutions

The purpose of the ACS application on distributed intelligence associated with EqDb for the MPD-NICA PLATFORM is to protect it from unauthorized service activities.

9.9.6.2 ACS Scope of Work

ACS should protect all NICA-MPD-PLATFORM RACKs against unauthorized access.

Authorized and trained service technicians may perform service activities only at a specific place and time, resulting from operator tasks ordered by the PLATFORM-MPD Administrator.

Service technicians will be equipped with electronic identifiers, the use of which will allow to open a specific RACK and perform the ordered service activities.

ACS for NICA-MPD-PLATFORM, will be closely related to EqDb and electronic locks and controllers for each RACK.RACK ACS Scope

9.9.6.3 ACS Proposed solution and Design description

In order to implement the ACS system for NICA-MPD-PLATFORM, a solution is proposed in which each RACK will be equipped with an individual electronic lock connected to the central ACS system. The serviceman will provide access by means of an RFID or other identifier, e.g. in the form of an access card. The service authorization is granted by the System Administrator defining: Person, Place and Time of system opening.

9.9.7 RACK CCTV Closed Circuit TeleVision

9.9.7.1 CCTV The goal of the proposed solutions

The purpose of the Closed-Circuit TeleVision CCTV system is to provide a preview of the situation on the MPD_NICA PLATFORM. It should be emphasized that both the security of the persons serving the system and the high cost of the installed apartments are important arguments for the installation enabling remote observation of the situation on PLATFORM MD-NICA.

9.9.7.2 CCTV Scope of Work

A CCTV system coupled with the ACS system for NICA-MPD-PLATFORM should be designed and manufactured. The system should write data in EqDb and use the initial settings data saved in EqDb.

9.9.7.3 CCTV Proposed solution and Design description

Designed CCTV will be equipped with colour cameras with a rotating head on each level PLAATFORM MPD-NICA. The cameras should be hermetic and heat-resistant with their own heating of the systems and lighting. Each camera should be remotely controlled and equipped with Ethernet PoE interface. All connections and required installations must be made. Making vandal-proof cameras.

9.9.8 RACK SAS Sound Alert System

9.9.8.1 SAS The goal of the proposed solutions

The purpose of this system is to send audio messages to personnel working on PLDFORM MPD-NICA, as well as in MPD ROOM about hazards and the manner of the required response. For example, IMMEDIATELY LEAVE A LOCATION, EVACUATION, RUN!

9.9.8.2 SAS Scope of Work

It is necessary to design and perform a SAS system with the required topology that allows effective warning of the hazards of the Personnel working on NICA-MPD-PLATFORM for each level. An acoustic (buzzer) and a voice alert in several languages are required (Russian, English). Warnings should be accompanied by a light form, e.g. flashing light with warning lamps.

The required scope of the robot is: Design, execution, installation, commissioning and training of personnel together with as-built documentation.

9.9.8.3 SAS Proposed solution and Design description

The implementation of this system is recommended to be modelled on typical warning systems, e.g. BOSCH.

9.9.9 RACK SES Smoke Extraction System

9.9.9.1 SES The goal of the proposed solutions

The purpose of the construction of this system is the safety of the personnel, as well as smoke removal of the apparatus in the event of a fire hazard.

9.9.9.2 SES Scope of Work

The work to be done depends largely on the scope of the Project for the whole building complex. Therefore, this project should be closely coordinated with the General Contractor of the NICA Project.

9.9.9.3 SES Proposed solution and Design description

The proposed solution is a connection system with smoke exhaust ventilation of the NICA complex building. Ensure proper coordination of fire safety measures: cutting the fresh air supply and warning the Service Person in a situation of fire hazard.

9.9.10 RACK FUS Free User Space - Minimum 36U

9.9.10.1 FUS The goal of the proposed solutions

This is the main goal of building PALTFORM MPD-NICA. In this area, MPD control and supply equipment will be installed. All NICA-MPD-PLATFORM infrastructure devices must be designed and constructed to meet this task.

9.9.10.2 FUS Scope of Work

All NICA-MPD-PLATFORM infrastructure devices must be designed and constructed to meet this task.

9.9.10.3 FUS Proposed solution and Design description

The following technologies are proposed: BOSCH, CISCO, HP, IBM, MICROSOFT, NATIONAL INSTRUMENTS, ORACLE, RITTAL, R & M, SIEMENS, as described in T & D Report.

9.9.11 RACK Options Equipments

9.9.11.1 OE The goal of the proposed solutions

The purpose of this activity is to provide a reserve in all PLDFORM MPD-NICA resources. The designed system should be open and development. The planned range is 15%.

9.9.11.2 OE Scope of Work

All planned works, especially executive ones, should be oversized in the range of 15 - 20%. Especially this applies to system and cabling equipment.

9.9.11.3 OE Proposed solution and Design description

Proposed solutions and implementation provide for reserve and redundant solutions. This applies to systems and apparatus. In the case of cabling, redundant cable routes should be designed separately in case of unforeseen failures.

9.9.12 RACK IS Interface Set

9.9.12.1 IS The goal of the proposed solutions

The purpose of this interface system is to adapt NICA-MPD-PLATFORM to various frequently unspecified requirements of Users and constructors at this stage.

9.9.12.2 IS Scope of Work

The scope of work results from the analysis of the most commonly used interfaces.

9.9.12.3 IS Proposed solution and Design description

Each RACK is designed to connect measuring and control equipment in accordance with the standards for basic interfaces:

a) Ethernet (FO-Cu, PoE)
b) GPIB
c) RS-485
d) RS-232
e) SIEMENS Controller
f) USB

And additionally:

a) c-RIO
b) CAMAC
c) PXI-e
g) VME

The basic wiring of the RACK is controlled using an on-line Cable connection system with EqDb.

10 CONTAINER Technical Description

It is a Structural, Mechanical Group RACK's, a CONTAINER consists of several (from four to eight) RACKS, mechanically connected in a group and installed in a common place.

CONTAINER is a real (physical) structure.

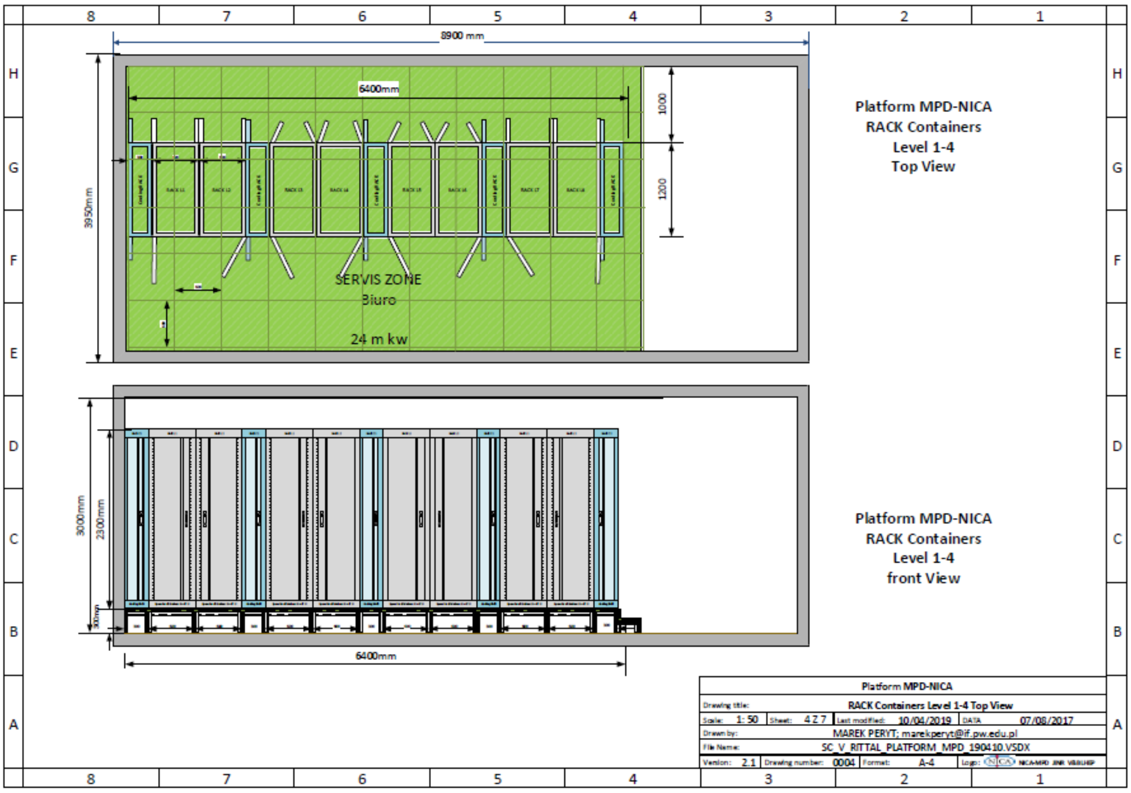


Figure 9—1; CONTAINER; PLATFORM MPD-NICA, LEVEL 2-4.

CONTAINERS may differ in mechanical design. The project includes the basic infrastructure necessary for the correct operation of the CONTAINER in the PLATFORM system for MPD-NICA.

CONTAINER has its own infrastructure. It includes, in particular, power supply systems, grounding devices, devices for personnel security and installed equipment, access to networks (IT networks, the Internet), necessary fire protection systems, access control systems, organization and authorization of cable connections, etc.

The developed solution is aimed at sharply reducing the cost of creating the NICA-MPD-PLATFORM and its operation. This goal will be achieved due to a significant reduction in assembly operations at the V&BLHEP JINR. Production, assembly and diagnostics of finished system components will be carried out at the specialized manufacturing plants of the manufacturer. Thanks to this solution, the final installation of the STICKER, and CONTAINERS on the MPD-NICA technical PLATFORM at JINR will be greatly simplified due to the thorough preparation of the Project components on the manufacturer's site.

CONTAINERS will be delivered at JINR, in the form of ready-made and tested modules. They will be equipped with basic mechanical, electrical, electronic and IT infrastructure.

CONTAINERS will be designed to ensure their safe transport (TIR). This solution has many logistical advantages. When creating a RACK equipped with basic equipment will take into account the need for their future transportation. CONTAINERS will be equipped with all the necessary elements, mechanical infrastructure, fasteners, wire rails and cable shafts, technical floors, connections, etc.

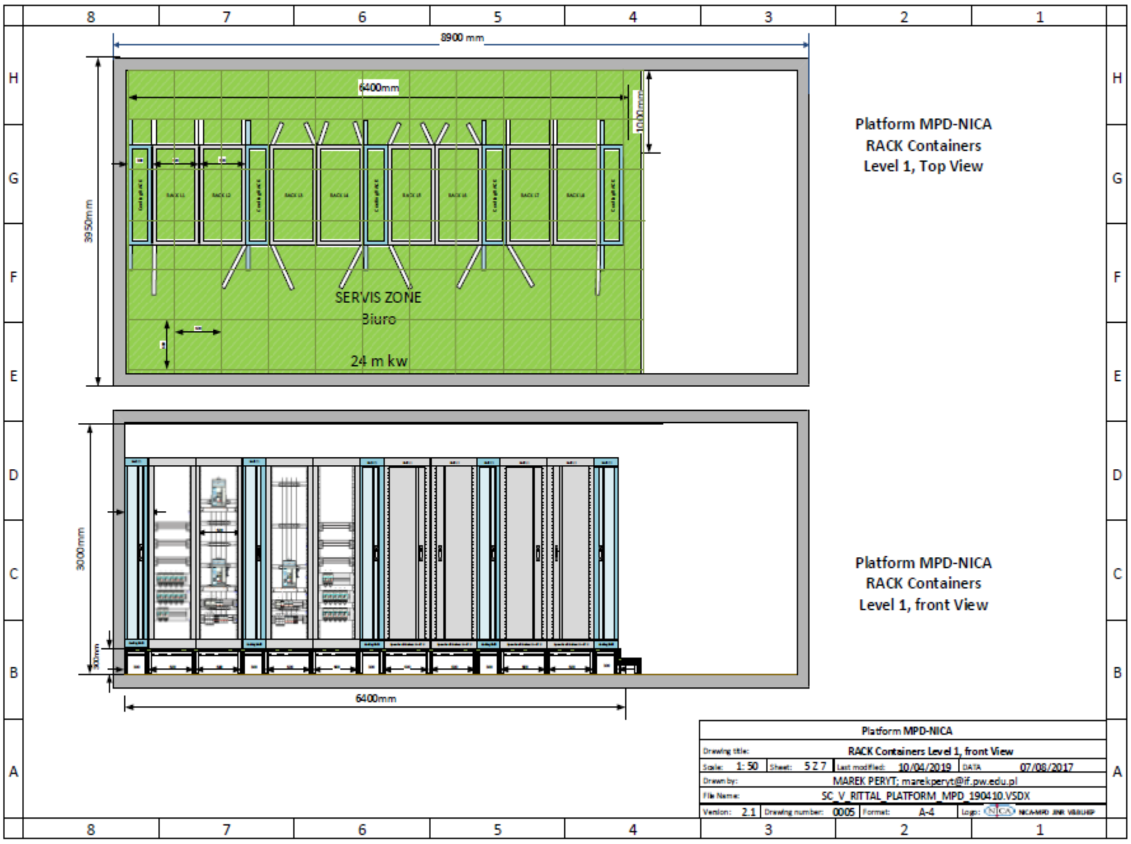


Figure 10—2; CONTAINER; RACK Slow Control System; PLATFORM MPD-NICA LEVEL1

10.1 CONTAINER Standard Equipment.

A CONTAINER is a RACKS group, so it easily inherits the RACK functions.

CONTAINER will be additionally equipped with its own infrastructure, consisting of:

a) **FAS F**ire **A**larm **S**ystem,
b) **CRWS C**able **R**ace **W**ay **S**ystem,
c) **VAC V**entilating and **A**ir **C**onditioning,
d) **ACS A**ccess **C**ontrol **S**ystem,
e) **SES S**moke **E**xtraction **S**ystem,
f) **CCTV C**losed **C**ircuit **T**ele**V**ision,
g) **SAS S**ound **A**lert **S**ystem,

The implementation of these systems for the CONTAINER will differ from their implementation for the RACK. The CONTAINER functionality is logically like the RACK functionality, but it is much broader, and in a sense, is the logical sum of the RACK capabilities that make up this CONTAINER. The RACK and CONTAINER systems are functionally integrated.

Power Supply throughout the entire MPD-NICA PLATFORM system. The PLATFORM energy infrastructure is at the first Level. A Power Supply System has been developed, which can automatically connect the PLATFORM NICA-MPD to one of two Power Supply Lines. Both Lines were designed as 3 x 380 V, 50 Hz, 800 A. The following Power Supply System this CONTAINER is designed for further power distribution.

A typical block of this switch provides 3 x 380 V, 50 Hz and 25 A at the output, which is enough to power one standard RACK. Further Power Distribution will be performed in RACK and will be controlled by the Slow Control System. Power circuits will be laid on the NICA-MPD-PLATFORM, and in the CONTAINER space in the protected area under the RACK technical Level 1. Cable shields will be grounded and connected to earth in a special way.

All circuits are protected against leakage current > 30 mA, which guarantees additional security for the PSS Personnel Service System.

10.1.1 FAS Fire Alarm System,

Earlier in the RACK section, the FAS Fire Alarm System was described in detail for each MASTER RACK and SLAVE RACK. The described system is a good fire protection for RACK. Similar solutions should be developed and implemented for MPD-NICA CONTAINER and PLATFORM. This part of the FAS system will be combined with a global FAS for the entire MPD Project.

All closed spaces and cooling ventilation ducts will be equipped with appropriate smoke and fire detectors, so that the entire controlled area is under control. All fire detectors will be connected to the global FAS-NICA system.

It will include all FAS subsystems. The FAS fire panel will be connected to the automatic fire brigade notification system.

It is planned to develop and implement an audible warning system, cooperating with the PSS Personnel Service System. The goal is, of course, safety!

10.1.2 CRWS Cable Race Way System,

Cables their arrangement on NICA-MPD-PLATFORM, fastenings, verification of bend radii and cogging technology described in a separate project, attached to TDR.

10.1.3 VAC Ventilating and Air Conditioning,

VAC Ventilation and Air Conditioning is a very important component of the infrastructure for RACK, CONTAINER and NICA-MPD-PLATFORM. In previous sections of the Project, arguments were made in favour of using a double cooling medium — air and liquid. These basic HVAC functions will be applied to the entire MPD-NICA Project.

The infrastructure of the RACK, CONTAINER and NICA-MPD-PLATFORM must be ready to accept installations for local and global HVAC.

The entire MPD-NICA Project will be connected to the central ventilation and air conditioning system. The project provides for local and autonomous cooling of the RACK.

10.1.4 ACS Access Control System,

ACS for the container inherits functionality from each RACK, additionally supported by the CCTV system.

10.1.5 SES Smoke Extraction System,

SES Smoke Extraction System, another single system whose main task is safety. The task of this system is to activate a highly efficient unit to remove smoke in case of fire.

An emergency with the MPD-NICA installation can provoke complex chemical consequences and the formation of a poisonous atmosphere in the danger zone. The SES installation should reduce the unpredictable effects of air pollution and personnel risk.

10.1.6 SAS Sound Alert System,

In addition, it is assumed that in the event of such a threat, the notified fire departments will receive an **SMS S**hort **M**essage **S**ervice message with information stored in the EqDb database of the suspected substances that currently pose a threat. Therefore, it is required that EqDb reliably record information about the materials used, for example: the type of insulation cables, the chemical composition of paints used for painting structures, process fluids, building materials, especially organic, etc.

Such information will allow the fire brigade units to take the right measures to fight the fire.

10.1.7 CCTV Closed Circuit TeleVision,

CCTV is very useful in complex electronic systems.

a) CCTV plays an important protective role by providing ongoing personal monitoring.

b) CCTV facilitates remote control

CCTV will be developed as a distributed system of weatherproof cameras in many locations, remotely controlled, connected to the NICANet converged IT network.

10.1.8 EqDb Equipment Database

…is an enhanced version of the DCDB Detector Construction Data Base, developed and implemented in the ALICE-CERN project by specialists from the Physics Department of the Warsaw University of Technology as part of the ALICE collaboration.

EqDb is a high-level version (UpDate) of DCDB. The DCDB database was developed as a database for the ALICE detector. Later it turned out that there are additional requirements of Users regarding the registration of many additional data. This EqDb system allows you to register administrative information, such as orders, deliveries and detector construction processes, the cost of its production, any movements of components for testing or maintenance. Cable connections records are also an important new feature. There is a case when an error in cable connections caused by careless maintenance at CERN led to a false result: the speed of light was exceeded. After about two weeks, this message was refuted. It turned out that the connection error caused an incorrect measurement sequence. To avoid such situations for the future, EqDb has a built-in connection authorization mechanism based on RFID Radio Frequency IDentification technology. Special resonant circuits that control the ends of the most important cable connections allow you to automatically detect errors in cable connections.

EqDb works online with a slow control system and is an important element of technical support for the entire MPD-NICA project.

10.1.9 CITNet Convergent IT Network for NICA-MPD-PLATFORM

CITNet Converged IT Network is being developed.

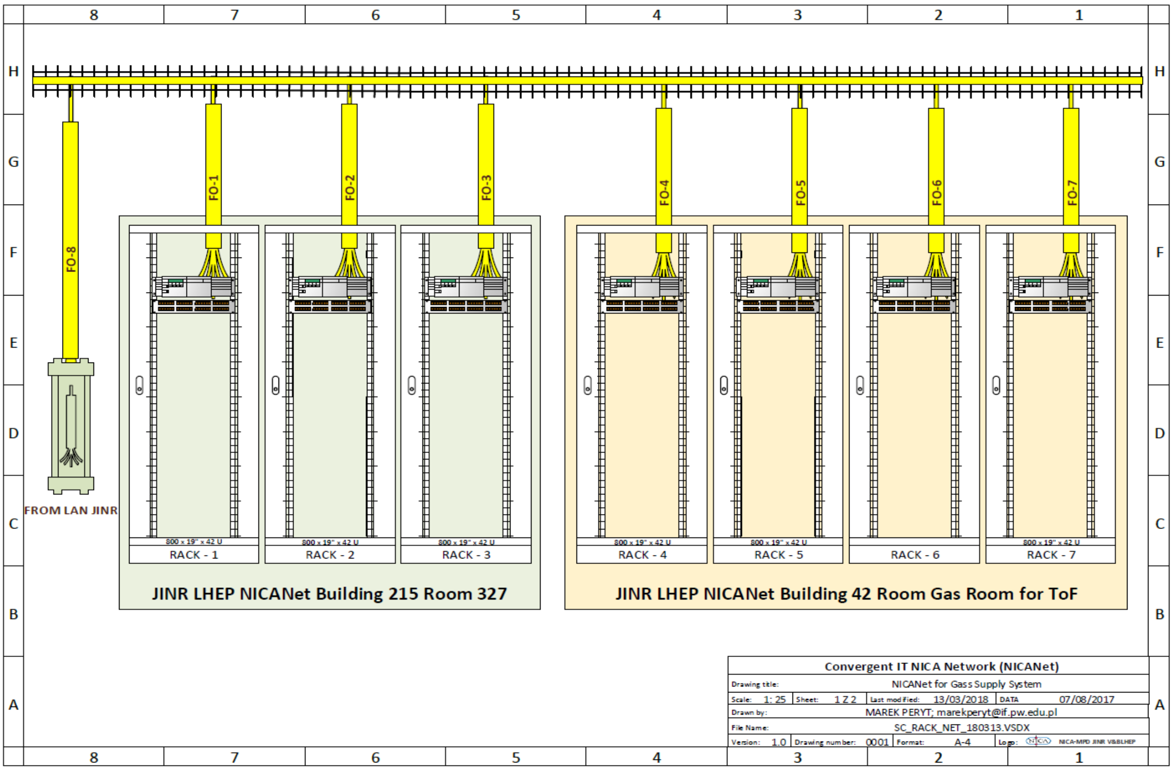


Figure 10—3; CLUSTER CITNet

The purpose of using CITNet converged network: Unification of the interface for connecting the NICA-MPD-PLATFORM with the rest of the JINR network. This solution means fewer cables and less work related to network management. A converging network provides remote administration at local and global levels. This makes it possible to control various devices, such as IT, as well as equipment for measurement, control and monitoring.

Applications running on user computers can be used both for data transfer and control using various media, including voice, sound alert systems or SMS messages.

However, the main purpose of implementing a converged network is to reduce costs. Large economic benefits are expected as the cost of a single high bandwidth connection is lower than for many channels at lower speeds.

Another goal is to efficiently and securely connect NICA-MPD-PLATFORM equipment. A VPN Virtual Private Network is also involved - a virtual private network channel connecting CNNet to other cooperating DaCe Data Center, such as the WUT Warsaw University of Technology, which works with JINR in the MPD- NICA.

Summing up, the goal of the developed solution is to provide an effective and secure communication between the individual systems of the MPD-NICA Project and the users.

Figure 10-3 and Figure 10-4 shows the solution concept.

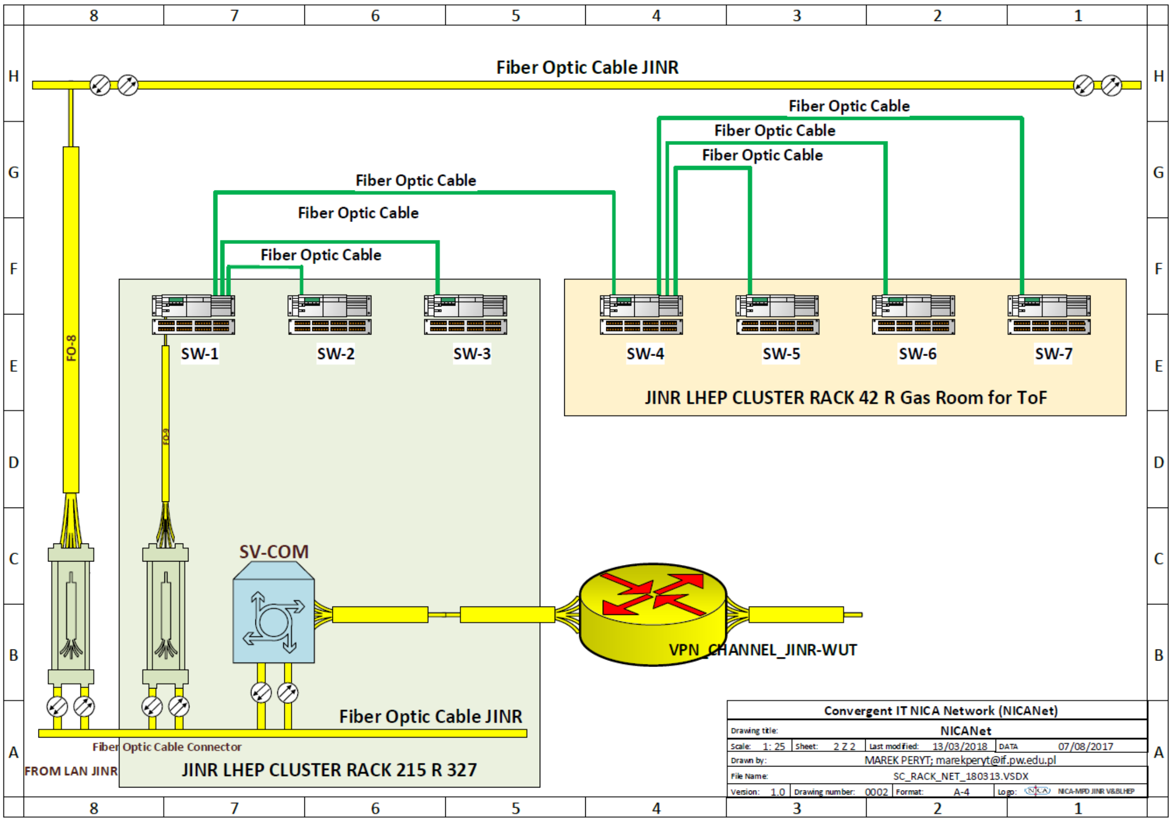


Figure 10—4; CITNet, CLUSTER SCS and GSS, VPN Channel

11 NICA-MPD-PLATFORM Technical Description

NICA-MPD-PLATFORM is a set of CONTAINERS consisting of a set of RACK. Such a clear mechanical structure of the NICA-MPD-PLATFORM is shown in Figure 11-1.

Figure 11—1; PLATFORM MPD-NICA, Block Diagram; Level 1-4.

Currently, the NICA-MPD-PLATFORM, is planned as a four-tier steel structure, on which 3-4 CONTAINERS will be installed, on each of three or four levels. The first - the lowest level - level acts as a distributor of electrical energy, providing all the system racks. The developed distribution system and the power distribution system from the first level can be used by other systems until the power balance is exhausted. The available power range to be used is approximately 400 kW. At the same time, the desired power consumption of the LEVEL MPD-NICA 2-4 TOWER is about 200 kW. It should be expected that about half of the available power will be used by other devices.

the ACS. A person authorized to carry out the operator's activities will be able to carry out his activities only after logging in to the ACS system. Login is possible using special code cards or mobile applications.

12 Technical Requirements

12.1 CONTAINER LEVEL 1: Electrical Switch and Power Supply

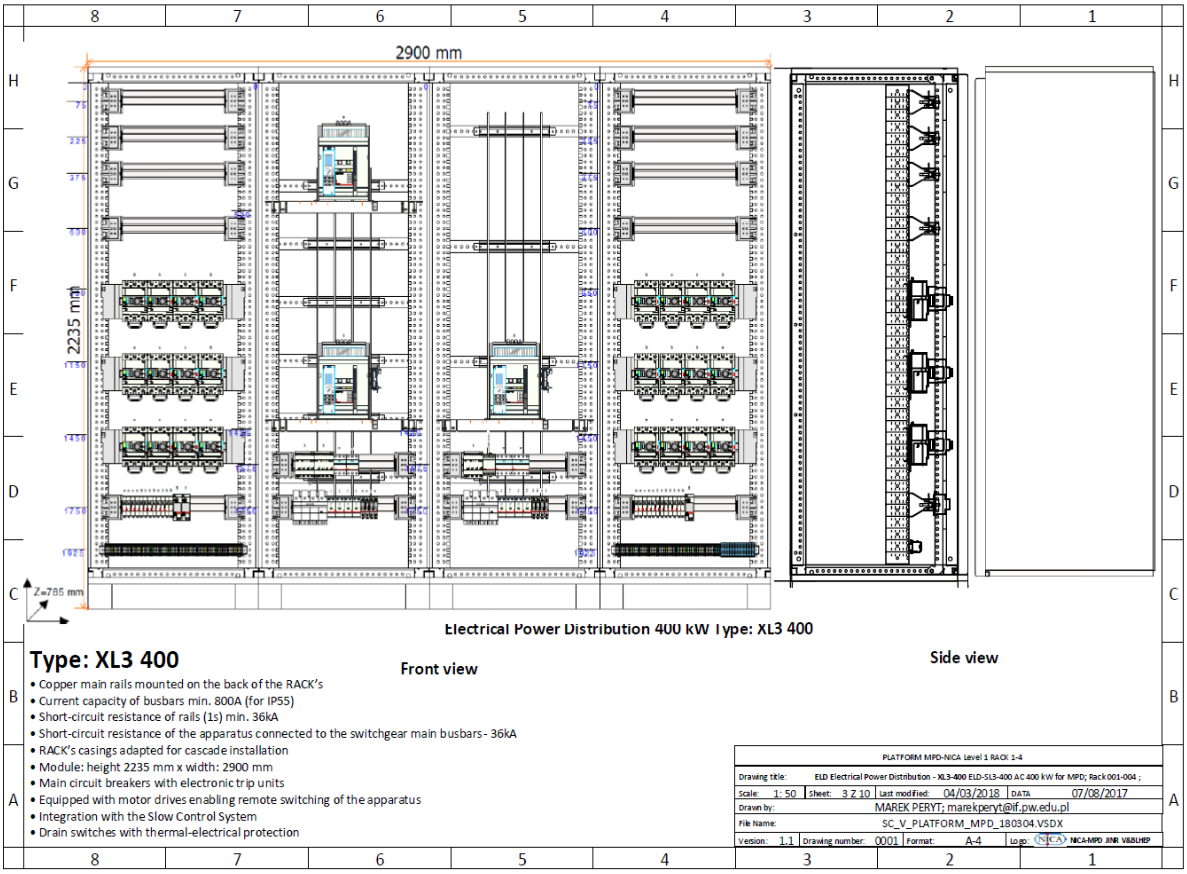


Figure 12—1; Switchgear Camera Visualization.

NICA-MPD-PLATFORM has its own electrical infrastructure. The lowest NICA-MPD-PLATFORM CONTAINER (LEVEL 1), form a CLUSTER: Power Supply. In this NICA-MPD-PLATFORM CONTAINER, an ELECTRIC DISTRIBUTOR is installed with a total power of 400 kW. The CONTAINER project is shown in Figures Figure <12-1; 12-2; 12-3; 12-4>.

The project assumes the lower level of the NICA-MPD-PLATFORM, to be used for Power Supply tasks. POWER CONTAINER is an automatic switching system for high voltage Power Lines (2x400kW).

All-important ELECTRICAL DISTRIBUTION SYSTEMS are connected to the SCS Slow Control System and are monitored. ELECTRIC DISTRIBUTOR is developed in Legrand Technology. Upper NICA-MPD-PLATFORM CONTAINERS powered by this ELECTRIC DISTRIBUTOR.

THE ELECTRIC DISTRIBUTOR (ELECTRIC DISTRIBUTOR) is powered by two lines 3 x 380 V, 800 A, with the <N> NEUTRAL and <PE> conductor **P**rotective **E**arth (or **P**rotectiv**E** conductor).

12.2 CONTAINER LEVEL 1: Switchgear 400 kW, Front View.

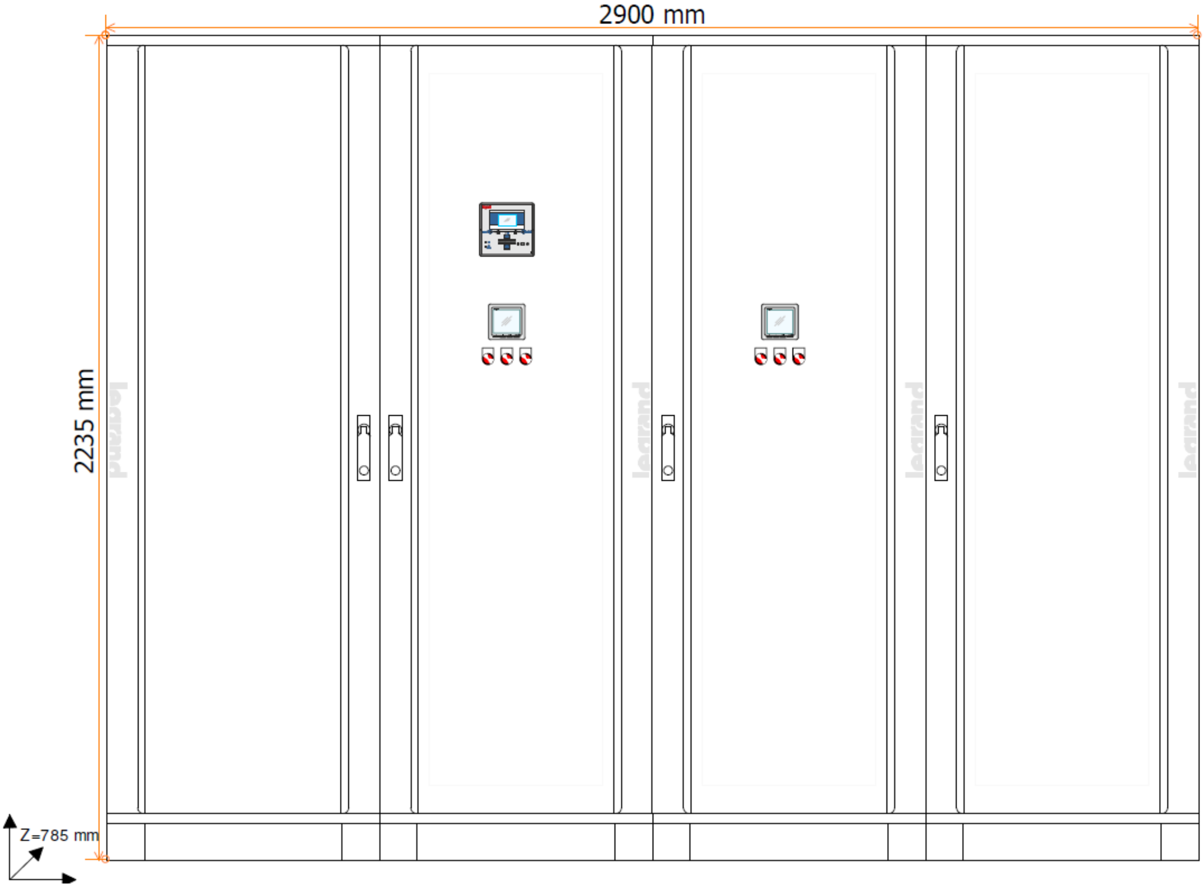


Figure 12—2; 400 kW Switchgear, Front View.

12.3 CONTAINER LEVEL 1: Switchgear 400 kW, Side View.

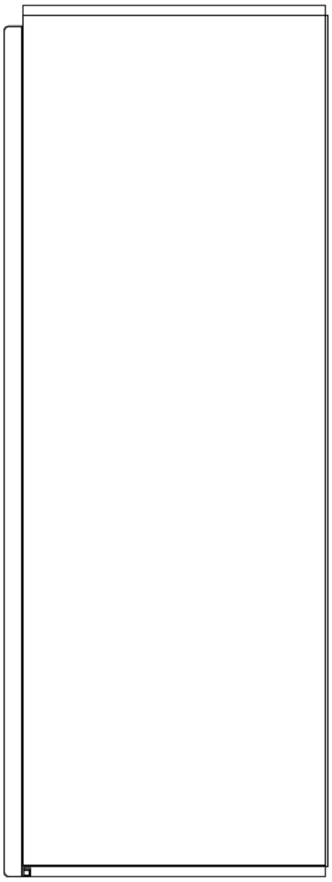


Figure 12—3; 400 kW Switchgear, Side View.

13 CLUSTER Technical Description

CLUSTER is a group of functionally similar RACK or parts of RACK, logically connected in an IT system that controls the structure.

The goal of the RACK Group, called CLUSTER, is the need to isy management RACK with similar functionality. The reasons may be different. One of them will be the situation when a device designed for the implementation of a specific technological task will not physically fit in one RACK. A good example is the GSS Gas Supply System (for a ToF detector) which takes up four RACK. In this situation, a good solution is to create a group CLUSTER, designed for one task. That's why we define the RACKS Groups as a CLUSTER.

A similar situation will arise if the device for performing the MASTER RACK task does not fit into one RACK. Therefore, we will create a CLUSTER consisting of the required number of Racks and call it the RACK MASTER.

Components of the RACK, differing in their functions, may have different IP numbers or different identifiers of other logical addresses. It is possible to create a CLUSTER with a single IP number, visible from the outside by a slow control system, and to control it, as if it is a single logical device with many expected functionalities.

The concept of CLUSTER devices installed in different RACK, as well as in different places is permitted. A CLUSTER can also be created with the help of RACKS in different CONTAINERS.

14 Management

The SCS slow control system is very complex, so one of the main design tenets is the availability of the SCS DSC slow control system. There are two types of RACKs that can be handled remotely using the SCADA SCS system.

a) RACK MASTER manages all installed RACKs.
b) RACK SLAVE, this group is controlled from the MASTER RACK level.

The control of the RACK takes place centrally from the Panel Operator in the SCADA system.

14.1 Hierarchy and LEVEL Numbering

A uniform convention was adopted: Naming and Numbering Convention for MPD Detector,

Part Identification - Generic Scheme

A detailed description of this convention is given in the section (see TDR, 21 APPENDIX V)…

14.2 Logical Groups: CLUSTER - RACK

A CLUSTER is a group of functionally similar RACKS, “logically displayed” in the IT system that controls their structure.

Such logical groups, hereinafter referred to as the CLUSTER, will be managed in the SCS Slow Monitoring System. To facilitate the management of IT by such structures, we logically combine.

15 Cable and Installation Routes Race Way System

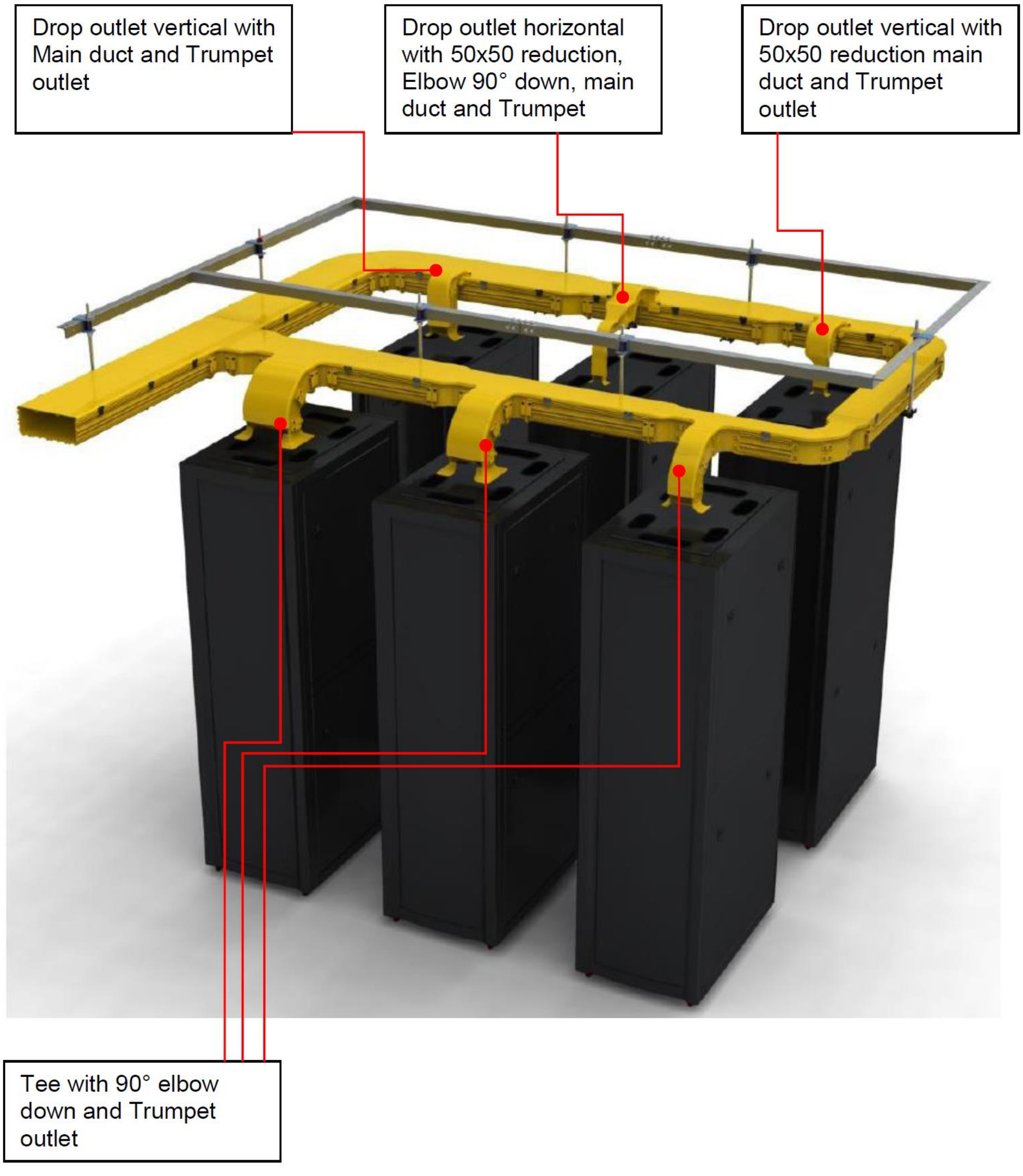


Figure 14—1; Example of use Drop Outlet & Tee RaceWay System

15.1 Examples of Fiber Optic Storage Technology, RaceWaySystem

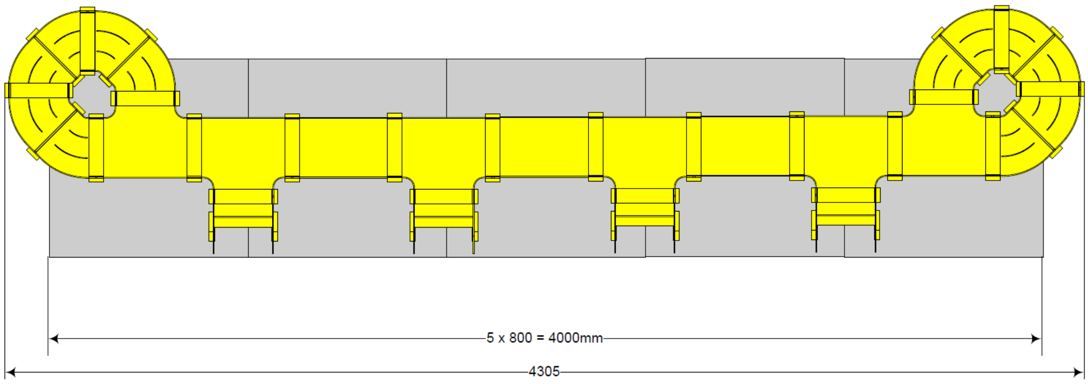


Figure 15—2; Example of Fiber Optic Storage Technology in Race Way System

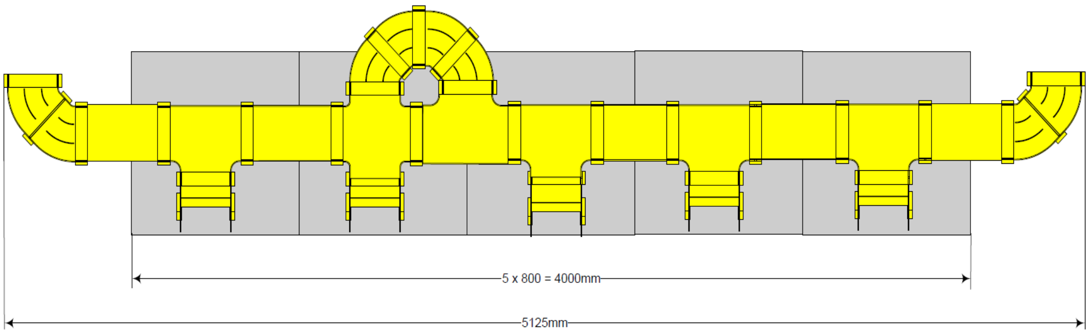


Figure 15—3; Example of Fiber Optic Storage Technology in Race Way System (Between Main Duct)

16 Some notes about the…

The project emphasizes the importance of power line quality, phase symmetry, the role of a neutral conductor, the quality of electrical grounding and its protective role in ensuring personnel safety.

Below we present the most important concepts of the features of these systems and the emerging technical solutions.

16.1 Power Supply, Neutral Conductor and Structure Grounding

The system created under this project consumes electricity supplied from the power plant in the form of three-phase lines 380 V, 50 Hz.

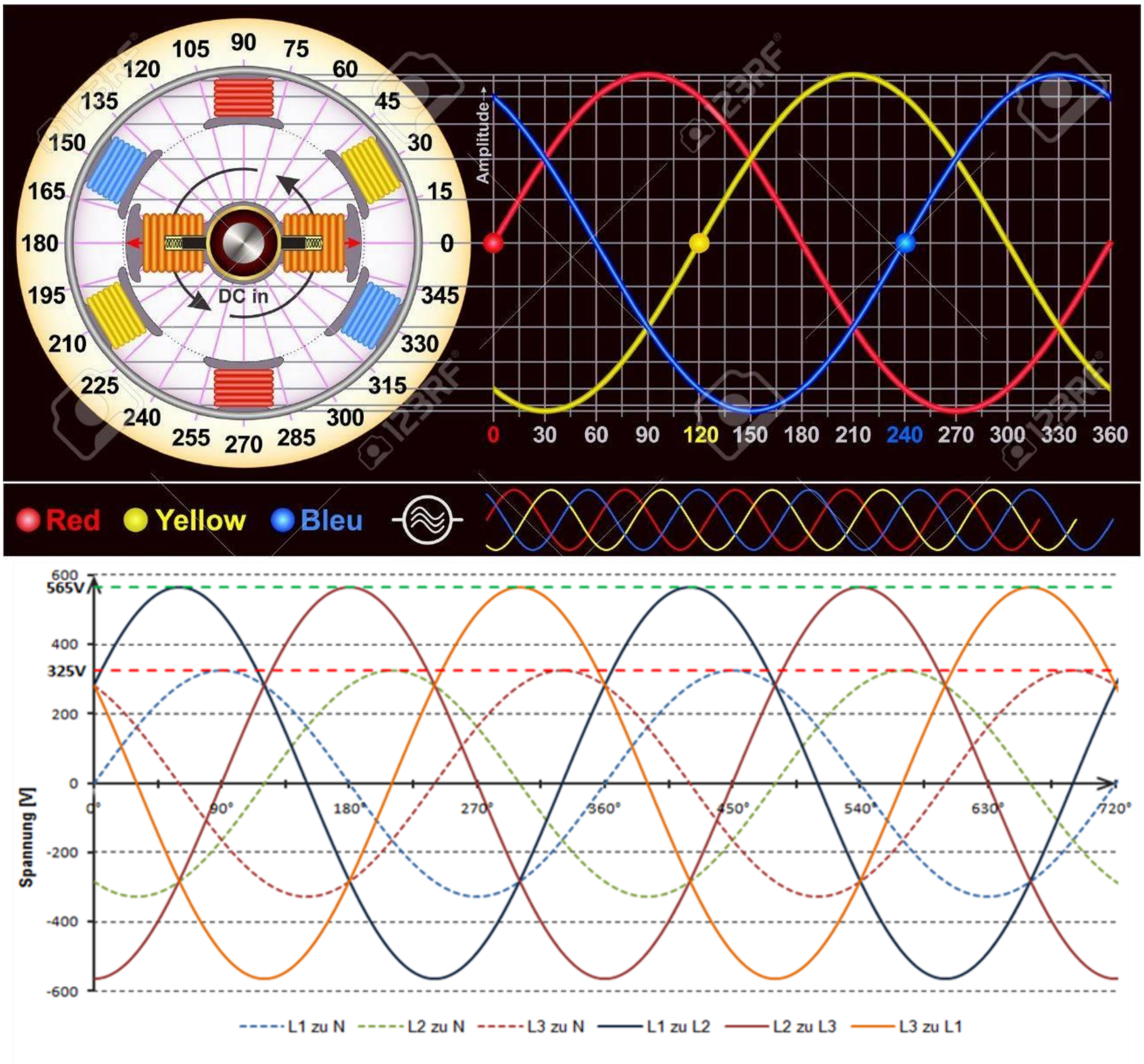


Figure 16—1; 3 Phase Sin Wave Generator (from Internet…)

These are usually three electrical lines, labelled L1, L2 and L3. A diagram of such a power source is shown in Figure 16-1.

The expected energy parameters transmitted in this way are three angular sinusoidal voltage signals, shifted in phase by 120^0, which rotate with angular velocity in the form of vectors

$$\omega = 2\pi f$$

ω- angular velocity

π- (pi=3,14)

f- frequency

From this figure it is easy to determine the reciprocal geometric relationships and the values of the voltage U: see ure 16-1.

effective voltage: phase line - neutral line ______________________ $U_{RMS} = 220$ V

effective voltage: phase – phase ______________________________ $U_{P\text{-}P} = 380$ V

RMS Root **M**ean **S**quare,

The effective value of alternating current is the value of direct current, which, during a period equal to the period of alternating current, will produce the same thermal effect as this alternating current signal.

LLS Line Load Symmetry with a symmetrical load on the phase lines at the receiver side, no current flows through the neutral wire. This is a very important feature of the three-phase power

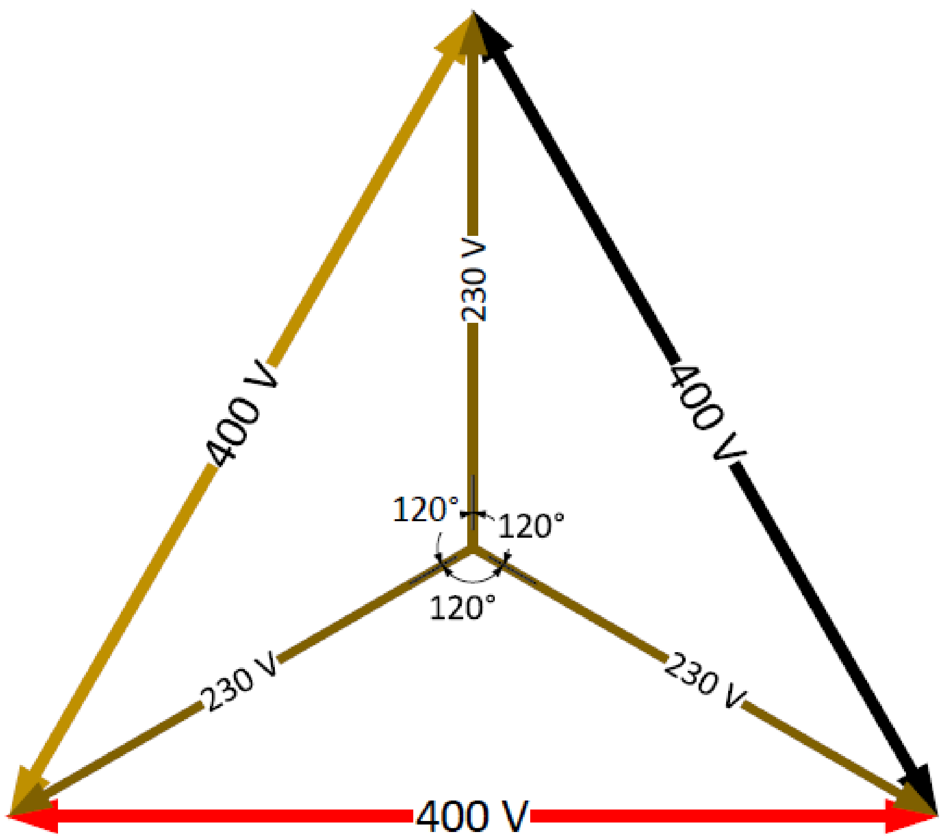


Figure 16—2; Voltage triangle. 230 V: Phase line - Neutral, 400 V: Phase line - Phase line,

system. It should be noted here that most of the components of the MPD detector and all devices operating in the experiment use a phase neutral conductor of the system (see Figure 16-2). And from the analysis of the phase wave triangle, it follows that the voltage in this case is 220 V.

Phase symmetry is very important even when using a single-phase connection.

Suppose that our receiver is connected to a phase line and a neutral conductor (neutral). This is the most popular case of powering electronic circuits from a three-phase line. If the system is asymmetric. it is easy to show that the voltage drop between the load connection point and the grounded neutral conductor is in accordance with Ohm's law

$$U_n = I_n * R_n$$

Where <R_n> is the resistance (RESISTANCE) of the wire, and <I_n> is the value of the current flowing through the neutral wire <N>.

At this stage, it is worth noting that today, when using semiconductor technologies, the supply voltage of the electrical circuitry is small - usually a few volts, from 3,5 V to 5 V. In this situation, even a small voltage drop on the neutral conductor causes significant malfunctions in electronic circuits, which even lead to their destruction! For us, the task is to avoid communication between the power sources of different measuring systems. This must be taken into account when designing power supply systems, neutral lines and grounding.

Therefore, the project involves the careful balancing of power lines, the separation of neutral lines and ground circuits, as well as the careful separation of neutral lines for analog and digital circuits and for high-frequency and low-frequency circuits.

These questions will be separately analysed and elaborated. If we neglect this stage of technical solutions, it will be difficult to filter out perturbations from experimental information.

17 APPENDIX I

17.1 Cooling system

Cooling RACKs NICA-MPD-PLATFORM, will be made in liquid-air version.

Figure 17—1; Liquid Cooling Package LCP Rack CW
Numer katalogowy SK 3312.250

This solution ensures high purity of cooling air, improves service and lowers operating costs.

The operation and design of the platform cooling system are described below.

17.2 Device description

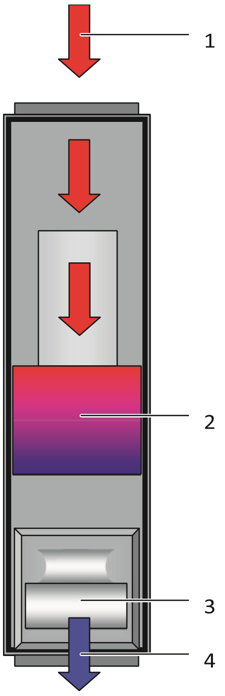
17.2.1 General functional description

The temperature of the impelled cold air is controlled by continuously comparing the actual temperature with the setpoint temperature (pre-set to +22°C).

If the actual temperature exceeds the setpoint temperature, the speed of the compressor is automatically increased, providing a greater cooling output from the heat exchanger, until the setpoint temperature is reached.

The temperature differential between the setpoint and the warm air intake is used to calculate and control the fan speed.

Any condensate incurred is collected in the condensate collecting tray integrated into the LCP DX below the heat exchanger, and from there is routed outside via a condensate discharge hose.



Key

[1]. Air inlet
[2]. Heat exchanger
[3]. Fan module
[4]. Air outlet

Figure 17—2;
Air routing – top view

17.2.2 Air routing

In order to achieve enough cooling in the server enclosure, it is important to ensure that the cooling air passes through the interior of the built-in units and is unable to flow past at the sides.

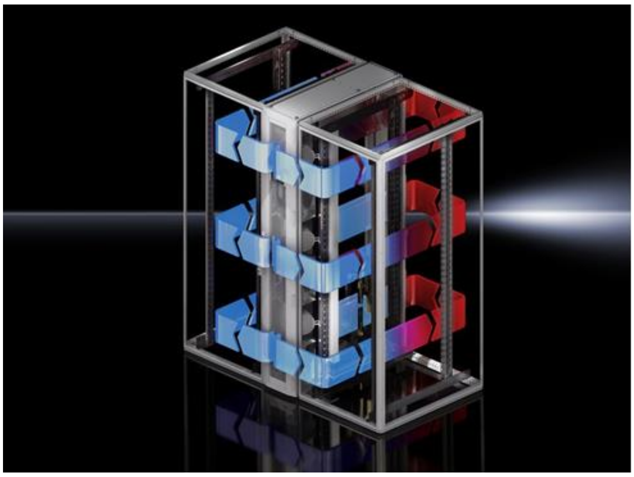


Figure 17—3; Air routing

Targeted air routing by hot air extraction from the hot aisle and cold air blown into the cold aisle has a fundamental effect on the amount of heat to be dissipated. In order to ensure targeted air routing in the system, the server enclosure should be divided vertically into warm air and cold air sections. The division is accomplished in the front section of the server assembly to the left and right of the 482.6 mm (19") level using foam strips or air baffle plates which, depending on the enclosure width and the number of server enclosures to be cooled, can be ordered as an accessory.

If devices which require sideways air throughput are also built into the server enclosure (e.g. switches, router, etc.), these may be cooled by means of targeted placement of the foam strips or air baffle plates.

Additionally, the system consisting of LCP DX, server enclosure and cold aisle containment should be well sealed in order to avoid a decrease of the cooling capacity due to mixing of cold and hot air. This is achieved by sealing the cold aisle with doors at the beginning and end of the rack rows and sealing it at the top with roof elements. Existing cable entry glands are additionally sealed e.g. using suitable brush strips.

17.3 3 Equipment assembly

17.3.1 Unit components

Figure 21-3 shows the routes of air circulation in the RACK '

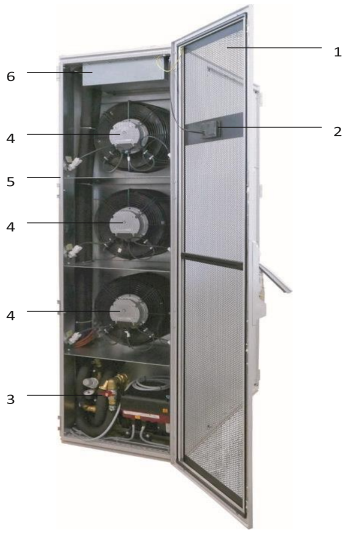


Figure 17—4; LCP DX/FC front – open front door

Key

[1]. LCP door
[2]. Display
[3]. Water unit (LCP DX/FC version only)
[4]. Fan (3 x)
[5]. Rack
[6]. Additional electronics box for options.

Key

[1]. Rear doors
[2]. Differential pressure sensor (option "air filter")
[3]. Expansion tank (LCU DX/FC version only)
[4]. Water unit pipework (LCP DX/FC version only)
[5]. Humidity sensor (option "humidifier" and "dehumidification“)
[6]. Air filter (option "air filter")
[7]. Connection lines to the external condenser
[8]. "Compressor" maintenance switch
[9]. Compressor
[10]. Humidifier (option "humidifier")
[11]. Inverter
[12]. Main switch
[13]. Electronics box with voltage connection and network connection

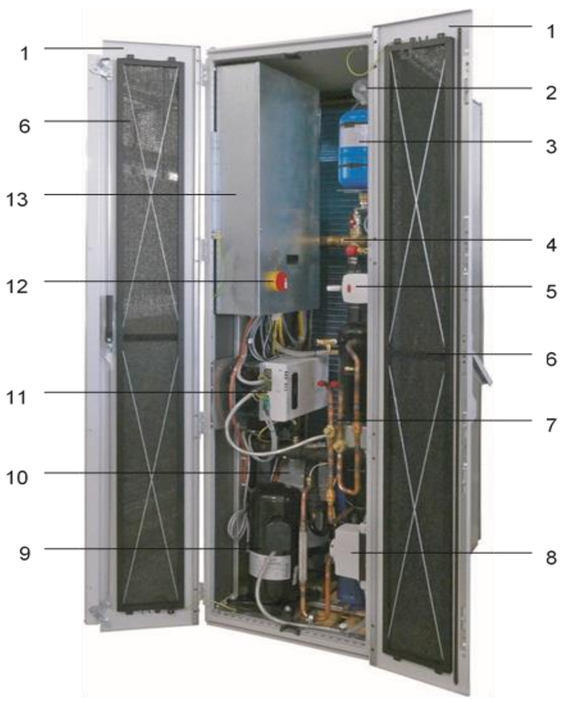
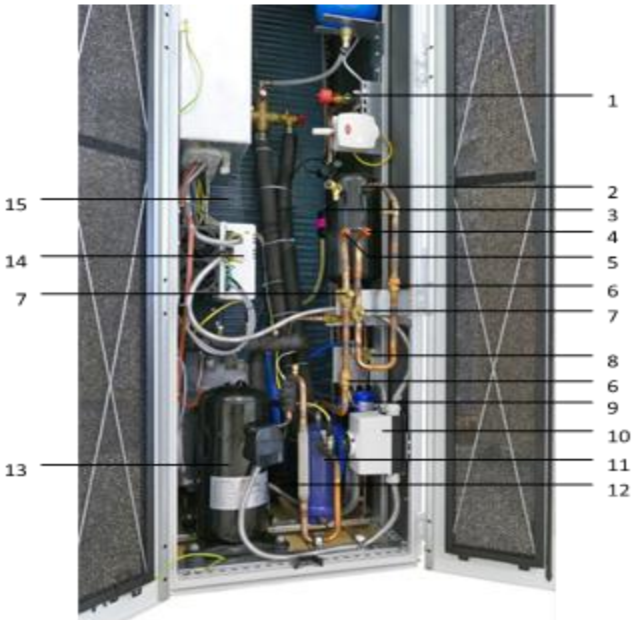


Figure 17—5; LCP DX/FC rear – rear door open

17.3.2 Coolant circuit

The coolant circuit consists of the following components:



Key

[1]. Electronic expansion valve
[2]. Refrigerant collector
[3]. Filter dryer
[4]. Liquid line
[5]. Hot gas line
[6]. Non-return valve
[7]. Manual shut-off valves liquid line and hot gas line
[8]. Oil filter
[9]. Sight glass refrigerant
[10]. "Compressor" maintenance switch
[11]. Oil separator
[12]. Condensate collecting tray
[13]. Compressor
[14]. Inverter

Figure 17—6; Coolant circuit – rear of the unit

Compressor: The compressor compresses the cool-ant and causes it to circulate from the low-pressure side (evaporator coil) to the high-pressure side (external condenser). The motor is activated by an external inverter, which controls the speed of the compressor and therefore allows the cooling output to be precisely adapted to the actual cooling requirement.

Evaporator coil: The evaporator coil (air/coolant heat exchanger) is positioned in the centre of the LCP DX. In the LCP DX/FC, the heating exchanger module is provided in duplicate, with separate modules for the cooling water circuit and the coolant circuit. Any condensate incurred is discharged into a condensate collecting tray in the bottom section of the device.

Electronic expansion valve: The expansion valve sup-plies the evaporator coil with the required volume of coolant to provide the corresponding cooling output in the current ambient conditions.

External condenser: The condenser is sited outdoors from the room where the LCP DX is situated. In the LCP DX/FC, the external condenser is also provided in duplicate, with separate modules for the cooling water circuit and the coolant circuit. Connection details for the LCP DX may be found in section 6 "Installation".

Temperature sensors: There are two temperature sen-sors installed on the front of the device near the fans. These measure the cold air temperature and forward the readings to the control unit. There are two further temperature sensors installed on the rear of the evaporator coil. These measure the hot air temperature and Evaporator coil

17.3.3 Water circuit

In the LCP DX/FC, a water-cooling circuit is integrated in addition to the coolant circuit. The unit is operated with an external condenser for indirect free cooling. Hence, in the appropriate ambient conditions, cooling of the hot air occurs either with the water-based cooling circuit only, in a mixed mode with both circuits, or with the coolant based circuit only.

Figure 17—8; Fan Module.

Key

[1]. Electrical connection for condenser, for indirect free cooling
[2]. Pump
[3]. Cooling water inlet (where connected to the top of the device)
[4]. Cooling water return (where connected to the top of the device)
[5]. Manometer
[6]. Pressure regulating valve
[7]. Shut-off valve
[8]. Connection for filling

17.3.4 Fan module

A fan module is essentially comprised of the fan itself. All three fan modules are controlled via a joint control unit. Fans may be operated with linear control between 30% and 100%.

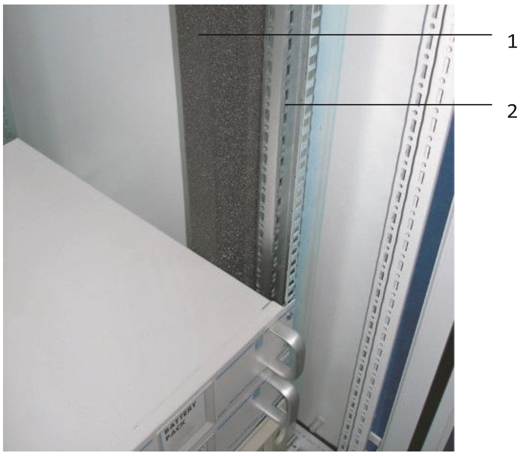
The fan modules are installed on rack-mounted shelves in the front section of the LCP DX.

It takes approximately 2 minutes to replace a single fan module with the system operational (see "Fan replacement").

Figure 17—7; Assembly Screws

Key

[1]. Assembly screws (4 x)
[2]. DC connection cable (control voltage)
[3]. AC connection cable (power supply)
[4]. Fan
[5]. Air baffle plate



Key

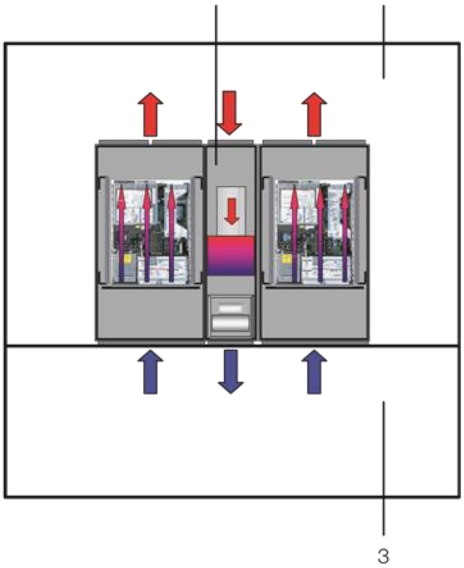
[1]. LCP DX
[2]. Hot aisle
[3]. Cold aisle

Figure 17—10; Foam strip and Device RACK

17.3.5 Seal the device enclosure

In order to ensure targeted air routing in the system, the device enclosure is vertically divided into hot air and cold air zones by sealing the 482.6 mm (19") level. Proceed as follows to seal the 482.6 mm (19") level:

If the device enclosure is only partially configured, seal the open sections of the 482.6 mm (19") level using blanking plates. Screw these tightly into the server rack from the front.



Key

[1]. Foam strip
[2]. Server rack

Figure 17—9; Installation room with cold aisle containment

If the device enclosure contains devices which require cooling via sideways air throughput (e.g. switches, router, etc.), cut-outs must be incorporated into the foam strips.

To do this, cut out a piece of the foam strip using a sharp knife.

If several devices which require sideways air throughput are included, cut out several pieces of the foam strip, as is appropriate, so that, ultimately, there is a cut-out in the foam to the left or right at the height of each such device in the server rack. Ensure that there are no gaps on the hot air side of the devices.

Using a sharp knife, cut additional pieces from the foam strip that are at least as long as the height of the built-in devices.

Attach the foam strips to the cold air side of the devices set back towards the rear, making sure that all fans built into the devices can draw air and that none of them are blocked.

The foam strips can be attached between the front and rear uprights of the server rack along the entire depth of the devices with sideways air throughput (fig. 12, item 1).

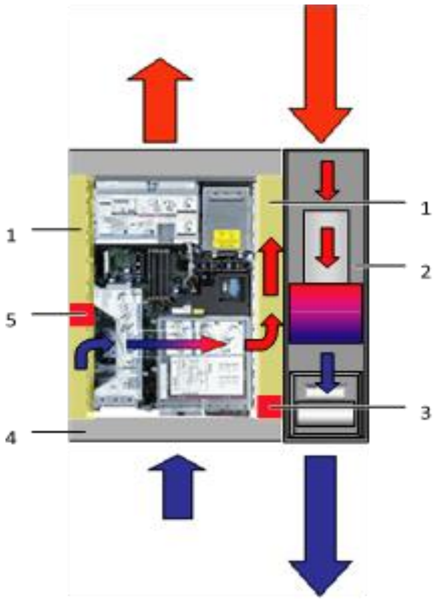


Figure 17—11; Area in which the foam strips can be positioned

Key

[1].	Area in which the foam strips can be positioned
[2].	LCP DX
[3].	Foam strips on hot air side
[4].	Server enclosure
[5].	Foam strips on cold air side

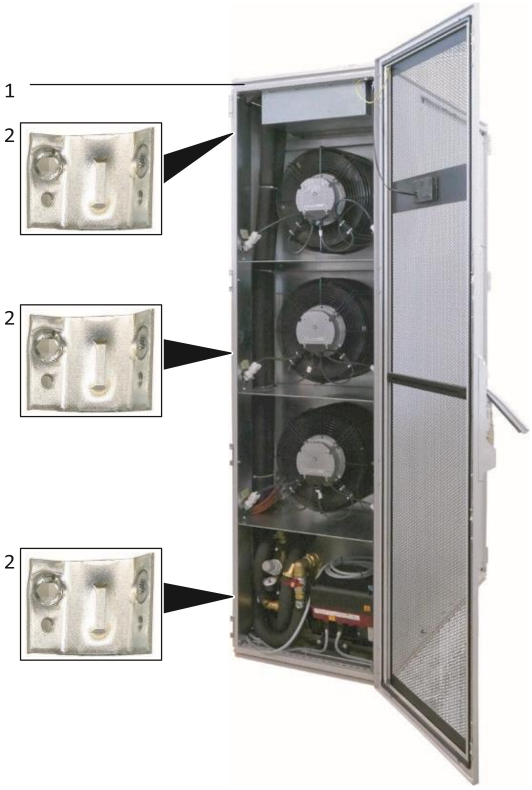


Figure 17—12; Rear LCP-DX.

Key

[1]. LCP DX

[2]. Baying connector

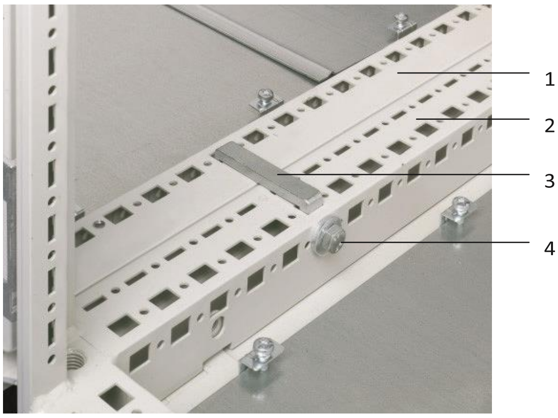


Figure 17—13; LCP-DX Assembly…

Key

[1]. LCP DX

[2]. Server enclosure

[3]. Baying clamp

[4]. Assembly screw of baying clamp

18 APPENDIX II

18.1 Ice water aggregate

Cooling system NICA-MPD-PLATFORM requires its own chiller water unit with a capacity of approximately 270 kW. The unit will be connected to the UPS, in the winter version, the system must ensure operation of the cooling circuits at temperatures up to -40^{0}C

Figure 18—1; Chiller for IT cooling

Order number SK 3232.851

The RITTAL IT chiller in conjunction with free cooling supplies exceptionally energy- and cost-efficient IT cooling media. The system is specially designed for supplying critical IT applications cooled via LCP, air/water heat exchangers or CRAC systems. In this atmospherically sealed system, redundant, speed-regulated pumps, compressors, emergency cooling or buffer stores ensure optimum operational reliability and fail-safeness. Alongside optional heat recovery from the system, connection to RITTAL free cooling systems ensures exceptionally energy-efficient operation. Free cooling uses cold ambient air for cooling, reduces operating costs by up to 80%, extends the service life of components, and increases operational reliability. If the free cooling performance is insufficient, the IT chiller will cut in.

[1]. Redundant pumps, speed-controlled
[2]. Redundant scroll compactor
[3]. Intelligent control concept
[4]. Interfaces: SNMP, BACnet
[5]. Integral or separate free coolers (optional)
[6]. Integral automatic bypass valve
[7]. Flow monitor, Operating costs are minimised, thanks to high water inlet temperatures for LCP and CRAC operation
[8]. High COP (coefficient of performance)
[9]. Integration into RiZone

18.2 Mixed water for LCP

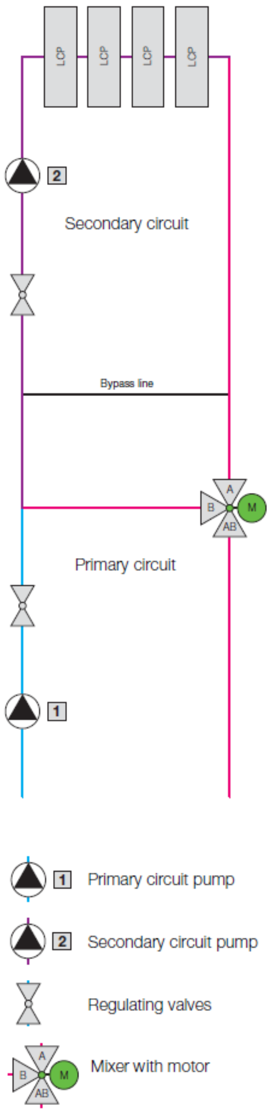


Figure 18—2;
Cold Water SYstem

IT climate control generally poses a major challenge for the functioning of the cold-water system, because the IT equipment whose heat loss is dissipated by the cold-water system can undergo multiple load changes per minute. This hysteresis is transferred directly to the cold-water system, leading to a fluctuating dT in the cold-water system. If the IT equipment causes a major load step, leading to a rapid increase in heat loss, cold water must be made available immediately by the cold-water system. Depending on the distance of the cooling unit from the IT cold water circuit, this can create a very significant dead time, during which no water is available to cool the IT heat loss.

Use of a hydraulic circuit can compensate for this response, caused by the IT equipment. By assembling a hydraulic circuit such as an injection circuit, the cold-water system is able to counteract the hysteresis generated by the IT equipment.

18.3 Dimensioning and design of the pipework for IT climate control

Because of hysteresis induced by the IT equipment, dT fluctuations in the cold-water circuit are unavoidable. Fluctuations of between 1 K and 10 K are not uncommon in IT climate control. For this reason, the usual dT of 6 K for a cold-water circuit cannot be used to calculate the pipework. With LCPs, the volumetric flow required for the rated cooling output is always specified. This specified volumetric flow is used to select the correct pipe dimensions when calculating the pipework. Because very high cooling outputs of up to 55 kW are required for each LCP, in addition to individual sections of pipe it is also advisable to hydraulically regulate the individual connection lines.

18.4 Function of the injection circuit

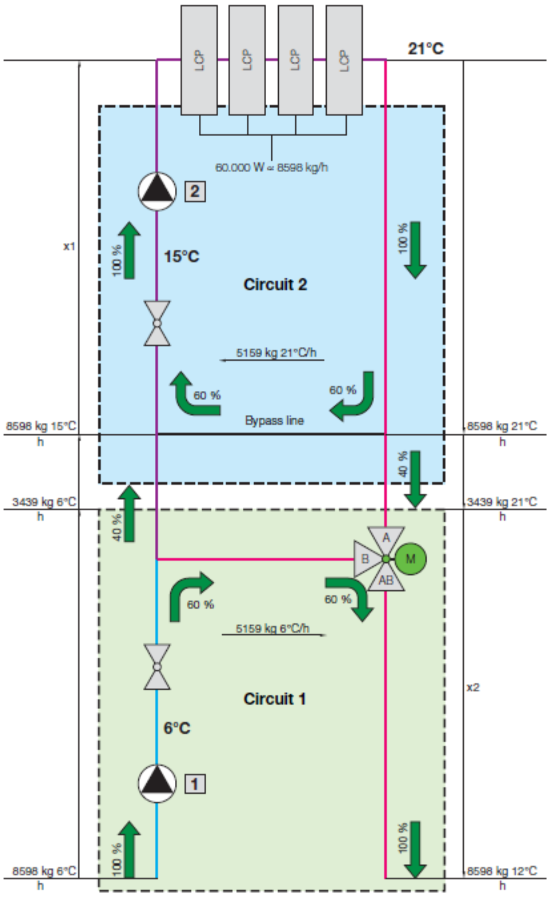


Figure 18—3; Function of the injection circuit

The injection circuit is a tried-and-tested hydraulic circuit which is used whenever it is necessary to make water at the correct temperature available quickly to the equipment. The primary circuit is installed as close as possible to the secondary circuit. The secondary circuit is assembled in the immediate vicinity of the equipment. The cold water is able to circulate permanently in the primary circuit, and is therefore always available when needed by the secondary circuit. Without this circuit, the cold water would first need to cover the entire distance from the producer to the equipment whenever the flow rate is altered by the equipment. Here too, there may be a significantly lower temperature in the primary circuit than in the secondary circuit (primary circuit 6°C/secondary circuit 15°C as a result of mixing).

In this way, the primary circuit pump 1 permanently supplies the secondary circuit with water. The mixer valve in the return limits the volume of water flowing out of the secondary circuit and

back into the primary circuit. This therefore limits the incoming water volume as well. The secondary circuit pump allows the entire volume of water required for cooling in the secondary circuit to circulate and is responsible for mixing the temperatures.

Pump 2 allows water from the secondary return to be “injected” into the secondary inlet via the bypass. In this way, cold water from the primary circuit is raised directly to the correct temperature level. The injection circuit is just one example of many possibilities for adapting the cold-water system to the requirements of IT climate control.

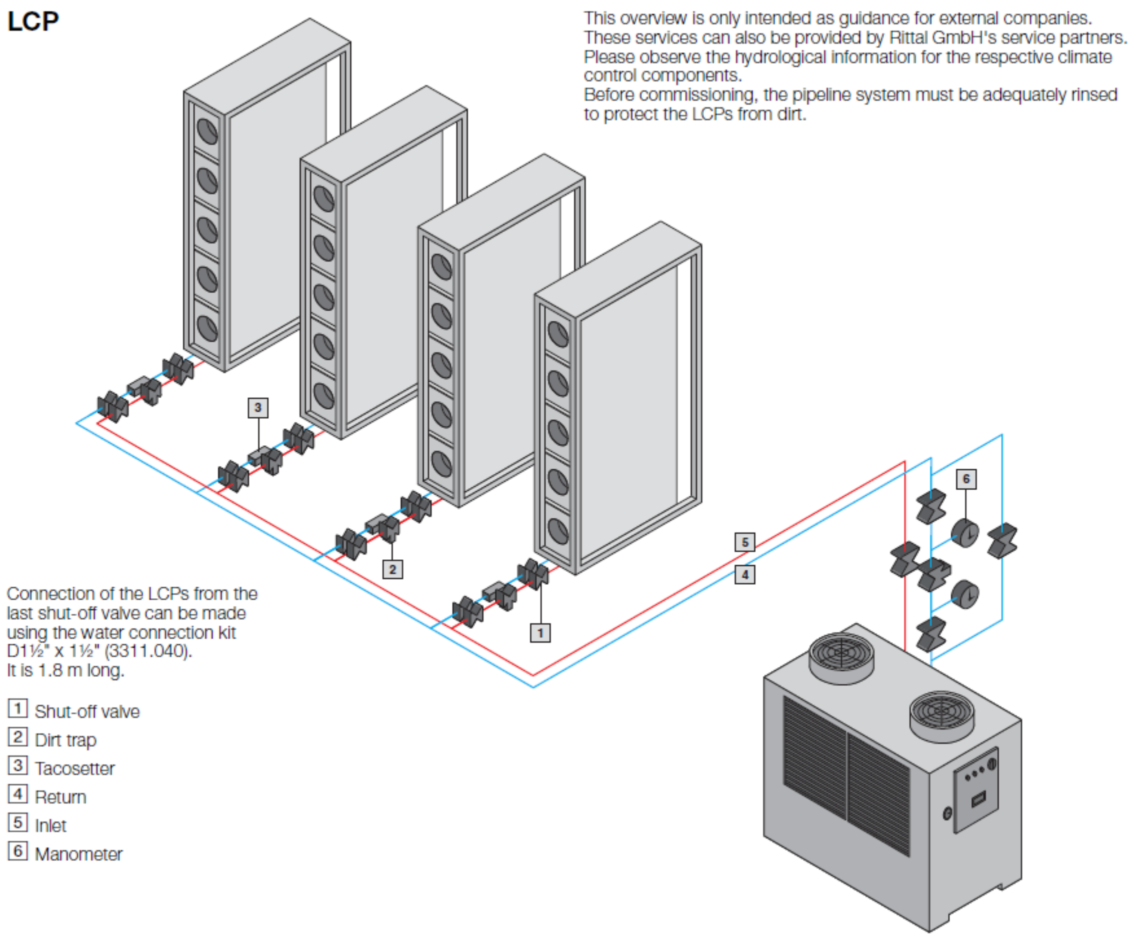


Figure 18—4; LCP Diagram.

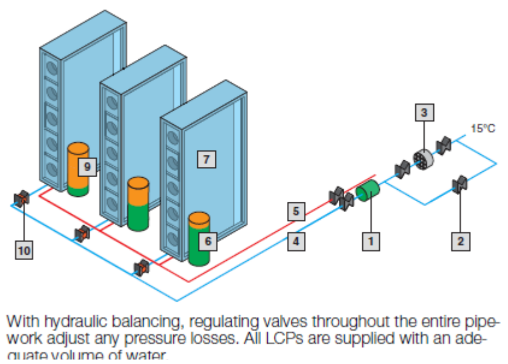


Figure 18—6; Cooling distribution with hydraulic balancing

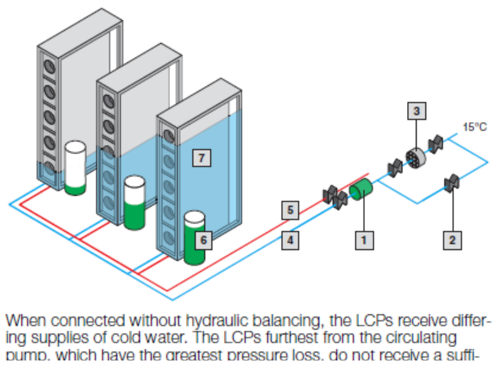


Figure 18—6; Cooling distribution without hydraulic balancing

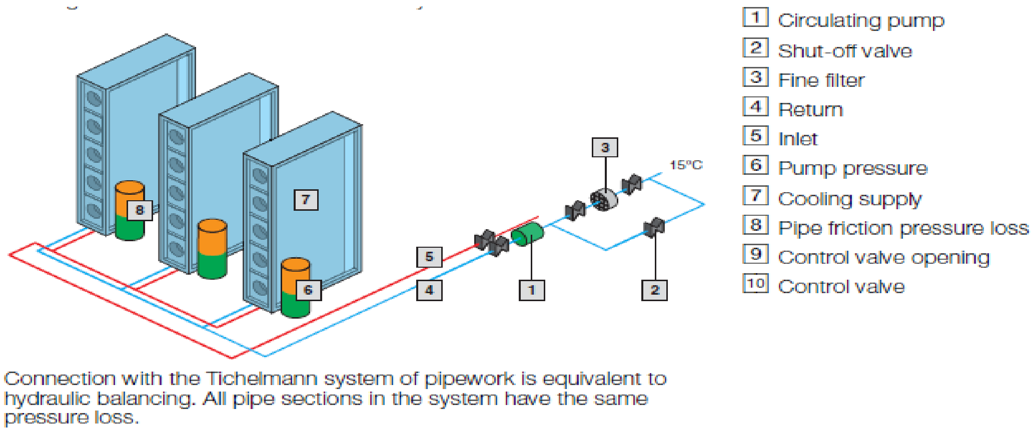


Figure 18—7; Cooling distribution with Tlchellman system.

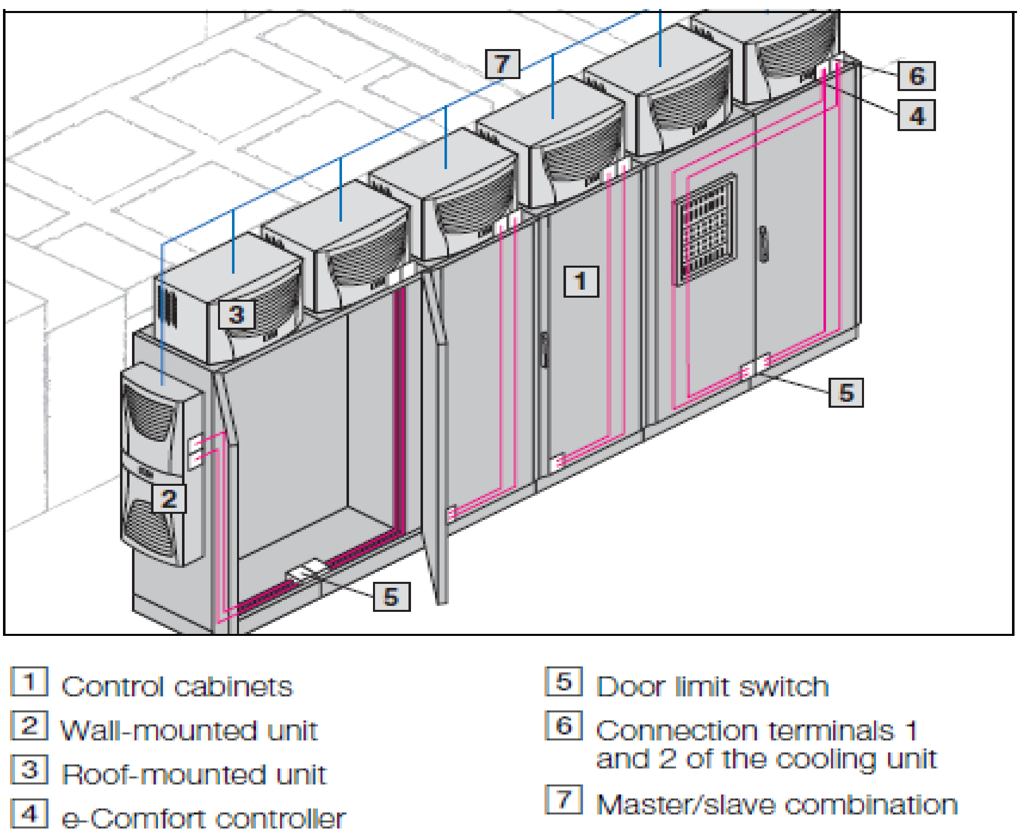


Figure 18—8; Control Cabinets.

18.4.1 Master/slave operating mode

In open bayed enclosure systems, which are not separate from one another, cooling units and air/water heat exchangers with e-Comfort control should always be used. These may be linked in master/slave mode via bus cable SK 3124.100:

[1]. Simultaneous activation and deactivation of the devices
[2]. Parallel fault and door limit switch function
[3]. Even temperature distribution across all sections of the enclosure

18.4.2 Master/slave operation and interface board

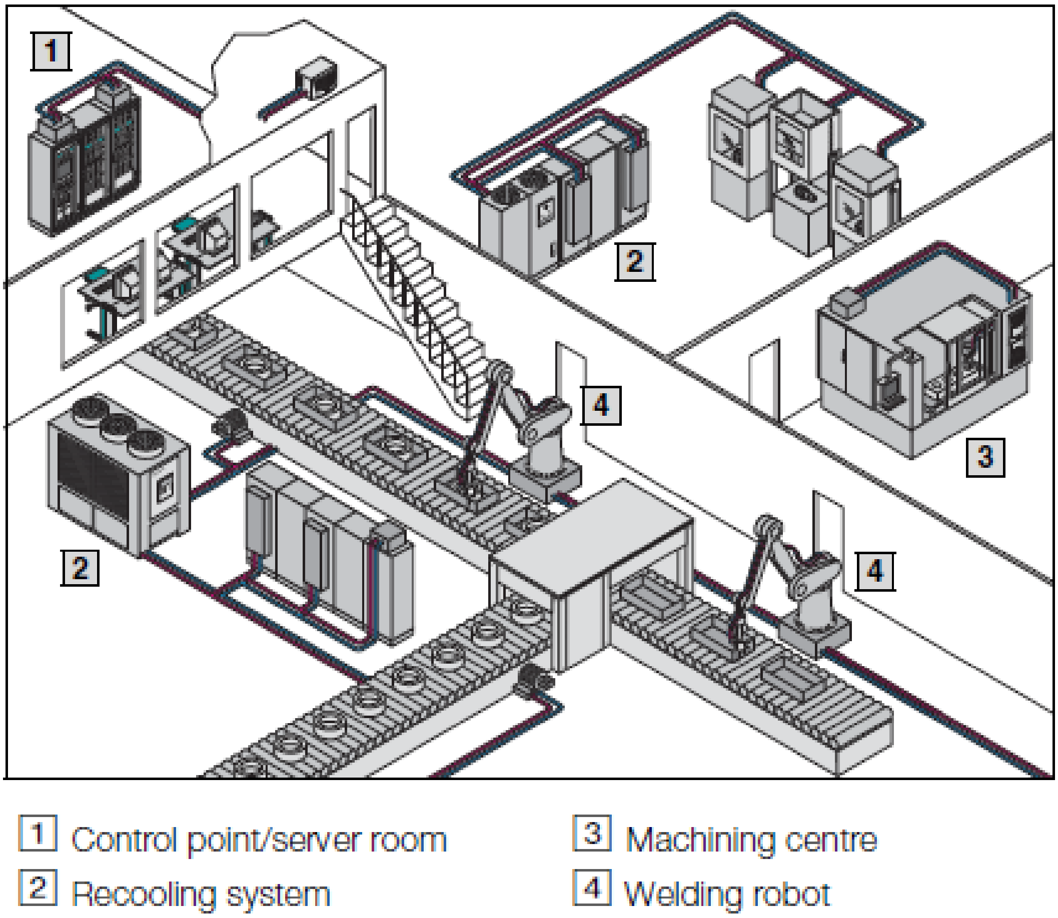


Figure 18—9; Control Server Room.

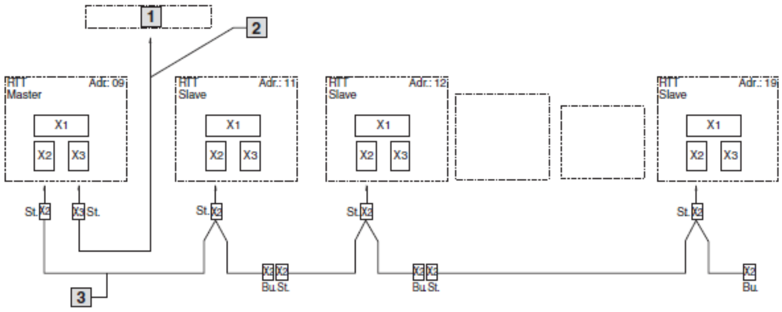


Figure 18—10; Application example…

Application example:

[1]. Serial interface card, Model No. 3124.200
[2]. Serial interface cable
[3]. Master/slave BUS cable, Model No. 3124.100

RTT = Rittal TopTherm cooling unit / air/water heat exchanger
X1 = Supply connection/door limit switch/alarms
X2 = Master/slave connection SUB-D, 9-pole
X3 = Serial interface SUB-D, 9-pole
St. = SUB-D connector, 9-pole
Bu. = SUB-D jack, 9-pole
Connection example:
Master/slave operating mode with bus cable and interface board

Description:

The address of the master depends on the number of attached slave units (09 = master with 9 slave units). The address of a slave unit always begins with a 1. The 2nd digit represents the actual address. Up to a maximum of 9 slave units may be operated with one master unit, whereby any unit may be the master. The maximum overall length of all connected units is 50 m. Single-phase and 3-phase units may be connected.

19 APPENDIX III

19.1 Power Distribution

Figure 19—1; Busbar holder Flat copper bars
Order number SV 9340.010

19.2 Unit international

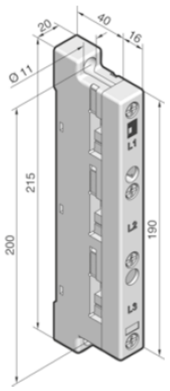
RiLine busbar systems (60 mm)

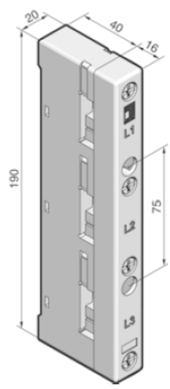
Flat copper bar systems
up to 800 A

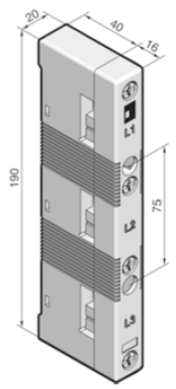
Technical information
for the calculation of
rated currents to
DIN 43 671,
see chapter 2-102, page 1/2

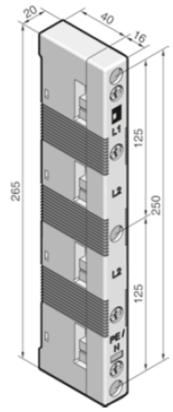
Note:
– UL approval only applies in conjunction with AC application

Approvals:
c UL us LISTED
E191125









Number of poles		3-pole			4-pole
Bar centre distance mm		60			60
Rated operating voltage	IEC	1000 V AC	1000 V AC	1000 V AC	1000 V AC
		–	–	1500 V DC	–
	UL	–	–	600 V AC	600 V AC
For busbars mm	12 x 5/10[1)]	■	■	–	■
	15 x 5 – 25 x 10, 30 x 5	■	■	■	■
	30 x 10	■	■	■	■
For application		IEC	IEC	IEC/UL	IEC/UL
Model No. SV		**9340.010**	**9340.000**	**9340.050[2)]** UL	**9340.004[2)]** UL

Figure 19—2; Busbar holder Flat copper bars

Figure 19—3; End Cover
Order number SV 9340.070

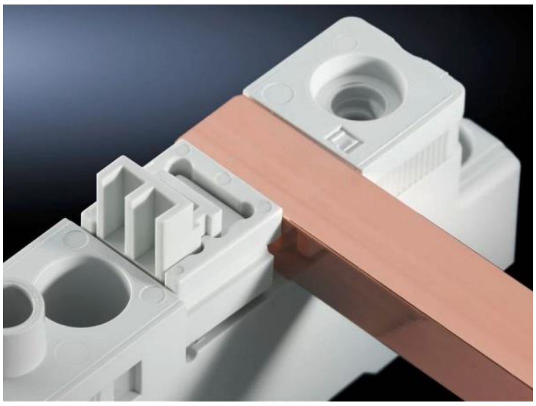


Figure 19—3;Bus Bar System…

RiLine busbar systems (60 mm)

Connection adaptors

Rated current max. 63 – 800 A

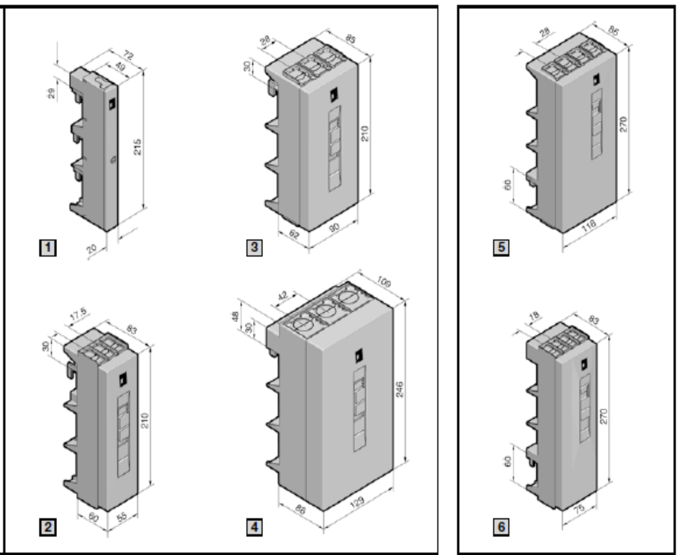
For 60 mm busbar systems

Note:

- For technical information on the connection of conductors and connectors, see chapter 2-101, page 4
- UL approval only applies in conjunction with AC application
- The rated operating voltage for DC applications depends on the busbar arrangement in the busbar support SV 9340.050, SV 9341.050, SV 9342.050

Approvals:

E191125 E191125



Version		3-pole				4-pole	
		1	2	3	4	5	6
Rated current max.	IEC	63 A	125 A 1)	250 A 1)	800 A	125 A	250 A
	UL	60 A	125 A	250 A	600 A	125 A	250 A
Rated operating voltage	IEC	690 V AC	690 V AC	690 V AC	690 V AC	690 V AC	690 V AC
	UL	600 V AC	600 V AC	600 V AC	600 V AC	600 V AC	600 V AC
		Model No. SV				**Model No. SV**	
Cable outlet	Top/bottom	–	**9342.220**	**9342.250**	**9342.280**	**9342.224**	**9342.254**
	Top	**9342.200**	–	–	–	–	–
	Bottom	**9342.210**	**9342.240**	**9342.270**	**9342.300**	–	–
Rated operating voltage IEC	L1 + L2	1000 V DC	1000 V DC	1000 V DC	1000 V DC	–	–
	L1 + L3	1500 V DC	1500 V DC	1500 V DC	1500 V DC	–	–
		Model No. SV				**Model No. SV**	
Cable outlet at the bottom		**9342.210**	**9342.240**	**9342.270**	**9342.300**	–	–

Figure 19—5; Connection Adapter
Order number SV 9342.250

Figure 19—6; OM adapter with connecting cables
Order number SV 9340.710

OM adaptors with connection cables

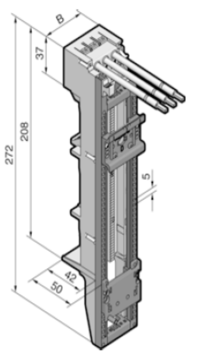
Rated current max. 16 – 25 A

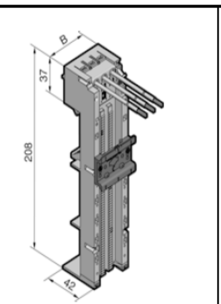
3-pole, for 60 mm bar systems

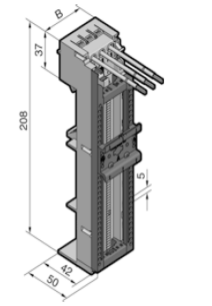
Note:
- For technical information on current carrying capacity of connection cables, see chapter 2-101, page 5
- Maximum continuous operating temperature of the adaptor's connection cables: 105°C

Approvals:

c UL us LISTED
E191125







		9340.760	9340.310	9340.340
Width (B) mm		45	45	45
Rated current max.	IEC	16 A	25 A	25 A
	UL	–	25 A	25 A
Rated operating voltage	IEC	690 V AC	690 V AC	690 V AC
	UL	–	600 V AC	600 V AC
Connection cables[1] Length (mm)		AWG 12 (165)[3]	AWG 12 (130)	AWG 12 (130)
Support rail version[2]		TS 45D	TS 45C	TS 45C
Support rail height mm		10	10	10
Model No. SV		**9340.760** UL	**9340.310** UL	**9340.340** UL

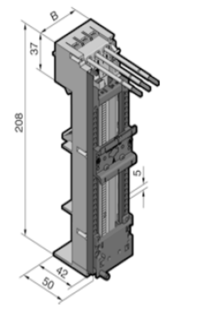
[1] AWG = American Wire Gauges · AWG 12 = 3.31 mm² ≙ 4 mm²
[2] TS XXC with anti-slip guard · TS XXD without anti-slip guard · TS XXD-V without anti-slip guard, for variable positioning on the support frame (support rail latch is secured from behind with the support frame loosened)
[3] OM adaptors with extended connection cables for switchgear, e.g. Siemens 3RV2011... and 3RV2021... (build size S00/S0)

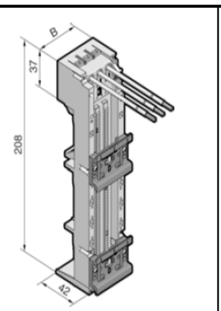
3-pole, for 60 mm bar systems

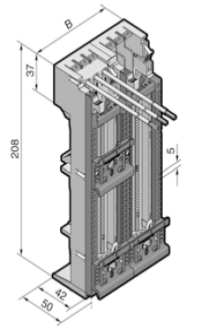
Note:
- For technical information on current carrying capacity of connection cables, see chapter 2-101, page 5
- Maximum continuous operating temperature of the adaptor's connection cables: 105°C

Approvals:

c UL us LISTED
E191125







		9340.370	9340.320	9340.400
Width (B) mm		45	45	90
Rated current max.	IEC	25 A	25 A	25 A
	UL	25 A	–	–
Rated operating voltage	IEC	690 V AC	690 V AC	690 V AC
	UL	600 V AC	–	–
Connection cables[1] Length (mm)		AWG 12 (130)	AWG 12 (130)	AWG 12 (130)
Support rail version[2]		TS 45C	TS 45D	TS 45D, TS 45D-V
Support rail height mm		10	10	10
Model No. SV		**9340.370** UL	**9340.320** UL	**9340.400** UL

[1] AWG = American Wire Gauges · AWG 12 = 3.31 mm² ≙ 4 mm²
[2] TS XXC with anti-slip guard · TS XXD without anti-slip guard · TS XXD-V without anti-slip guard, for variable positioning on the support frame (support rail latch is secured from behind with the support frame loosened)

Figure 19—4; Adaptors with connection cable.

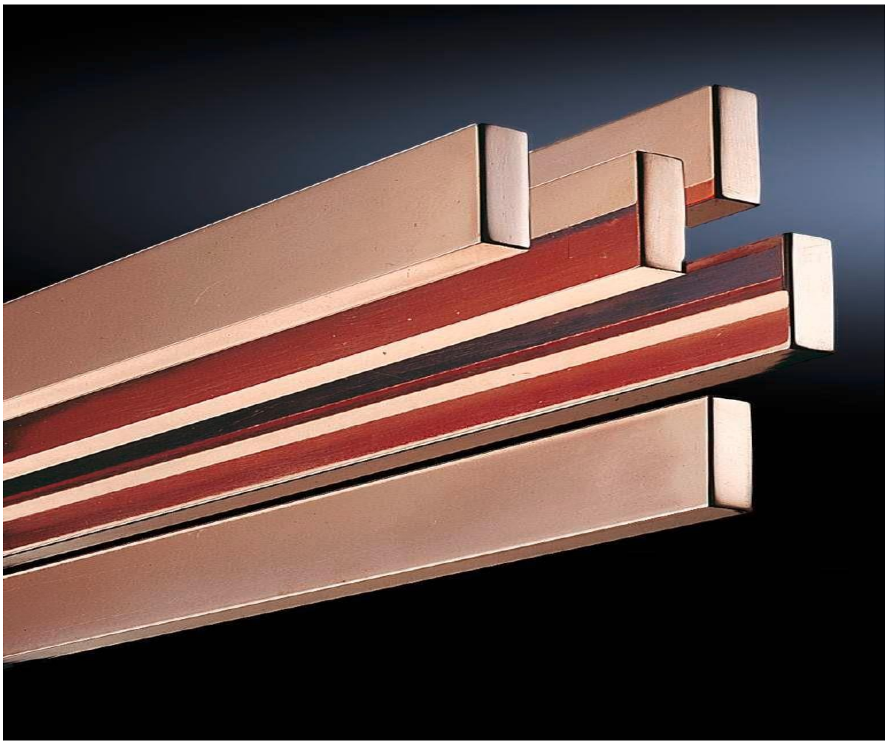


Figure 19—8; Busbars E-Cu
Order number SV 3581.000

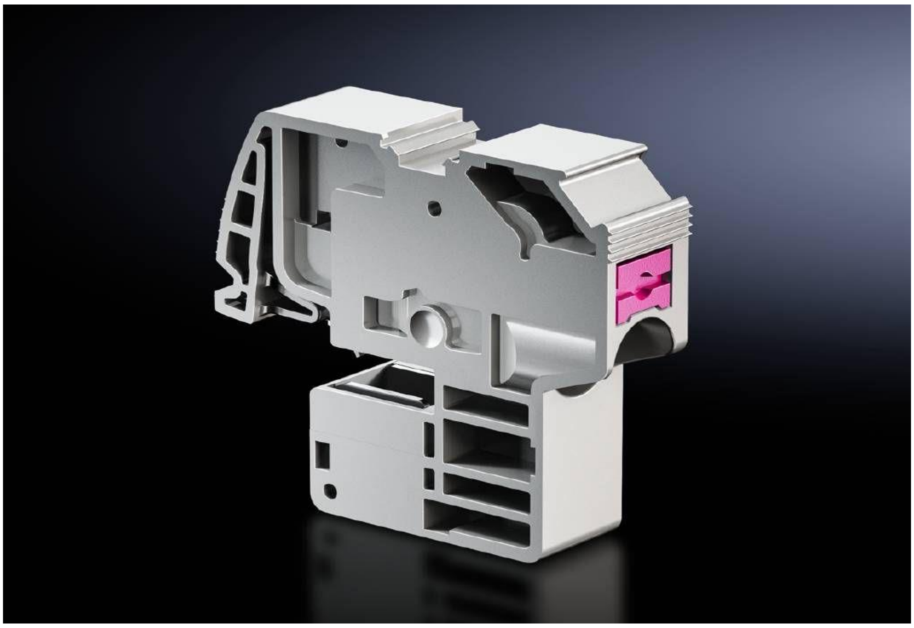


Figure 19—9 Conductor connection terminals push-in
Order number SV 3451.505

Figure 19—5; Schienenverbinder
Bestell-Nummer SV 9350.075

Figure 19—7; NH fuse switch disconnector
Gr. 00 to 3
Order number SV 9343.000

Figure 19—7; Sammelschienen-Abdeckprofile
Bestell-Nummer SV 9350.010

Figure 19—8; Smart Monitoring System NH-Messmodul für NH-Sicherungslasttrenner
Bestell-Nummer SV 9343.070

20 APPENDIX IV

20.1 Power Distribution Unit international

Compact power distributor for use in IT servers and network enclosures. Please observe the relevant product dimensions and check whether the PDU may be installed in your preferred rack. The PDU dimensions and the minimum rack height required may be found in the ordering table in the RITTAL Catalogue. The technical specifications listed below apply wholly or partially to the following PDU products:

a) PDU metered (power measurement at the infeed or per phase. Without switching function)

Figure 20—1; PDU international, execution manager
Order number DK 7955.433

b) PDU switched (power measurement at the infeed or per phase. With switching function)
c) PDU managed (power measurement per individual outgoing slot. With switching function)
d) Slave PDU managed (like PDU managed, but without display and network interface, with CAN bus for connecting to CMC III or PDU metered/switched/managed)

Technical specifications apply to the following product variants:

PDU metered DK 7955.2XX, PDU switched DK 7955.3XX, PDU managed DK 7955.4XX Technical

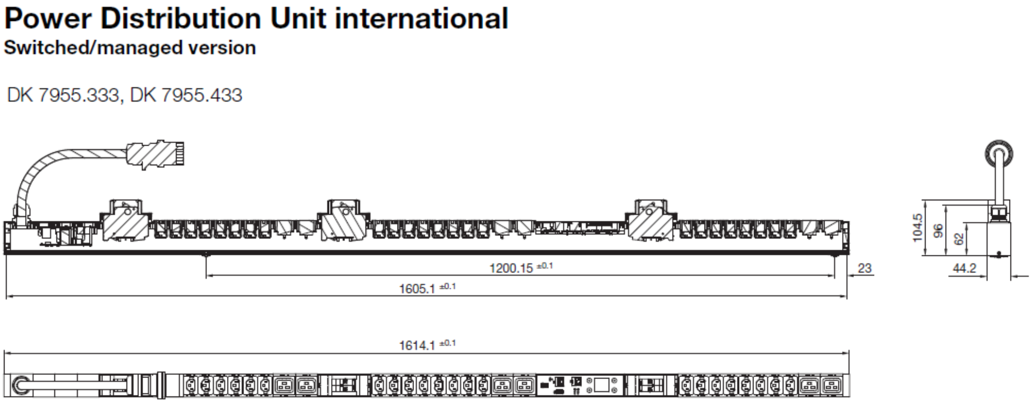


Figure 20—2; Power Distributor Unit International.

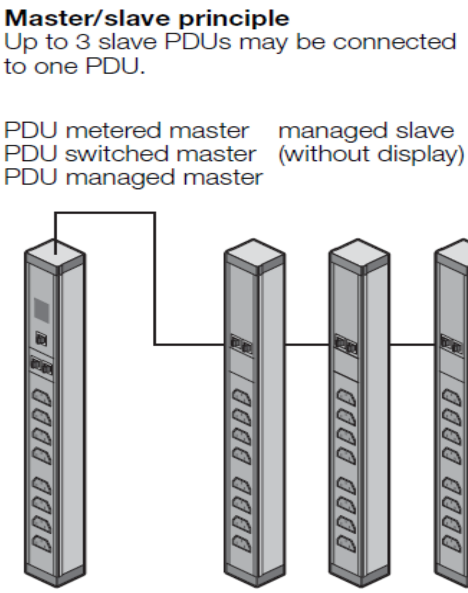


Figure 20—3;PDU MASTER SLAVE Principle.

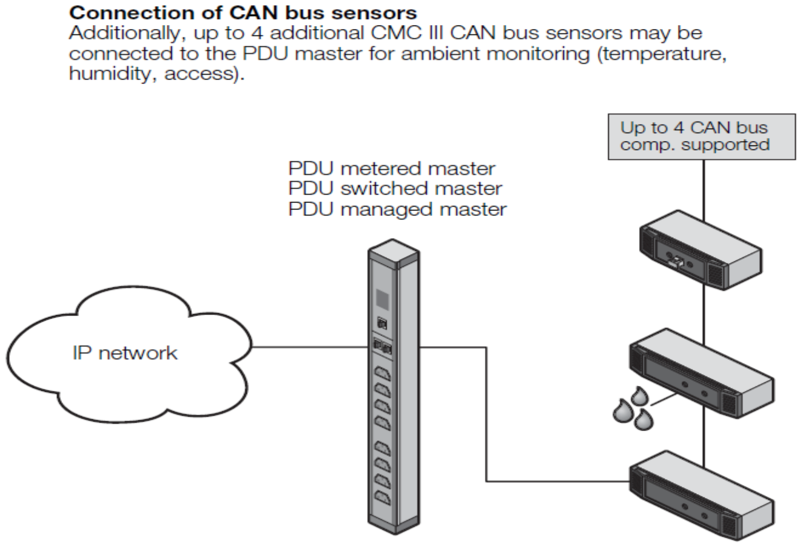


Figure 20—4; Connection of CAN bus sensors.

20.2 Power Distribution Unit, sample applications

Master/slave principle Up to 3 slave PDUs may be connected to one PDU.

Figure 20—5; Master/slave principle Up to 3 slave PDUs may be connected to one PDU.

Connection of CAN bus sensors. Additionally, up to 4 additional CMC III CAN bus sensors may be connected to the PDU master for ambient monitoring (temperature, humidity, access).

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21 APPENDIX V

21.1 Naming and Numbering Convention for MPD Detector Part Identification - Generic Scheme

This document outlines a convention for naming and numbering of individual detector parts. The goal of the convention is to provide a straightforward and independent method for deriving a unique part identification number for each sub-detector component produced in the NICA-MPD detector groups and used in the construction of the MPD detector. The part identification numbers will be used for physical labelling of components, as database identifiers in the various MPD and external EqDb (Equipment Database), and to ensure traceability of the parts carrying an identifier throughout the lifetime of the experiment.

Naming and Numbering Convention for the NICA MPD & BM@N Detectors Part Identification & Generic Scheme

NICA-MPD Project Document No: NICA-MPD-2018-001	EDMS Document No.: 000001	Released: 02/09/2018	Page: 1 of 6
		Modified: 02/09/2018	Vers. No.: 1.0

Naming and Numbering Convention for MPD Detector Part Identification - Generic Scheme

Abstract

This document outlines a convention for naming and numbering of individual detector parts. The goal of the convention is to provide a straightforward and independent method for deriving a unique part identification number for each sub-detector component produced in the NICA-MPD detector groups and used in the construction of the MPD detector. The part identification numbers will be used for physical labelling of components, as database identifiers in the various MPD and external **EqDb** (**Eq**uipment **D**ata**b**ase), and to ensure traceability of the parts carrying an identifier throughout the lifetime of the experiment.

Prepared by: **M. J. PERYT ES JINR; WUT**	Checked by:	Approved by:
Distribution List: **NICA ALL**	EDMS approval required by:	Engineering Support, April 2019

1. Introduction

1.1 This document outlines a standard convention for assignment of a unique part identifier for every physical component in the MPD detector. As all naming conventions, this one will be effective only if adopted by all institutes and laboratories participating in the MPD experiment and is an integral part of the global MPD naming and numbering scheme: the MPD coordinate system [1] and the rules for the determination of equipment functional position names in a sub-detector [2]. Following the guidelines from [2], all detector groups in MPD should establish a document that defines the convention for functional position names for the sub-detectors under their responsibility.

1.2 The concept of a globally applicable and accepted convention is of special importance in view of the distributed production of the MPD sub-detectors. The convention should allow for an independent part identification number generation on-site, with enough built-in protection to assure that the generated ID is not duplicated elsewhere. During the construction phase the part identifiers will simplify the installation of the MPD detector from its sub-detector components and will allow the creation of a centralized part repository from the individual sub-detector repositories. It will also facilitate traceability of components used in the detector and during part replacement, which is now mandatory due to INB regulations.

1.3 The MPD detector part identifier convention is based on principles widely used in industry and outlined in the EAN international standard [3]. Similar schemes are adopted by other NICA experiments, notably BM@N [4] and other.

2. Application and scope of the convention

1.4 A physical object in a sub-detector should get a part identifier if it can be described as:

1.5 An indivisible logical component or an assembly of components with a set of characteristics that have to be stored and to be retrievable for subsequent use. For example: an electronics chip, spool of wire, a readout card, detector module;

1.6 A service or connection element. For example: electronics crate, power supply, signal cable, gas or water pipe.

1.7 The decision to assign a part identifier to an object is at the discretion of the detector group, since trivial objects do not necessitate having one.

3. Structure of the part identifier

3.1. The part identifier is fixed length, 16 – character alpha-numeric code composed of:

3.1.1. 7-character prefix, which carries information about the sub-detector and the detector group. The prefix is codified and can only contain a fixed set codes:

3.1.2. 9-character field, which contains two reserved positions witch special functions (see section 3.3) and a serial number with 9 999 999 possible values, assigned by groups. The serial number should contain only digits from 0-9 in every position.

3.2. Any example of the part identifier structure and position assignment is given in Figure 1.

4. FIGURE 1. MPD Part Identifier. Structure and position assignment. In the example, the part belongs to the TPC sub-detector and is produced at GSI Darmstadt.

	PREFIX							SUB-DETECTOR - FIELDS								
	1	T	P	C	G	S	I	0	0	1	2	3	4	5	6	7
POSITION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	MPD experimental code (fixed to 1)	Sub-detector or system code (see Table 1)			Group code (see Table 2)			Reserved (default 0)		Serial Number						

Position No.1 In the prefix is used for experiment's code. For MPD, its value is 1. The BM@N collaboration code is 2 etc. see Table 1.

5. The part identifier prefix, (positions 1 to 7)

5.1. The main role of the prefix is to assure that all part identifiers issued by sub-detector group are unique and to provide some information on the part origin and its sub-detector association. All allowed prefixes and their assignment to systems and sub-detectors are given in **Table 1** and to groups are given in **Table 2**

6. The part identifier sub-detector fields, (positions 8 to 16)

6.1. The detector groups assign the value in the **reserved positions 8 and 9** and **the serial number (positions 10-16).** The rules for the use of the reserved fields are given in section 3.3.

6.2. In principle, the serial number is not supposed to describe the type or nature of the part it identifies. In practice, ranges of numbers may be reserved in advance for similar parts, for example numbers from 1-10000 can be retained for readout cards, numbers from 10001 to 10100 can be set aside for optical fibres, etc. If needed, a range of numbers can be assigned by the detector group for external use, for example by a subcontractor. The general rule is that the use of serial numbers should be sufficiently documented by each detector group by keeping a log of the number to part type relation and through databases.

7. Reserved positions

7.1. Position No.1 in the part identifier prefix assures that all parts, which belong to the NICA-MPD experiment, can be identified in the NICA environment by a person or automatic bar code reader without any knowledge of the NICA-MPD naming and numbering convention. This functionality and the value of 1 are mandated by a centrally defined coding scheme, outlined in [5].

7.2. Position No.8 is to be used by the detector groups for additional distinction of the part origin:

7.2.1. The value remains zero if the part is produced by the detector group;

7.2.2. Digits other than zero or letters can be assigned to an external supplier of a given part. The detector group should document the meaning of the number or letter combination.

7.3. Position No.9 is to be used for the special case, when the part is a cable (signal, LV, HV, communication, fibre optics), or a gas or water pipe. Its value is zero for all other components. A cable is signified by a letter C in this position, a pipe is signified by letter P.

8. Bar code standard for production of part identifier stickers

8.1. It will often be necessary to encode the part identifier into a bar code sticker for a specific part. The most commonly used bar code standard today is UCC/EAN-128 [3].

8.2. This is one of the most compact linear bar code systems, an important advantage for labelling of small objects. The code also incorporates two independent self-checking features that improve the scanning reliability.

8.3. The use of barcodes for part labelling is mandatory and will facilitate operation and bookkeeping.

9. Sub-detector and group codes

9.1. **Table 1** lists the mnemonic codes for the sub-detectors and **systems to be used in positions, 2-4** and **Table 2** gives the **group codes to be used in positions 5-7 of the part identifier.**

10. Table 1. Sub-detectors and systems mnemonic codes

	Code	Sub-detector or system
1.	MPD	Multi-Purpose Detector
2.	SPD	
3.	BMN	BM@N
4.	MAG	Magnets
5.		
6.		
7.		
8.		
9.		
10	ITR	Inner TRacker
11.	TPC	Time Projection Chamber
12	ECT	Straw End-Cap Tracker
13.	TOF	Time of Flight
14.	EMC	ElectroMagnetic Calorimeter
15.	BBC	Beam-Beam Counter
16.	ZDC	Zero Degree Calorimeter
17.	FD1, FD2	Forward Detector1
18.		
19.	CPC	Cathode Pad Chamber
20.	CRY	Cryostat
21.	EqDb	Equipment Database
22.	DAQ	Data Acquisition
23.	SCS	Slow Control System
24.	DCS	Detector Control System
25.	RAP	RACK Platform
26.	GSS	Gas Supply System
27.	SFR	Space Frame
28.	EXH	Experimental hall
29.	FS	Forward Spectrometer
30.	OTR	Other (not classify)
40.	EqDb	Equipment Database

11. Table 2. Group mnemonic codes

	Code	Institute	
	ALE	ALESSANDRIA	
	ALI	ALIGARH	
	AMS	AMSTERDAM	AMSTERDAM INSTITUTE FOR ADVANCED METROPOLITAN SOLUTIONS Marineterrein Amsterdam Kattenburgerstraat 5, Building 025, 1018 JA Amsterdam https://www.ams-institute.org/institute/contact/
	ATH	ATHENS	ATHENS TECH COLLEGE Τατοΐου 2 & Όθωνος 77 Κηφισιά 2 Tatoiou Str. & 77 Othonos Str.ZIP 145 61, Kifisia http://www.athtech.gr/en/
	BAI	BARI Politecnico	Politecnico di Bari Via Amendola 126/b - 70126 Bari http://www.poliba.it/
	BAI	BARI University	
	BEI	BEIJING	
	BUC	BERGEN College	
	BUR	BHUBANESWAR	
	BIR	BIRMINGHAM	
	BRA	BRATISLAVA	
	BIP	BUCHAREST IPNE	
	BIS	BUCHAREST ISS	
	BOL	BOLOGNA	
	BUD	BUDAPEST	
	UCT	CAPE TOWN	
	CAG	CAGLIARI	
	CAT	CATANIA	
	CER	CERN	
	CHA	CHANDIGARH	
	CLR	CLERMONT-FERRAND	
	OSU	COLUMBUS State University	
	OSC	COLUMBUS S.C. Centre	
	CRE	CREIGHTON	
	NBI	COPENHAGEN	
	GSI	DARMSTADT GSI	
	IKF	DARMSTADT IKF	
	JIN	DUBNA JINR / RCANP	International Intergovernmental Organization Joint Institute for Nuclear Research Joliot-Curie, 6 Dubna, Moscow region, Russia, 141980 http://www.jinr.ru/about-en/
	FRA	FRANKFURT	
	GAT	GATCHINA	
	HDP	HEIDELBERG-PHYS.	
	KIP	HEIDELBERG-KIRS.	
	JAI	JAIPUR	
	JAM	JAMMU	

	HIP	JYVASKYLA	
	KAN	KANGNUNG	
	KPT	KHARKOV IPT	
	KIE	KIEV	
	KSA	KOLKATA SAHA	
	KVE	KOLKATA VECC	
	KHS	KHARKOV SRTIIE	
	KOS	KOSICE IEP	
	KRA	KRAKOW	
	KUR	KURCHATOV	
	LNL	LEGNARO	
	LIS	LISBON	
	LUN	LUND	
	LYO	LYON	
	MEX	MEXICO	
	MIN	MOSCOW INR	
	MME	MOSCOW MEPHI	
	MTE	MOSCOW ITEP	
	MUE	MUENSTER	
	NAN	NANTES	
	NOV	NOVOSIBIRSK	
	OAK	OAK RIDGE	
	ORS	ORSAY	
	OSL	OSLO	
	PAD	PADOVA	
	POH	POHANG	
	PRG	PRAGUE	
	PRO	PROTVINO	
	PUE	PUEBLA	
	REZ	REZ	
	ROM	ROMA LA SAPIENZA	
	SAC	SACLAY	
	SAL	SALERNO	
	SAR	SAROV VNIIEF	
	SFE	SPLIT FESB	
	SPB	ST PETERSBURG RF	
	STR	STRASBOURG	
	TBG	TBILISI GA	
	TBS	TBILISI	
	TOR	TORINO	
	TRI	TRIESTE	
	UTR	UTRECHT	PO Box 80125, 3508 TC Utrecht https://www.uu.nl/en
	WAI	WARSAW SOLTAN INSTITUTE	Poland, PL-00-681, Warsaw, Hoża st., 69; http://www.ipj.gov.pl
	WAU	WARSAW UNIVERSITY OF TECHNOOGIES.	Poland, PL-00-661, Warsaw, Plac Politechniki 1; https://www.pw.edu.pl/
	WOR	WORMS	
	WUH	WUHAN	Wuhan Institute of Physics and Mathematics, CAS Add:West No.30 Xiao Hong Shan,Wuhan 430071 China http://english.wipm.cas.cn/

	YER	YEREVAN	2. Alikhanian Br. Street, Yerevan, Armenia, 0036 https://www.yerphi.am/
	RBI	ZAGREB	Ruđer Bošković Institute Bijenička cesta 54, 10000 Zagreb https://www.irb.hr/

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[2] Rules for Development of Functional Position Description for the MPD Sub-Detectors, to be submitted as MPD Internal Note.

[3] EAN International Article Numbering Association EAN INTERNATIONAL, Rue Royale 145, 1000 Brussels, BELGIUM, http://www.ean-int.org

[4] NICA-MPD Part Identification, **NICA-MPD-2018-004**. Coding Schemes and Barcodes for Part Identifiers.

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JINR Preprints, E13-2017-82

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23 TECHNICAL TASK

Директор ЛФВЭ

Кекелидзе В.Д.

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«_____»___________________2019 г.

23.1 THE MAIN TASKS TO BE CARRIED OUT

Using the comments and suggestions of technical and engineering solutions described in the document: TDR Technical Design Report NICA-MPD-PLATFORM for the Slow Control System, the Technical Design Report: Requirements & System Description, you must achieve your goals and perform technical tasks:

23.2 GOAL

The goals of the engineering and technical activities described below are design and implementation of the MPD-NICA PLATFORM with its installation in MPD-ROOM, commissioning, implementation and commissioning.

At the final stage of the work, as-built documentation should be prepared, trained by the Operating Personnel, in the number of people required by JINR and the Collaboration of the NICA, and perform operational tests to check the achievement of the assumed objectives.

23.2.1 TECHNICAL TASK 1: Executive project for UNIT, based on the technical functionality analysis presented in the TDR.

TECHNICAL TASK 1 consists in: implementing the Executive Project for the UNIT module, indicating the conditions for the performance, delivery, installation and receipt of engineering and technical works, tasks specified in TDR.

The design applies to all UNIT equipment described in TDR for NICA-MPD-PLATFORM.

The subject of delivery is the electronic version of the project in the form of a PDF and two copies of the paper form. The project will be carried out in English.

23.2.2 TECHNICAL TASK 2: Execution of UNIT in the test version, based on TECHNICAL TASK 1.

TECHNICAL TASK 2 consists of: consists in the execution of the UNIT module described in TDR and performed in accordance with the Detailed Design.

The aim of this task is to create a test set that will be tested and subjected to technical verification in real working conditions.

UNIT should consist of:

a) Four RACKs 600 x 1200 x 47 U,
b) Three cooling RACKs,
c) Standard and operating installations described in the TDR.

The UNIT must be delivered to JINR and installed at the place, time and technical scope indicated by JINR.

23.2.3 TECHNICAL TASK 3: Executive project NICA-MPD-PLATFORM, based on the technical functionality analysis presented in the TDR.

TECHNICAL TASK 3, consists in the execution of the Executive Project, indicating the conditions for the performance, delivery, installation and receipt of engineering and technical works, the main task specified in the TDR.

The design applies to the entire PLDFORM MPD-NICA equipment described in the TDR.

Performing this technical task requires a detailed TDR analysis, leading to the creation of a transparent Executive Project enabling:

a) specification of ingredients,
b) defining the necessary operations and technical work at the manufacturer's, and at the installation site of the apparatus at JINR,
c) valuation of components, works and installations, delivery to the recipient,
d) tasks for other industry sectors
e) specification of the conditions for receipt of the project.

The subject of delivery is the electronic version of the project in the form of a PDF and two copies of the paper form. The project will be carried out in English.

23.2.4 TECHNICAL TASK 4: Executive cabling project for NICA-MPD-PLATFORM and MPD

TECHNICAL TASK 4, consists in the execution of the Executive Project, Cable Routes, indicating the conditions for the performance, delivery, installation and receipt of engineering and technical works, the main task specified in the TDR.

The project concerns cable routes, their implementation for a complete connection of MPD-NICA PLATFORM, described in TDR.

A specification of technical and technological conditions is required for cable routes and optical and copper IT cabling, as well as power cables and wires, as well as route and media installations for GSS gas supply systems for MPD.

The project should also take into account the routes and installation of other required utilities, eg cooling of the whole NICA-MPD-PLATFORM.

The subject of delivery is the electronic version of the project in the form of a PDF and two copies of the paper form. The project will be carried out in English.

23.2.5 TECHNICAL TASK 5: Execution NICA-MPD-PLATFORM.

TECHNICAL TASK 5, consists in making the entire MPD-NICA PLATFORM described in TDR.

NICA-MPD-PLATFORM should be delivered to JINR and installed in the place and technical scope indicated by JINR.

The aim of this task is to perform a full system, which will be checked and subjected to technical verification, in real working conditions.

NICA-MPD-PLATFORM consists of:

a) Eight UNIT with cooling RACK 47 U,
b) Standard equipment,
c) Operational cabling,
d) Standard and operational installations described in TDR.
e) Required Cable Routes
f) Cable and media routes required
g) ACS Access Control System

23.2.6 TECHNICAL TASK 5: Installation NICA-MPD-PLATFORM w JINR.

TECHNICAL TASK 5, consists in making a full NICA-MPD-PLATFORM installation, including: required electrical power installations, optical and copper IT, performing required media installations and connecting cooling installations.

It is required to perform the installation of the PLATFORM-MPD work management software on the server designated by JINR.

After connecting and installing all necessary installations and software, NICA-MPD-PLATFORM work tests will be performed, followed by an operational and operational RUN.

The ultimate goal of this task is to perform the installation of the full NICA-MPD-PLATFORM system, which will be tested and subjected to technical verification in real working conditions..

23.2.7 TECHNICAL TASK 6: Cable and Logical Connection NICA-MPD-PLATFORM z MPD.

TEHNICAL TASK 6, consists in performing NICA-MPD-PLATFORM to MPD connection in all required and possible installations. The terms of these connections will be defined in detail by the responsible persons at JINR for individual sub-detectors and supporting installations.

After connecting and installing all necessary installations and software, NICA-MPD-PLATFORM work tests will be performed in cooperation with the MPD detector.

Then the operational and operational RUN will be made.

The goal of this task is to perform the installation of the full NICA-MPD-PLATFORM system together with MPD, which will be tested and subjected to technical verification, in real working conditions.

23.2.8 TECHNICAL TASK 7: Tests and Research NICA-MPD-PLATFORM.

TECHNICAL TASK 7, consists in performing scheduled NICA-MPD-PLATFORM testing and service tests as well as service and checking tasks that should be performed at specific times and conditions in order to ensure safe and correct operation of PLATFORM-MPD-NICA.

The Technical Report prepared after the tests and tests will be approved in JINR as the binding instruction for safe operation of NICA-MPD-PLATFORM.

23.2.9 TECHNICAL TASK 8: Preparation of as-built documentation and putting into operation in JINR NICA-MPD-PLATFORM.

TECHNICAL TASK 8, consists in the implementation of the final technical documentation, as-built.

The subject of delivery is the electronic version of the documentation in PDF format and two copies of the paper form. The project will be carried out in English.

23.2.10 Technical Task 9: Training of the Staff.

TECHNICAL TASK 9, is to design a training system for operational staff and their implementation. JINR will assign people for these trainings.

A handbook for the required course will be prepared.

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Date 2019-05-17

Пэрыт M. J. ________________________________

Головатюк В. М.______________________________