

 <p><b>ATTIKO METRO S.A.</b></p>	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b>  <b>Design, performance, material and workmanship specifications for:</b>  <b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

<b>Code</b>	<b>Specification Description</b>
<p><b>P_B_EXT_DP015450</b></p>	<p><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>

	<p align="center"><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p align="center"><b>Design, performance, material and workmanship specifications for:</b></p> <p align="center"><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p align="center"><b>RFP-384/20</b></p>
---	---	---

**CONTENTS:**

1	INTRODUCTION .....	4
1.1	Purpose of this specification .....	4
1.2	Specification Scope.....	4
2	DEFINITIONS AND ABBREVIATIONS.....	6
3	STANDARDS AND REGULATIONS .....	8
4	ENVIRONMENTAL CONDITIONS.....	10
4.1	Outdoor average air conditions .....	10
4.2	Indoor air conditions .....	10
5	DESIGN RESPONSIBILITY .....	12
6	BACS SYSTEM CONCEPT .....	14
6.1	Concept of the Tunnel Ventilation system, HVAC system and E&M Systems .	14
6.2	Required works to the already operating BACS system.....	17
6.3	Interface with the Intrusion Detection System .....	19
6.4	Interface with the Fire Detection System (FDS) .....	20
6.5	Interface with the Automatic Fare Collection System (AFC).....	20
6.6	BACS Control interface with the OCC.....	21
7	BACS SYSTEM REQUIREMENTS .....	22
7.1	General .....	22
7.2	Operation requirements.....	24
7.3	General Principles of Control and Monitoring .....	26
7.4	Communication Network .....	30
7.5	Programmable Logic Controller (PLC) .....	31
7.6	BACS Software .....	33
7.7	Fireman Box (FB).....	35
8	BACS and HUMAN-MACHINE INTERFACE (HMI) REQUIREMENTS .....	36
8.1	OCC and SMR Operator Workstation (Operator Terminals) .....	36
8.2	User Interface Software Requirements.....	37
8.3	System Access Security .....	38
8.4	System Integrity .....	38
8.5	Alarms and Events.....	38
8.6	Workstation Screen Based Functions .....	39
8.7	BACS Tools.....	43
8.8	Printers .....	44
8.9	Equipment and finishes.....	45
9	DOCUMENTATION.....	46
9.1	General .....	46
9.2	Detailed Final Design (DFD).....	46
9.3	Other documentation .....	46
9.4	Manuals.....	47
10	TRAINING REQUIREMENTS.....	48
10.1	General .....	48
10.2	Engineering design and technical assistance training .....	49
10.3	Operation training.....	49
11	SYSTEM TESTS AND INSPECTIONS.....	50

 <p><b>ATTIKO METRO S.A.</b></p>	<p align="center"><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p align="center"><b>Design, performance, material and workmanship specifications for:</b></p> <p align="center"><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p align="center"><b>RFP-384/20</b></p>
---	---	---

11.1	Factory Acceptance Test (FAT).....	51
11.2	Start-up Testing and Commissioning .....	51
11.3	Site Acceptance Test (SAT).....	52
11.4	System Integration Tests (SIT).....	52
12	RELIABILITY, AVAILABILITY, MAINTAINABILITY AND SAFETY (RAMS).....	53
12.1	Availability Analysis .....	53
12.2	Protection against internal failures .....	53
12.3	Protection against internal mutual perturbations.....	53
12.4	Protection against external perturbations .....	54
12.5	Safety Assessments.....	54
13	QUALITY ASSURANCE.....	55
14	SPARE PARTS, SPECIAL TOOLS AND TECHNICAL SUPPORT.....	56
14.1	Parts list and Spare Parts list.....	56
14.2	Special Tools and Test equipment .....	56
	APPENDIX A – New tunnel and station ventilation systems I/O point list – general requirements.....	58
	APPENDIX B – HVAC and E&M systems equipment list of new tunnels/stations .....	69
	APPENDIX C – FDS interface with the HVAC systems of the new stations – I/O point list .....	74
	APPENDIX d – Intrusion detection system interface with the BACS system – I/O Point List .....	76
	APPENDIX E: Architecture of the already installed EBI r410.2 system of control and monitoring in the OCC.....	77

	<p align="center"><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p align="center"><b>Design, performance, material and workmanship specifications for:</b></p> <p align="center"><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p align="center"><b>RFP-384/20</b></p>
---	---	---

## 1 INTRODUCTION

### 1.1 Purpose of this specification

The scope of this contract includes the Design, Supply, Installation and Commissioning of a Building Automation and Control System (BACS), which shall monitor and control the electromechanical systems installed in the buildings within the Stations, ventilation shafts and tunnels of Phase B of the Extension to Piraeus at local level from the SMR room in each Station as well as centrally from the Operation Control Centre (OCC) at Syntagma.

The Phase B extension to Piraeus incorporates three (3) new stations, namely: Maniatika station, Piraeus station and Dimitiko Theatro station. It also incorporates three (3) intershafts (Tzavella, Mela, Rolo), as well as a terminal shaft (Panepistimio) and an electrical equipment recess at the forestation of Dimotiko Theatro terminal station.

The scope of the contract shall also include the necessary upgrading of the existing and operating equipment and software of the BACS system at the OCC level and at local level in the stations operating in Lines 2 and 3, as required, except the Base Project stations (Monastiraki – Ethniki Amyra and Sepolia – Dafni). In this framework, required shall be the upgrading of the EBI system in the OCC and in the Station Master Rooms, to which the local BACS equipment must be connected. Finally, it is stressed that, for safety reasons, the installation of the new BACS system and final commissioning shall be effected without any interruption of the control system already in operation locally as well in the OCC.

The Procurement shall also include the design, construction, supply, installation and commissioning of the Fireman Boxes in each new Station, as well the design, construction, supply, installation and wiring of the PLC Panels.

This Technical Specification shall be read in conjunction with the Conditions of Contract, the General Specifications, the Specifications for Tunnel Ventilation and HVAC systems, the specifications for the remaining E&M systems, as well as with the all other Contract documents.

The information contained in this specification may not cover all the design criteria in detail, such as the precise Local Area Network (LAN) configuration, software development, hardware/software integration, mapping configuration, PLCs interfacing requirements, graphics displays etc. The Contractor shall design and work out the above matters, which shall be subject to AM’s approval; the Contractor shall have the option to propose improved solutions or choices on individual technical or operational issues, which however shall be subject to AM’s approval.

### 1.2 Specification Scope

This Technical Specification covers the principles and the essential requirements for the design, development, supply, factory testing, shipment, delivery to site, installation, interfaces, site testing, commissioning, start of commercial operation as well as Spare Parts, Special tools and Technical Support for the maintenance period of the system-wide BACS for which the contractor shall provide as a minimum the following items:

- Analysis of Requirements and Technical Specifications and development of comprehensive Functional Design.
- Coordination of the main contractor’s interfaces with other systems and preparation of the Plan for the BACS system implementation and development.

 <p><b>ATTIKO METRO S.A.</b></p>	<p align="center"><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p align="center"><b>Design, performance, material and workmanship specifications for:</b></p> <p align="center"><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p align="center"><b>RFP-384/20</b></p>
---	---	---

- Hardware and software design.
- Software development and Hardware manufacturing.
- Hardware and software factory acceptance test.
- Delivery to the site.
- Site installation (including control and monitoring system hardware, software and the LAN cabling with all the necessary components).
- Interfaces with other systems as required.
- Integration into the existing EBI system in the OCC (including hardware, along with all necessary upgrades to the existing software).
- Commissioning.
- Site Acceptance test (SAT).
- System Integration test (SIT).
- Trial run assistance and system handover.
- Delivery of documentation, drawings, test reports etc..
- Certification.
- Training.

 <p><b>ATTIKO METRO S.A.</b></p>	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p><b>Design, performance, material and workmanship specifications for:</b></p> <p><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

## 2 DEFINITIONS AND ABBREVIATIONS

Definitions and abbreviations used in this document are as follows:

A/C	-	Air Conditioning
ACU	-	Air Conditioning Unit
AF	-	Air Filter
AM	-	ATTIKO METRO S.A.
ATP	-	Automatic Train Protection
ATS	-	Automatic Train Supervision
ATO	-	Automatic Train Operation
BACS	-	Building Automation and Control System
BMS	-	Building Management System
BSF	-	Blast Shaft Fan
CP	-	Communication Processor
CPU	-	Central Processing Unit
CCR	-	Central Control Room
DC	-	Direct current (denoting the 750V DC traction power)
DFD	-	Detailed Final Design
DPS	-	Differential Pressure Switch
DP	-	Decentralised Periphery
EBB	-	Earthing Bus Bar
ECS	-	Environmental Control System
E/E/PE-	-	Electrical/Electronic/Programmable Electronic system
EIXL	-	Electronic Interlocking
ELOT	-	Greek Organisation for Standardisation
EMC	-	Electromagnetic Compatibility
EMI	-	Electromagnetic Interference
ESC	-	Escalator
EXF	-	Exhaust Fan
FAP	-	Fire Alarm Panel
FAM	-	Fire Alarm Management
FAT	-	Factory Acceptance Test
FB	-	Fireman Box
FD	-	Fire Damper
FDTM	-	Fire Damper with Thermal mechanism
FDETM-	-	Fire Damper with Electrical / Thermal mechanism
FDS	-	Fire Detection System
FO	-	Fibre Optic
GFD	-	General Final Design
HMI	-	Human Machine Interface
HP	-	Heat Pump
HVAC	-	Heating, Ventilation and Air Conditioning
I/O	-	Input / Output
INV	-	Frequency Converter / Inverter
JF	-	Jet Fan
LAN	-	Local Area Network
LAS	-	Lighting and Auxiliary Power Substation
LED	-	Light Emitting Diode
MCC	-	Motor Control Centre



**“PROCUREMENT AND INSTALLATION OF THE BUILDING  
AUTOMATION AND CONTROL SYSTEM (BACS) OF  
PIRAEUS EXTENSION PHASE B”**

**RFP-384/20**

**Design, performance, material and workmanship  
specifications for:**

**BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)**

MFD	-	Motorized Fire Damper
MOD	-	Motorised Damper
MPI	-	Multi-Point Interface
MSS	-	Material Submission Specifications
MTBF	-	Mean Time Between Failures
MTTR	-	Minimum Time to Repair
OCC	-	Operations Control Centre
OPC	-	Open Connectivity via Open Standards
OLM	-	Optical Link Module
OTE	-	Over Track Exhaust
PLC	-	Programmable Logic Controller
PPC(DEDIE)	-	Public Power Corporation
PPS	-	Pumps
RAID	-	Redundant Array of Independent Disks
RAMS	-	Reliability, Availability, Maintainability and Safety
RC	-	Remote control
RM	-	Remote monitoring
RSD	-	Roller Shutter Door
RS	-	Rectifier Substation
SAF	-	Supply Air Fan
SAT	-	Site Acceptance Test
SIT	-	System Integration Test
SWB	-	Electrical Switchboard
SIL	-	Safety Integrity Level
SPS	-	Staircase Pressurisation System
SMR	-	Station Master Room
SSL	-	Secure Socket Layer
UPE	-	Under Platform Exhaust Air System
UPS	-	Uninterrupted Power Supply
WAN	-	Wide Area Network
WS	-	Workstation

 <p><b>ATTIKO METRO S.A.</b></p>	<p align="center"><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p align="center"><b>Design, performance, material and workmanship specifications for:</b></p> <p align="center"><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p align="center"><b>RFP-384/20</b></p>
---	---	---

### 3 STANDARDS AND REGULATIONS

The Contractor shall be responsible, that the proposed BACS system shall comply with the requirements set out in the following standards (the last available editions at the time of the Tender, preferably international standards approved by ELOT), but not limited with:

EN ISO 16484-1:	Building Automation and control systems – Part 1: Overview and definitions.
EN ISO 16484-2:	Building Automation and control systems – Part 2: Hardware.
EN ISO 16484-5:	Building Automation and control systems – Part 5: Data communication protocol.
EN ISO 16484-6:	Building Automation and control systems – Part 6: Data communication Conformance testing.
IEC 331:	Fire resisting characteristics of electric cables.
EN 50121-1: (IEC 62236-1)	Railway applications – Electromagnetic compatibility (EMC) – Part 1: General.
EN 50121-2: (IEC 62236-2)	Railway applications – Electromagnetic compatibility (EMC) – Part 2: Emission of the whole railway system to the outside world.
EN 61000-6-2:	Electromagnetic compatibility (EMC) Part 6-2: Generic standards: Immunity for industrial environments.
BS 5588-4:	Fire precautions in the design, construction and use of buildings - Code of practice for smoke control using pressure differentials.
EN 50274:	Low voltage switchgear and control gear assemblies – Protection against electric shock – Protection against unintentional direct contact with hazardous live parts.
EN 50122-1: (IEC 62128-1)	Railway applications. Fixed installation - Part 1: Protective provisions relating to electrical safety and earthing.
EN 50122-2: (IEC 62128-2)	Railway applications. Fixed installation. Part 2: Protective provisions against the effects of stray current caused by DC traction systems.
IEC 61131-2:	Programmable controllers - Part 2: Equipment requirements and tests.
IEC 61508-1:	Functional safety of E/E/PE safety-related systems. Part 1: General requirements.
IEC 61508-2:	Functional safety of E/E/PE safety-related systems. Part 2: Requirements for E/E/PE safety-related systems.
IEC 61508-3:	Functional safety of E/E/PE safety-related systems. Part 3: Software requirements.
IEC 61508-4:	Functional safety of E/E/PE safety-related systems. Part 4: Definitions and abbreviations.

 <p>ATTIKO METRO S.A.</p>	<p align="center"><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p align="center"><b>Design, performance, material and workmanship specifications for:</b></p> <p align="center"><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p align="center"><b>RFP-384/20</b></p>
--	---	---

IEC 61508-5:	Functional safety of E/E/PE safety-related systems. Part 5: Examples of methods for the determination of safety integrity levels (SIL).
EN 50126:	Railway applications - Specification and demonstration of reliability, availability, maintainability and safety (RAMS).
IEC 60529:	Degrees of protection provided by enclosures. IP code.
ISO 11064-1:	Ergonomic design of control centres. Part 1: Principles for the design of control centres.
ISO 11064-2:	Ergonomic design of control centres. Part 2: Principles for the arrangement of control suites.
ISO 9241-1:	Ergonomic requirements for office work with visual display terminals (VDTs). Part 1: General introduction.
ISO 13406-2:	Ergonomic requirements for work with visual displays based on flat panels. Part 2: Ergonomic requirements for flat panel displays.
ISO 9000:	Quality management systems – Fundamentals and vocabulary.
ISO 9001:	Quality management systems – Requirements.
ISO 9004:	Quality management systems – Guidelines for performance improvements.
ISO 10007:	Quality management systems – Guidelines for configuration management.
NFPA 130	

Where no relevant standards exist, the use of well proven equipment may be proposed for AM approval from manufacturers with proven experience in underground Metro networks, who have manufactured similar equipment at least during the last ten (10) years.

Where no confirmation is given in the **Design, Performance, Material and Workmanship** Specification, all details, materials, equipment and workmanship for which standards have been issued by the ELOT (Greek Organisation for Standardisation) or other International standards, the relevant specification shall be in accordance with such standards.

Where Greek Regulations or Local Ordinances affect the design or choice of plant, materials or equipment, the materials, equipment and machinery supplied shall comply with all relevant sections of such regulations.

	<p align="center"><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p align="center"><b>Design, performance, material and workmanship specifications for:</b></p> <p align="center"><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p align="center"><b>RFP-384/20</b></p>
---	---	---

## 4 ENVIRONMENTAL CONDITIONS

### 4.1 Outdoor average air conditions

<ul style="list-style-type: none"> <li>External ambient summer dry bulb temperature</li> </ul>	35° C (during summer) – for underground areas 36° C (during summer) – for over ground areas and buildings
<ul style="list-style-type: none"> <li>External ambient winter dry bulb temperature</li> </ul>	0° C (during winter)
<ul style="list-style-type: none"> <li>Relative humidity (average)</li> </ul>	50% (during summer) 70 % (during winter)
<ul style="list-style-type: none"> <li>Average daily temperature variation</li> </ul>	10° C

### 4.2 Indoor air conditions

4.2.1 The maximum allowable summer temperatures and the minimum allowable winter temperatures for areas / rooms within the Metro System, as based on the designed outdoor air conditions shall be as follows:

Area	Summer temperature	Winter temperature
<ul style="list-style-type: none"> <li>Concourse areas, platforms, staircases, accesses and all remaining public areas</li> </ul>	38° C (or +3° C above ambient temperature)	
<ul style="list-style-type: none"> <li>Tunnels</li> </ul>	38° C (or +3° C above ambient temperature)	
<ul style="list-style-type: none"> <li>Personnel Areas (Ticket Offices, SMR, Rest rooms, terminal station personnel room, Police – Security room, First Aid room, other personnel areas, guardhouses)</li> </ul>	26° C	20° C
<ul style="list-style-type: none"> <li>ATIMs Areas</li> <li>LAS Substation</li> <li>Rectifier Substation (RS)</li> <li>Cooling Facilities Room</li> <li>Ventilation Room</li> <li>Lifts plant room</li> <li>Lifts Shafts</li> <li>Fire Fighting Room</li> <li>Pumping Stations</li> <li>Storehouses</li> </ul>	40° C (or +5° C above ambient temperature)	
<ul style="list-style-type: none"> <li>Lockers</li> </ul>	40° C (or +5° C above ambient temperature)	20° C



**“PROCUREMENT AND INSTALLATION OF THE BUILDING  
AUTOMATION AND CONTROL SYSTEM (BACS) OF  
PIRAEUS EXTENSION PHASE B”**  
Design, performance, material and workmanship  
specifications for:  
**BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)**

**RFP-384/20**

• Central Control Room (in the OCC)	25° C - 26 °C humidity control 55% ± 5%	
• Tunnel Recess room	40° C (or +2° C to the tunnel temperature given above)	
• DEDDIE (PPC) Room (20KV)	Natural Ventilation only	
• Telecommunications and Signaling Rooms (Stations)	26° C / 50% RH (*)	
• Battery Room	28° C	
• Shops – Other Commercial areas / Recreational Areas	25° C / 50% RH (*)	20° C

\* The Relevant Humidity value is given only for the selection of the cooling units.

4.2.2 No humidity control is required for the aforementioned areas, except the Central Control Room in the OCC.

 <p><b>ATTIKO METRO S.A.</b></p>	<p align="center"><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p align="center"><b>Design, performance, material and workmanship specifications for:</b></p> <p align="center"><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p align="center"><b>RFP-384/20</b></p>
---	---	---

## **5 DESIGN RESPONSIBILITY**

The Contractor shall be responsible for the design, procurement, installation, testing and commissioning of the BACS, as well as for the entire pertinent equipment. The approval of the design by AM does not release the design responsibility of the Contractor.

The Contractor shall be responsible to take action, at his own cost, to modify, replace or adjust the BACS installations on site to meet the performance requirements as explicitly stated in the present Specifications document.

Equipment, materials and designs supplied for the BACS shall be designed and installed in accordance with the relevant European or National Standards - Regulations. Equipment to be used shall be listed and the relevant standard or specification indicated. Equipment in this context shall be taken to include both hardware and software.

All designs, material, equipment and accessories supplied under this Contract shall be to the approval of AM.

During the implementation of the Project, AM shall deliver to the Contractor all necessary DFD documents of E/M building systems, Tunnel Ventilation and HVAC Systems as well as the Technical Specifications of every system.

All the requirements as outlined in this specification must be regarded as minimum.

During the first stages of the Project design, the Contractor shall prepare a complete design and analysis based upon the User Requirements and from this, he shall provide a Detailed Final Design Report (DFD-Report). This DFD-Report shall be:

- Accurate and concise.
- Be easily understood by those people having to make use of it.
- Contain sufficient information so as to provide for a complete understanding of the systems functionality.

This document shall be approved by AM before the system design commences. Once approved, any changes to the design shall be submitted for approval by AM and once approved; they shall be included within a revision to the DFD-Report document.

In support of this, the Contractor shall implement a rigorous and traceable design change management system that allocates a unique number to each change and which as a minimum describes:

- The requirement for the change.
- The nature of the change.
- The full impact of the change in terms of technology applied, safety, cost and programme.

The Contractor shall prepare and submit Material Submission Sheets (MSS) for each individual equipment type proposed for approval by AM prior to purchase.

All drawings, schedules and plans produced shall be fully consistent with the AM Drawing Office Manual. All symbols, nomenclature and abbreviations used shall be described on the drawings.

All drawings, wiring and ladder diagrams etc., shall be supported by clearly presented flow charts and detailed functional and technical design specification explaining the operation of the proposed systems.

	<p align="center"> <b>“PROCUREMENT AND INSTALLATION OF THE BUILDING  AUTOMATION AND CONTROL SYSTEM (BACS) OF  PIRAEUS EXTENSION PHASE B”</b>  <b>Design, performance, material and workmanship  specifications for:</b>   <b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b> </p>	<p align="center"><b>RFP-384/20</b></p>
---	---	---

All materials shall, where applicable, comply with the fire safety standards.

All designs, materials and equipment shall continue to work correctly and safely in the presence of electromagnetic interference (EMI), if any, created by other equipment. The Contractor shall identify such sources and providing adequate screening or other remedial measures.

 <p>ATTIKO METRO S.A.</p>	<p align="center"><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p align="center"><b>Design, performance, material and workmanship specifications for:</b></p> <p align="center"><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p align="center"><b>RFP-384/20</b></p>
--	---	---

## 6 BACS SYSTEM CONCEPT

### 6.1 Concept of the Tunnel Ventilation system, HVAC system and E&M Systems

The purpose of the BACS is to control and monitor all Tunnel Ventilation and HVAC systems, as well as the E&M systems within the Stations, shafts and tunnels of Phase B of the Extension to Piraeus for normal and emergency conditions. The control and monitoring shall be performed centrally from the already installed Control and Monitoring System (EBI) and at local level from the individual/autonomous/ server-workstation to be installed by the Contractor in the SMR room in each Station.

The BACS shall also be capable to perform real-time trending and statistical process control for some of the critical parameters. It shall provide historical data storage of update to six (6) months.

The main components of the BACS are:

- Standard and redundant server BACS system of industrial type installed in the Operations Control Centre (OCC) – existing, already in operation.
- Workstations within the OCC, capable of easy operation of the already installed and operating facilities.
- Industrial type workstation acting simultaneously as client/server in the Station Master Room (SMR), capable of easy plant operation.
- PLC’s of industrial type, housed in PLC Panels to be installed within local plant rooms close to the Fan-switchboards (SWB) and E&M systems SWB in Stations. These areas shall be determined by the main contractor of the extension.
- A fibre optic local area ring network (LAN) - per station and intershaft, in any - providing high speed, secure communication between the Tunnel Ventilation and HVAC Systems PLCs and E&M systems PLCs in Stations and Shafts.
- Printer in the SMR of each station.
- Local LAN networks Interfaces to connect (communication) the PLCs to the central fibre optic redundant high-speed communication network (WAN) for communication with the OCC.

The WAN network already installed shall serve as the communication network for the communication of the PLCs of a station “N” with the operating and OCC based EBI BACS servers as well as for the peer-to-peer communication between the PLCs of the station “N” with the PLCs of stations “N-1” and “N+1”.

**NOTE:** The WAN network and the nodes do not constitute part of the scope of the BACS System Contractor; they do fall under the scope of the main contractor of the extension.

The workstation in the SMR shall be connected to the station based LAN and shall allow the SMR-operator to monitor and control all the Tunnel Ventilation and HVAC Systems and E&M equipment independently from / in parallel with the OCC based BACS.

In case of a WAN communication failure or a fault of the operating EBI in the OCC, the SMR operator shall be able to supervise and control all systems of his Station from the workstation and to execute the predetermined scenarios.

 <p><b>ATTIKO METRO S.A.</b></p>	<p align="center"><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p align="center"><b>Design, performance, material and workmanship specifications for:</b></p> <p align="center"><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p align="center"><b>RFP-384/20</b></p>
---	---	---

In case of a fault in the workstation of a Station, its supervision and control, as well as the implementation of the predetermined scenarios shall be carried out from the operating EBI workstations in the OCC.

The autonomous PLCs (not master-client) shall provide through the associated I/O modules the interface to the Tunnel Ventilation and HVAC switchboards as well as to Stations and Tunnels E&M equipment and shall perform local control logic, time and event-related operation, data management and control of the plant equipment as listed hereafter:

Shafts and Tunnels Ventilation equipment:

- Blast Shaft fans (BSF) and associated equipment;
- Under Platform and Over Track Exhaust fans (UPE/OTE) and associated equipment;
- Supply Air Fans (SAF) and the relevant equipment;
- Jet Fans (JF) in the Tunnels;
- Roller Shutters (RSD);
- Motorised Dampers (MOD);
- Fireman Box (FB);

HVAC and E&M equipment in Stations and Shafts:

- Supply Air Fans for technical area (SAF-E).
- Exhaust Fans (EXF).
- Motorised dampers (MOD).
- Cooling devices, their pumps and plant.
- Heat Pumps (HP).
- Fan Coil Units (FCU).
- Uninterruptible Power Supplies (UPS).
- Normal and Emergency Lighting.
- Pumping and drainage systems.
- Hydrants, hose reel systems and deluge valves (DEV).
- Monitoring of fire dampers.
- Lifts.
- Escalators.
- Interfacing with Fire Detection Switchboards.
- Interfacing with the Intrusion Detection System.
- Interfacing with the Automatic Fare Collection System.

The PLCs shall be electronic devices of industrial type with a central processor unit (CPU), power supply modules and modular I/O modules.

PLC-Panels shall be designed, manufactured and installed in compliance with the Material and Workmanship Specification.

PLC-Panels of the HVAC and Tunnel Ventilation (BSF, UPE/OTE etc.) shall be installed close to the Fan-switchboards (SWB) while PLC-Panels of the E/M systems in a place who will assigned by AM.

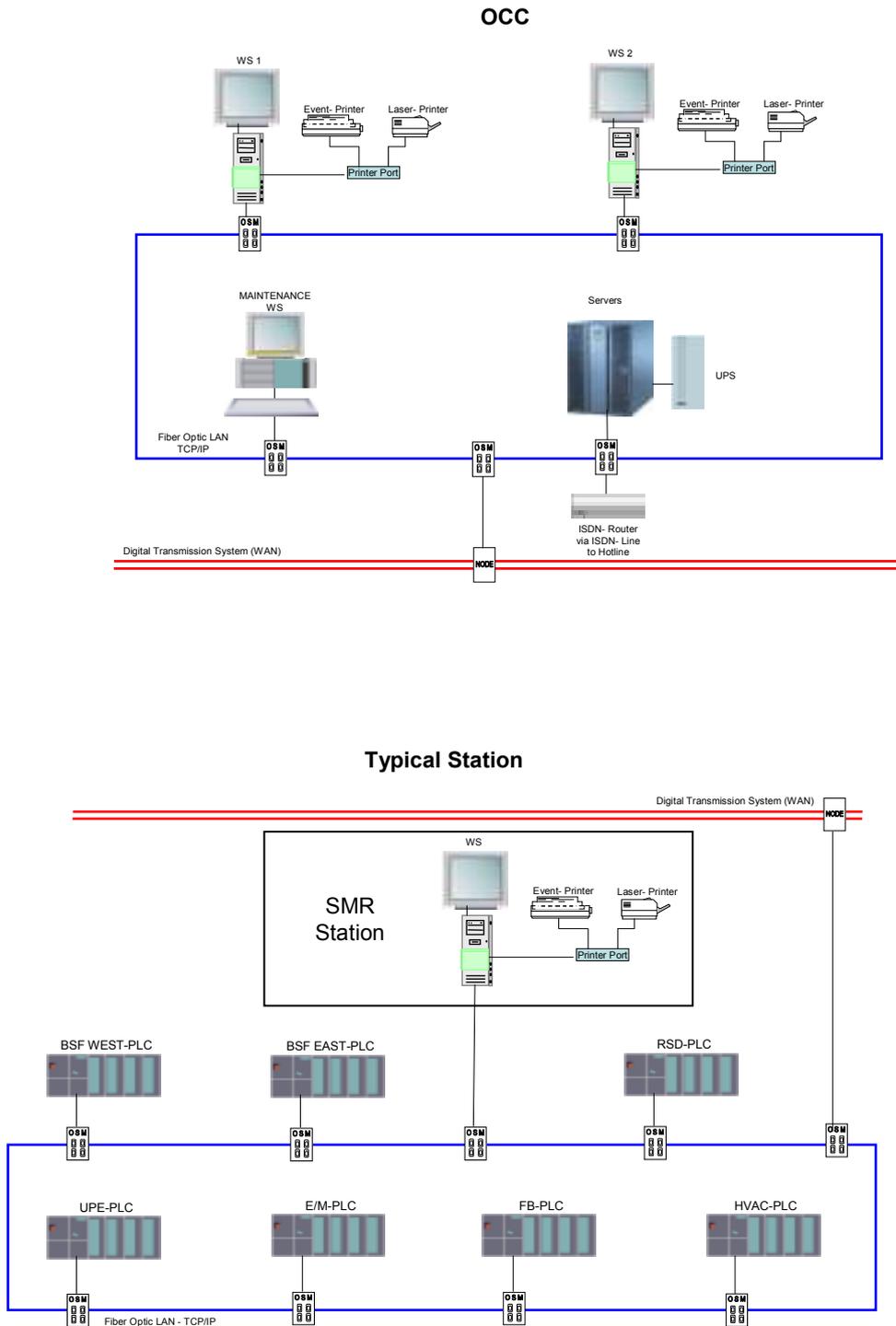
Figure 1 below shows a configuration of the system in the OCC, as well as an indicative configuration in a typical Station.



**“PROCUREMENT AND INSTALLATION OF THE BUILDING  
AUTOMATION AND CONTROL SYSTEM (BACS) OF  
PIRAEUS EXTENSION PHASE B”**  
Design, performance, material and workmanship  
specifications for:  
**BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)**

**RFP-384/20**

Figure 1 – (Indicative) Architecture of BACS control and monitoring system – network



	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p><b>Design, performance, material and workmanship specifications for:</b></p> <p><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

## 6.2 Required works to the already operating BACS system

Existing central facilities for the Control Systems ECS (for the Base Project) and BACS (for the future extensions of Lines 2 & 3) currently housed at the OCC at Syntagma station, control all the Tunnel Ventilation and HVAC systems, through two independent systems, provided by independent manufacturers (SIEMENS for the Base Project and HONEYWELL EBI for the future extensions). Additionally in the future extensions, the E/M systems in buildings (lifts, escalators, pumps, lighting etc.) are also controlled.

The Contractor shall install, test and commission the equipment of the stations and tunnels of Phase B of the Extension to Piraeus with EBI central monitoring and control system.

It is imperative to ensure the smooth operation of the EBI system as regards its communication with the existing systems and workstations of the operating extensions.

It is imperative to ensure the smooth migration upon commencement of the BACS system operation, without interrupting the operation of the EBI system. The Contractor shall be provided with specific time “windows” during night hours (00:55 – 04:30) Monday to Friday, which shall be used for the installation and testing of BACS software.

Given the necessary intervention in the existing central EBI monitoring and control system, the Contractor is required to take all necessary steps to protect the system against malware. To achieve this goal, the installation of modern updates (patches, updates etc.) is required during the project implementation period. Should there be software that is not supported by the manufacturer during the implementation of the project; the contractor shall take the necessary steps, according to the manufacturer's instructions, in order to update the installed software.

The Contractor should take into consideration the fact that works executed inside OCC and, in particular, works relevant to the BACS operating system, should be carried out through AM following the pertinent permit to be granted by STASY S.A..

At local level, the Contractor shall be obliged to supply, install and commission the entire equipment necessary for collecting all control points (I/O) and transferring same to the OCC via the WAN network.

The Contractor should also secure that, at local level, the new PLCs to be installed shall communicate Peer-to-Peer with the PLCs that have already been installed, as required, in line with the designs about the Tunnel Ventilation and HVAC systems.

In particular, in view of creating a BACS system, capable to communicate - at local level - with the equipment already installed and currently in operation, as well as with the central system – already installed and in operation - the Contractor shall:

1. Incorporate the new PLCs to be installed in the already installed and operating EBI central control and monitoring system and create in that system all necessary mimic panels, time plans and all other items stipulated in the Technical Specification;

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b>  <b>Design, performance, material and workmanship specifications for:</b>  <b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

2. Implement the Peer-to-Peer communication between the new PLCs to be installed in the stations of the Phase B extension to Piraeus and the PLCs (HONEYWELL PLC HC 900) which have already been installed, as required, for the smooth and proper operation of the Ventilation System for Stations and Tunnels;
3. Upgrade, at the points of interconnection among the operating stations and the stations of the Phase B extension to Piraeus, the operating software related to the emergency scenarios, as required, centrally and at local level for the comprehensive application of the emergency scenarios and make all necessary interventions to the EBI workstation / server in the existing station, so as to modify the existing data base and develop all necessary mimic panels in the EBI workstation / server of the existing station.

It is stressed that an emergency scenario shall be activated in full and shall be controlled as to its comprehensive implementation by EBI workstations in the OCC. The implementation of the scenario can also be monitored by the workstation located in the SMR.

In addition, an emergency scenario shall be activated in full and shall be controlled by the workstation in the SMR that activated the said scenario. The implementation of the scenario can be monitored by the OCC.

Adherence to items 1 to 3 shall result in satisfying the aforementioned requirements.

In addition, the Contractor shall proceed to a series of modifications to the operating EBI system, and more specifically:

- Re-arrangement of the priority whereby information is shown in the Alarm List of the Power Controller (e.g. all fire alarms shall be shown in red color, filter barrier fault shall be shown in yellow color, BSF and UPE fan faults – which are “deviated” when a scenario is activated - shall be shown in yellow color, while all remaining faults shall be shown in red etc.);
- Deletion from the Alarm List of the Power Controller (e.g. all faults related to fan coils, all faults of the heaters, all intrusion (indoor) related information, all lighting switchboards status information);
- Grouping of faults (one general fault for each lift, one general fault for each escalator);
- Creation of a common mask to include all shafts related intrusions (outdoor) and platform doors;
- Recording in the EBI-FB of the specified operation of the fans when a scenario is activated;
- Creation of a verification button to activate/de-activate all main fans (BSF, UPE, JF) and fire-curtains;
- The Contractor shall proceed to all necessary actions as regards the passwords of the Power Controllers and the Station Masters for the correct implementation of the aforementioned items.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b>  <b>Design, performance, material and workmanship specifications for:</b>  <b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

### 6.3 Interface with the Intrusion Detection System

The BACS shall be equipped with an interface for the connection with the Intrusion Detection system.

Table 1 presents the minimum requirements concerning the locations of the intrusion detection system within the stations and shafts of the Extension.

Table 1

Intrusion detection in Stations, Shafts	Open Door Contacts
Station entrance (Roller shutters etc., and/or personnel entrance doors)	
Station Master Room	
Ticket Issuing Booths	y
PSN Area	y
Platforms (Platform End Doors)	y
Technical Rooms	y
Tunnel Ventilation Plant Room	y
LAS Room	y
Telecom Room	y
Signaling Room	y
Battery Room	y
UPS Room	y
Rectifier Substation	y
PPC (DEDDIE) Room	y
Fire Fighting Room	
Inergen Room	
Central Pump-room	
Sump room	
Chiller plant room	
Empty rooms	
Blast Shaft Openings at street level (openings and/or grids)	y

The method of interface between the BACS and the Intrusion Detection system shall be effected via potential free contacts. The items to be transmitted shall concern the fire alarm status and not the door status, when the system is de-activated.

**Note:** The Intrusion Detection System is not included in the scope of the BACS Contractor; however, it constitutes scope of works of the main contractor.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p><b>Design, performance, material and workmanship specifications for:</b></p> <p><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

#### **6.4 Interface with the Fire Detection System (FDS)**

The FDS located at stations and shafts shall have a hardwired interface (I/O) or Modbus protocol with the HVAC PLCs and the HVAC Switchboards – in parallel, shall transmit the fire alarms and Fire Damper (FDTM, FDETM, MFD) status signals to the BACS and shall deactivate the involved fans at a hardware and at a software level.

The Fire Detection system shall monitor the environment in the station and the shafts to detect any potential fire hazards.

All fire alarms shall be generated automatically by smoke / heat detectors, by the flow of water within the sprinkler systems or manually by the operation of a manual break glass unit and shall be indicated on the fire alarm panel (FAP) and logged in detail within the Fire Alarm Management (FAM) system.

The BACS System shall collect the signals from the FDS shall display these signals in the appropriate graphic display screens and shall be responsible for their transfer in the OCC.

**NOTE:** The FDS is not in the scope of the BACS Contractor; however, it constitutes scope of works of the main contractor.

#### **6.5 Interface with the Automatic Fare Collection System (AFC)**

The purpose of this interface is the automatic opening of the AFC gates in case FAP announces a fire incident in a public areas, as well as in case an emergency scenario is activated in a tunnel and in a station either through the graphic environment of the BACS system in the OCC or in the Station Master Room or through the Fireman Box on the wall of a station connected with the BACS for the safe and smooth evacuation of the station.

The AFC System installed in stations shall be connected (hardwired) with one of the BACS available PCLs (PLC shall be selected in the DFD phase) for the BACS system to give the relevant command to the AFC system for gates' opening in case of emergency.

BACS shall issue two commands for the gates to open. One command shall be given to the Gates Control Panel and the second one to the Gates Power Supply Panel, in case the first command fails.

The status of each gate shall be displayed at central level at the OCC and locally at the Station Master Room on the work stations screens of the BACS system.

The primary connections with the AFCS, Fire Detection system and the BACS are depicted in the schematic diagram below:



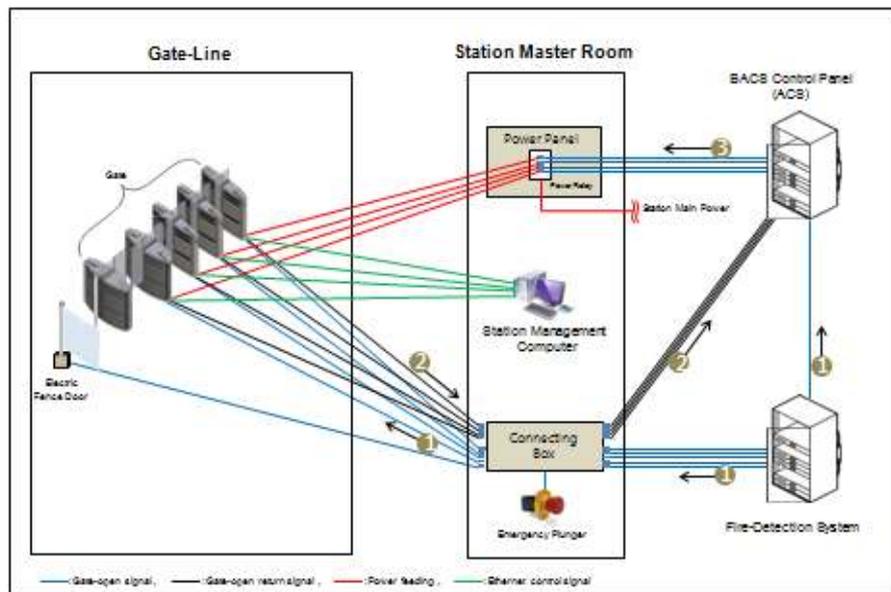
**“PROCUREMENT AND INSTALLATION OF THE BUILDING  
AUTOMATION AND CONTROL SYSTEM (BACS) OF  
PIRAEUS EXTENSION PHASE B”**

**Design, performance, material and workmanship  
specifications for:**

**BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)**

**RFP-384/20**

**● BACS & Fire-Detection Interface**



## 6.6 BACS Control interface with the OCC

The Tunnel Ventilation and HVAC systems PLC Controllers and the E&M systems PLC Controllers in Stations and shafts shall be interfaced independently with the central BACS at the OCC, where centralized control and monitoring is performed from the central OCC WS, via the Syntagma EBI servers and WAN network. It is not permitted to achieve this interface via protocol converters or intermediate servers.

The existing EBI workstations within the OCC shall allow the operator to monitor and control all the Tunnel Ventilation and HVAC Systems and E&M equipment remotely and execute additionally predetermined scenarios at the relevant PLCs in the event of emergencies, and execute other high-level control functions.

The existing EBI workstations of the OCC operator shall allow the OCC operator to modify equipment operational parameters such as set points and other controlling parameters such as equipment start and stop commands, design and change time- and event-tables.

Synchronisation of information between the Station based PLCs and the OCC based BACS shall take place upon initialisation, following restoration of any power loss at the station, as a result of a change to equipment status or if requested by the OCC.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p><b>Design, performance, material and workmanship specifications for:</b></p> <p><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

## **7 BACS SYSTEM REQUIREMENTS**

### **7.1 General**

The BACS System is a facility, which, centrally (OCC), has two servers with redundant configuration (primary/secondary or master/backup servers and hot stand-by redundancy) and with RAID5 configuration. All information to be gathered from the equipment of Phase B of the extension to Piraeus shall be collected, recorded and stored in these servers.

The Contractor shall upgrade/modify/replace – as required - the already installed servers (H/W, S/W, Application Layer) of the EBI control and monitoring system at the OCC for the integration of Phase B extension to Piraeus. The upgrade - modification - replacement shall be applied to the entire equipment of the stations, to the extent required, for the smooth operation and proper communication of the overall BACS system and the existing stations. The technical description to be submitted by the Contractor shall include in detail the required upgrades – modifications.

In the station, there shall be installed one Workstation acts as server/client with RAID 5 configuration to collect, record and store the information on the same LAN network, as well as the information necessary from the tunnel ventilation system of the adjacent stations, which shall be transmitted through the WAN network and are deemed required for the control and monitoring of the fire scenarios.

The operation of the workstation in the stations as a client is the one that the user - station master is required to use under normal circumstances. As a client, the user - station master shall be connected to the central BACS system in the OCC and with the EBI servers at Syntagma via the WAN network. The users in the OCC shall be informed about the actions of the user – station master on the mimic environment of the EBI Workstation in the OCC, and this information shall include as a minimum the activation / deactivation of scenarios and equipment as well as the user’s login – logout activities.

The operation of the workstation in the stations as a Server shall run permanently in the background and shall be synchronized with the exchange of information and the operation of the BACS system. The Server shall be used by the user - station master only in case of failure of the EBI system in the OCC or in case WAN communication problem. The migration from the client function to the Server function shall be automatic without any intervention by the user – station master.

This information shall be collected through the PLCs and transmitted to the SMR Workstation through the local LAN network and to the central servers through the WAN network.

The BACS shall be design with all the necessary provision and spare capacity to accommodate all the possible future extensions of the Metro.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b>  <b>Design, performance, material and workmanship specifications for:</b>  <b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

Moreover, provision shall be made so that all control and/or monitoring points related to the emergency scenarios of the Phase B extension to Piraeus, which shall concern the future stations, may be taken into consideration and be integrated in the software of the PLCs, in order to ensure their two-way communication with the PLCs to be installed in the future extensions excluding the obligation on the part of the Contractor of this Contract to execute any additional works. However, this requirement does not release the Contractor from the obligation to provide any information that AM may request in the future concerning the implementation of the interconnection of the system with future extensions.

It is imperative that when installing the new software, smooth transition has to be ensured without disrupting the existing system.

The BACS shall detect the following events

- Communications failure to a single PLC;
- Communications failure to multiple PLC(s);
- Alarm Printer Failure (Off-line, out of paper);
- Low Disk Space on any HMI system or Data Historian on the network.

All of the elements of the Tunnel Ventilation and HVAC Systems and E&M systems shall be designed for stand-alone operation such that the PLC control logic of the associated equipment shall be performed within the PLC, as close as possible to the equipment under control.

Equipment that is interrelated or associated such as a Fan and MOD combinations shall not be located in different PLCs.

Workstations (WS) shall be provided within the OCC and the SMR to allow the operator to monitor and control in real time the related Tunnel Ventilation and HVAC Systems and E&M systems equipment.

All BACS equipment shall be capable of continuous operation between the limits of environmental conditions as given in section 4 without the use of air-conditioning equipment. All equipment shall be designed to operate fully within the stated conditions. The Contractor shall provide certificates for all equipment types to be supplied stating that the equipment is able to operate under the pre-determined environmental and operational limits.

The Contractor shall be responsible for ensuring that his equipment and systems are not adversely affected by the modified environmental conditions caused by the localized heat emissions of other installed equipment.

All BACS equipment supplied shall be able to withstand power supply surges, interference and spikes caused by lightning currents and equipment, mains and traction supply surges, according to the standards (Section 3).

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p><b>Design, performance, material and workmanship specifications for:</b></p> <p><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

All the hardware supplied shall be the latest series available for use at the time of the factory tests. Replacement parts for all hardware shall be available for a minimum of ten (10) years after commissioning of the last, in terms of time of commissioning, station. Sufficient quantity of spare parts shall be provided (see paragraph 14.1) to ensure availability and safe and reliable operation of the system, calculation shall be based on provided and proved Mean Time Between Failures (MTBF) and Minimum Time to Repair (MTTR) values. Reliability, Availability, Maintainability and Safety (RAMS) should be proved in compliance with standards, specified in Section 3.

All BACS the hardware installed shall contain at least 15% spare capacity for future needs and be easily expandable, if required.

All BACS hardware shall be of industrial type for heavy environmental conditions and be immune to harsh environmental factors, within the desired industrial range of values. All the units shall have a suitable IP protection rating, as recommended by the standards (Section 3). PLC-Panels installed in plant rooms shall have an IP protection rating of at least IP 54.

## **7.2 Operation requirements**

The BACS shall be designed to meet the normal and emergency operational and performance requirements of the tunnel ventilation, HVAC systems and E&M systems.

All BACS equipment items as PLCs, Workstation and Printers in the SMR shall be connected to the emergency Lighting UPS.

### **7.2.1 Normal operation**

The tunnel Ventilation, HVAC and E&M equipment of each station and the relevant activation / deactivation processes shall be executed according to pre-determined operational time- and event-tables.

Some of the HVAC equipment like A/C units, Chillers, Heat Pumps which have their own independent automatic control system shall be activated / deactivated from the BACS SMR or OCC operator.

The building services and the environmental conditions inside the station shall be maintained at acceptable levels, ensuring optimum use of the facilities under automatically operated control.

An operator within the SMR or OCC shall be able to:

- View, monitor, control and modify in real time the operation and status of the equipment;
- View and modify in real time the controlling parameters, set points or operating parameters of the equipment;
- Intervene and change the status of the Tunnel Ventilation, HVAC and other E&M equipment of the station and tunnel;
- Prepare and prints reports and logs or request historical or current reports on the status of the station and equipment;

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b>  <b>Design, performance, material and workmanship specifications for:</b>  <b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

### 7.2.2 Tunnel Ventilation and HVAC Systems Emergency operation

The Tunnel and Station Ventilation Systems shall be used to operate as smoke exhaust systems within the station public areas and related tunnel sections as per pre-determined emergency scenario requirements.

The details of the Emergency Scenarios concerning the Phase B extension to Piraeus shall adhere to the Specifications concerning the Tunnel Ventilation and HVAC Systems of these projects.

The Contractor shall be obliged to implement all the emergency scenarios stated above in the system software in the PLC to be installed at the Fireman Box.

The Contractor shall ensure that the emergency scenarios logic shall always be available (backed-up), so as to address an eventual loss of the above PLC, as well as the loss of any workstation (WS) or any server.

A Fireman Box (FB) will be installed at the concourse or street level near the station entrance of every station, easily accessible to firemen. Emergency scenarios concerning only the local station (“fire at platform level” and “fire at concourse level”) shall be easily activated by the FB. The FB shall have a mimic diagram showing the equipment of the station involved in the execution of the scenarios.

In case of emergency, the local metro and / or train staff shall immediately inform the OCC operators who shall manage the incident until the arrival of the fire brigade at the concerned station.

Until the arrival of a fireman, the OCC or SMR operator shall initiate all predetermined scenarios regarding the station and the tunnel from the workstation

In case a certain scenario is selected by the wall-mounted FB, then the scenario selected by the OCC or the Station Master Room operator shall be de-activated. Further scenario selections from the OCC or SMR operator are inhibited.

Once a scenario is activated, indication of the scenario and equipment status shall be indicated on the BACS workstations and at the FB and all affected switchboards (SWB).

The sequence of operation for each selector switch depending on the location is given in chapter 7.3.1.2.

The operation priority for emergency operations, starting from the lowest shall be:

- ⇒ OCC-workstation (emergency scenarios screen selector switch in Scenario mode);
- ⇒ SMR-workstation (emergency scenarios screen selector FB switch in Scenario mode);
- ⇒ Local switchboard controls (selector switch in position “local emergency”);
- ⇒ Station FB “scenario” mode (selector switch in position “Scenario”).

This means:

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p><b>Design, performance, material and workmanship specifications for:</b></p> <p><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

- The scenarios executed from the local wall-mounted FB will override the SMR – OCC workstation commands, as well as the switchboards’ “local emergency” mode commands;
- The commands executed from the switchboards in “local emergency” mode override the related Fan operation selected with the OCC and SMR workstation’s scenarios;
- The local SMR-workstation emergency scenarios screen commands will override the OCC workstation screen commands;

The BACS is to be considered as a protection system that monitors all events continuously.

Any change of state of the Tunnel Ventilation and HVAC Systems equipment shall be displayed with a complete graphic change on the operator workstations within the SMR and OCC within one (1) second.

Emergency scenarios executed from the OCC, SMR or FB shall override any other normal operation.

The HVAC PLCs and HVAC switchboards shall have a hardwired interface (I/O) with the Fire Detection System (FDS) and shall be used to shutdown the related SAF or HVAC systems or drive other E&M equipment to a safe operation position within one (1) second after receiving an alarm from the FDS.

On power loss and restoration the BACS and PLCs shall restart automatically and become fully operational within sixty (60) seconds. The operator workstations shall restart automatically and be available to display the most current information updated completely from the PLCs within three (3) minutes. The Tunnel Ventilation and HVAC Systems PLCs and E&M-PLCs on restating or cold start shall request the status of all plant.

### **7.3 General Principles of Control and Monitoring**

All plant shall have the ability to be operated automatically or manually.

The BACS shall normally operate the plant and equipment in accordance with predefined logic and/or control strategies automatically under the operation of local sensors or timetables.

The Operators shall be able to initiate manually the control of all plant and equipment from:

- a) OCC operator workstation;
- b) SMR operator workstation;
- c) Local switchboard via pushbuttons.

of selected equipment and interfaces with other equipment..

Table 1 below summarises the control locations for manual operation of equipment.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p><b>Design, performance, material and workmanship specifications for:</b></p> <p><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

**Table 1. Equipment Control Source**

Equipment Designation	Equipment use	Control available	Location
Electrical switchboards	Motor Control Centre (MCC). This is the central motor starter panel for a group of fans and MODs. This panel contains the electrical protection and control gear for the equipment under control and the PLC's in enclosed PLC-panels with associated I/O for the Tunnel Ventilation and HVAC Systems and E&M Systems. Local control can be selected and performed from this location.	2 or 3 position selector switch: Remote/Local or Remote/Local normal/ Local emergency	Blast shafts and station plant rooms
FB	Fireman Box This is a pushbutton operated back up panel that is principally used in emergency situations	2 position selector switch: Remote / Scenario	Station concourse near the entrance
SMR Operator workstation	Computer terminal with graphical interface within the station used by the operator for plant and equipment monitoring and control of the Tunnel Ventilation and HVAC Systems and E&M systems	Operation Modes: Auto / Manual	SMR
OCC Operator workstation EBI	Computer terminal EBI with graphical interface within the central Operations Control Centre used by the operator for plant and equipment monitoring and control and parameter adjustments of the Tunnel Ventilation and HVAC Systems and E&M systems.	Operation Modes: Auto / Manual	OCC

### 7.3.1 General control requirements

Lists containing the equipment of the Phase B extension to Piraeus to be controlled and monitored by the BACS System, as regards Tunnel Ventilation and HVAC Systems, E/M systems and FDS, are included as Appendices A to D of this Document.

Especially, regarding Tunnel Ventilation, which constitutes a critical system for the passengers' safety, the operation of fans under normal and emergency conditions is described here below in summary.

As regards the remaining E/M Systems, which are not automated, apart from the surveillance of the control points indicated in the aforementioned lists, their operation hours must also be recorded.

#### 7.3.1.1 Normal Operation of the BSF, UPE/OTE, SAF, JF and EXF fans

- **Hours run:**

The cumulative running hours of each fan shall be recorded. On initial fan start up the fan with the lowest operating hours shall start first. After a fan running is stopped or failure of a fan, then a duty / standby rotation / changeover shall be initiated.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p><b>Design, performance, material and workmanship specifications for:</b></p> <p><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

- **Duty / standby:**

Should a fan be operational and subsequently fail then an equipment fault shall be raised at the BACS and the standby fan shall be started.

- **Fan proving:**

Should a fan be operational but the flow is not proven within ten (10) seconds then the fan shall be stopped and the standby fan started. An alarm shall be raised at the system. This alarm will be by-passed if the fan is operating under emergency conditions.

- **Fan and damper combinations:**

On request to start the fan the damper shall open. With the damper confirmed as being fully opened (all sections), the fan shall be permitted to start. Should the fan fail to start within the proving period then the fan shall be commanded to stop and the associated damper closed. A duty / standby rotation principle shall be used. An alarm shall also be raised within the system. Should the damper fail to fully open within an adjustable time period then the damper open command shall be removed, the damper commanded to close and the fan start command removed. An alarm shall be raised within the system.

**Note:** Under emergency operation conditions (BSF, SAF and UPE/OTE fan) the related MOD and Fans shall start simultaneously irrespective if the MOD will fully open or not and all safety interlocks (e.g. winding- bearing temperature alarms or vibration alarms) will be disabled and bypassed.

- **Automatic control:**

Where a fan operates under automatic control (e.g. two EXF-fans on temperature control), then on achieving the first stage set point the fan with the lowest hours run shall start. On achieving the second stage set point then the standby or second fan shall start. On falling temperatures the fan with the highest cumulative hours run shall be stopped first. On reaching the second stage falling temperature alarm the first fan shall be stopped. Proper measures shall be designed to eliminate the effect of hysteresis, in order to avoid the frequent stopping / starting of the fans.

- **Manual control:**

On selecting a fan to manual all automatic features (e.g. temperature control, time-event-tables) shall be disabled; however the stage alarms shall still be provided to the system.

- **Remote control:**

If a fan-system selector switch at the local switchboard is selected to remote control, then no control is available from the local switchboard. The plant / equipment is then under the direct control of the Tunnel Ventilation and HVAC systems and E&M systems.

- **Local control:**

On selecting a fan system to “local (normal)” control at the local switchboard, all automatic features (e.g. temperature control) shall be disabled, however the stage alarms shall still be provided to the BACS.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b>  <b>Design, performance, material and workmanship specifications for:</b>  <b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

When an emergency fan system (e.g. BSF, SAF or UPE/OTE fan) is selected to “local emergency” control all safety interlocking is by-passed but alarms from these devices will still be monitored at the BACS.

- **Maintenance:**

All equipment shall have the facility to be set to maintenance by means of a maintenance switch close to the fan installation location. In such mode the equipment shall be disabled and not be available for the automatic or manual or remote control.

### **7.3.1.2 Emergency Operation of the BSF, UPE/OTE, SAF, JF fans (Control of fire scenarios)**

In all cases emergency operation shall take precedence over the normal operation of the equipment.

It is required that ventilation and smoke exhaust equipment, which participate in emergency scenarios, the way they have been programmed in the PLCs of the Tunnel Ventilation and HVAC systems, should have the capability of full activation of the emergency scenario within a maximum time duration of three (3) minutes. This duration includes possible change from an existing status or an already activated emergency scenario to a new scenario, which requires operation changes in already activated components (e.g. reversing of fans). It is noted that the related equipment includes all the control and activation elements such as breakers, frequency converters etc.

In case of failure of any equipment participating in the scenario, the scenario shall be continued; an alarm shall be raised within the BACS.

An emergency operating mode is selected by means of two selector switches situated within the FB, the local fan SWB or on the emergency scenarios layout of the SMR / OCC Operator WS screen.

Under all emergency operation modes all safety interlocks (e.g. winding - bearing temperature alarms or vibration alarms) for the BSF, UPE/OTE fans and JF will be bypassed and do not lead to a shut down of the related fan.

The following selector switches shall be available from the:

- **FB:**

“Remote” position;  
“Scenario” position;

- **Fan local switchboard:**

“Remote” position;  
“Local normal” position;  
“Local emergency” position;

- **SMR / OCC operator WS:**

“Remote” position;  
“Scenario” position;

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p><b>Design, performance, material and workmanship specifications for:</b></p> <p><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

The sequence of operation for each selector switch depending on location shall be defined as follows.

⇒ **FB “scenario” mode**

Initiated with the FB selector switch selected to this position. All functions from the FB to the BSF, UPE/OTE fans are realized by means of hardwired connections to the local SWB. If the specific scenario requires also the energization of equipment at an adjacent shaft, this energization takes place through the network.

The local SWB receive the signals from the scenario pushbuttons from the FB and initiate the predetermined fire scenario operation of the fans.

⇒ **SWB “Local emergency” mode**

Initiated with the SWB selector switch selected to this position. The PLC software logic is bypassed and all the operations from the SWB are controlled by hardwired connections. BSF and OTE fans, JF and RSD for each station and related tunnel section can be controlled from the related SWB by the use of hardwired pushbuttons, with indications provided by local lamps.

⇒ **OCC / SMR Operator workstation scenario emergency operation mode**

Initiated with the OCC / SMR Operator WS screen emergency scenarios selector switch selected to the “scenario” position.

⇒ **Switchboard “local normal” mode**

Initiated with the SWB selector switch selected to this position. The operator at the SWB can initiate operation of all fans and dampers by using the available SWB controls. The PLC is in full control of the fans and MODs, protection and interlocks of all the fans is activated by the PLC. This mode is mainly used for the maintenance.

⇒ **OCC / SMR Operator workstation “remote” mode**

The selector switch on the local SWB, of the FB and OCC / SMR Workstation emergency scenarios screens have to be in “remote” position. The plant is in full remote control and may be operated either manually or automatically as defined by predetermined algorithms or influenced by remote sensors. This is the normal operating state of the plant.

#### **7.4 Communication Network**

The Contractor shall be responsible for the design and installation of a fibre optic local area network (LAN) in a ring layout in the Station, including related tunnel sections (shaft, recesses) providing a secure high-speed communication system.

This LAN shall connect locally and perform the information transmission among the geographically distributed Tunnel Ventilation and HVAC system PLCs, E&M systems PLCs and the SMR located workstations.

The technology and design of the LAN shall be determined based on the requirement to connect the PLCs to the system-wide WAN that connects the stations to the OCC and on the operation and performance criteria.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p><b>Design, performance, material and workmanship specifications for:</b></p> <p><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

The communication between the OCC based BACS servers and the Tunnel Ventilation and HVAC Systems PLCs and Station and Tunnel E&M systems PLCs as well as the peer-to-peer communication between these PLCs of the station “N” with the PLCs of stations “N-1” and “N+1” shall be established through the system wide WAN.

To achieve real-time data acquisition performance, the time delay between the local PLCs and BACS servers should be less than 0.5 secs.

The connection protocol shall be ETHERNET TCP/IP. This protocol provides a link between interconnected networks operating on different hardware architecture platforms and different operating systems.

Failure of communications between the station based PLCs and the BACS servers, or failure of the BACS itself shall not affect the ability of the PLCs to control the process.

Failure to one of the PLCs shall not prevent the remaining PLCs of the same LAN network from transmitting data related to the systems under their control, as well as from receiving commands both from the workstations at OCC and the workstations at the SMR.

The LAN ring shall be routed via physically separate routings to maintain the integrity under fire conditions.

The LAN shall support at least fifty (50) connected devices (nodes) excluding repeaters.

All control and communication cables and their construction or testing methods shall be subject to approval by AM.

All control and communication cables shall be installed by competent staff, suitably trained and supplied with all necessary plant, equipment and tools. The installation of cables shall be such as to provide an orderly formation, free from unnecessary bends and crossings that will permit the removal of any one cable without undue disturbance to adjacent cables.

All control and communication cables shall be constructed in accordance to the National or International standards (see Section 3).

The construction of control and communication cables shall be fire resistant as specified by valid standards. Low smoke and halogen free material shall be used for both insulation and sheath.

## **7.5 Programmable Logic Controller (PLC)**

PLC's shall be electronic devices of industrial type with central processor unit (CPU), memory, communication processors (CP) and power supply modules.

PLCs shall be of the latest generation during the preparation of the Detailed Final Design (DFD) for this Project.

All the equipment, as presented in the Control & Monitoring Points List, shall be connected to the PLC-I/O modules.

Each CPU and CP shall perform internal self-diagnostics and provide an alarm indication for hardware failure.

The CPU shall be capable of detecting any failure or malfunction in any other modules and provide an alarm output.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p><b>Design, performance, material and workmanship specifications for:</b></p> <p><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

The PLC-processors shall have status LEDs at least for:

- Processor status (Running / Standby / Fault);
- Forces (Applied/ on);
- Internal battery status;
- Fatal alarm;
- Communications status.

The power supply requirements shall be suitable for operation at 230V AC, supplied from the station UPS system. The Contractor shall identify within the tender the power consumption requirements.

The PLC will be equipped with all the I/O cards necessary for the control and monitoring of all the equipment connected to that particular panel. I/O shall be modular and capable of future expansion without disruption or change to the existing equipment.

I/O modules shall be replaceable whilst on line and without the need to power down the equipment or disconnect the field wiring. The I/O modules will interface with the field equipment via approved terminals. Field wiring shall not connect directly to the I/O module. Hard keying methods shall prevent the incorrect replacement of a module.

Within the BACS, the communications highway shall be a real time, controls communication network capable of high-speed data transport and which shall:

- Be high speed, minimum 100Mb / sec;
- Allow multiple controllers to control I/O on the same wire;
- Allow multicast of both inputs and peer-to-peer data;
- Allow network access from any CP / node for viewing the network status and the uploading and downloading of programmes.

The PLCs in the Station and shaft shall communicate with the local Workstations/server via Communication Processors (CPs), which shall be connected to the local LAN network of the station. The local LAN of each station shall be connected in each station to the node of the data communication network OTN.

Via the WAN the PLCs shall as well communicate with the central OCC based EBI-BACS servers.

Upon detecting a LAN network failure an alarm shall be provided to warn the operator in the SMR and in the OCC of the failure in the station LAN ring network.

Each PLC shall automatically resume communications following a network recovery.

The use of Open architectures shall be maximised.

Each PLC shall have a maximum scan time of 2 ms per 1KB of word. Upon completion of the functional programme, communications etc., the processor memory shall as a minimum retain 30% as spare memory capacity.

The PLCs and associated equipment shall be housed within an enclosure (PLC panel) having a degree of protection not less than IP 54. The PLC panels shall be installed next to the controlled system panels (HVAC, Ventilation systems, E/M systems). Enclosure design and equipment layouts etc. shall be approved by AM before manufacture.

All equipment shall operate continuously under the demanding industrial environmental conditions, as specified in the standards, listed in the Section 3.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p><b>Design, performance, material and workmanship specifications for:</b></p> <p><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

Aspects of Electromagnetic Compatibility shall be considered in the design and layout of equipment, as specified in the standards, listed in the Section 3.

## **7.6 BACS Software**

The software and firmware developed for the BACS shall follow the requirements of the standards, as described in Section 3 and shall adopt a structured methodology and be based around a concept of standard software tasks and modules, which are integrated to provide the functionality as required each application / location.

Within the structured software design methodology the Contractor shall produce structure diagrams, data flow diagrams that detail the functionality and interface requirements.

As a minimum the following BACS software shall be supplied:

- a) System’s software including all programs for the normal real-time operation of the BACS, containing all application programs.
- b) Auxiliary programs for the modification or correction of the programs, control of the real time on-line operation, post-processing required, printing, memory programming and memory change.
- c) Auxiliary programs for detecting, analysing and correcting errors.
- d) Diagnostics to detect faults or controlling the operation of the system and/or its PLC-subsystems. The subsystems contain CPU’s and the relevant secondary units.
- e) Test software to check the software’s application during the system’s development.

All the above software shall be in the latest release with all tools enabled for programming and maintenance (full edition), shall not be subject to license renewal / lease (annual or otherwise). This must be clearly stated in the technical data sheet or be certified by the manufacturer and copyright holder.

### **7.6.1 Structured approach**

The software shall comprise a hierarchical structure which using techniques that functionally breaks down the requirement in to a number of smaller, more manageable, comprehensible functions having well defined interfaces shall be used.

The PLC Software programming shall use industry standard programming languages, as defined by the standards, listed in the Section 3.

Where more than one programming language is used, it shall be used in a consistent manner and shall be seamlessly integrated into the PLC system to avoid confusion in understanding the application.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p><b>Design, performance, material and workmanship specifications for:</b></p> <p><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

The organisation of the programme data, data tables and programme files within the PLC shall be structured and methodical in approach using different files for functions to allow ease of understanding. The code shall be accompanied by full comments so as it is readily understood by the personnel of AM's Engineering Department. All variables and parameters to be used (flags, DBs etc.) shall be provided both in lists and in electronic format, fully substantiated with comments and clarifications (name, description, type, format, comments etc.). The PLC internal file structure shall be used consistently throughout the project for the Tunnel Ventilation and HVAC Systems and Station and Tunnel E&M systems.

The Contractor shall submit to AM for approval complete flow diagrams for the entire equipment under control.

### 7.6.2 Software Design

The BACS software shall be easy-to-use and have an open architecture. The system shall have the built-in flexibility to permit easy configuration of the system in accordance with the specific end user requirements as well as quick and easy modification by the end user in the field.

All software shall be understandable, analysable, testable, verifiable and maintainable. The software shall be designed and fully documented so that is understandable to the competent staff, not involved with the production of the software.

The PLC software shall include a 'watchdog' timer system to monitor and detect faults and to cause the equipment to enter a recovery state in the case of failure of the operational software.

### 7.6.3 Software tools

The BACS systems should come with a development tool package that comprises all the basic sub-modules and objects for addition of new processes. The integrated set of tools shall include real-time graphic displays in different time scale, simple data manipulation (such as addition, subtraction etc.) and Statistical Process Control functions.

The system shall provide services enabling suitably qualified and authorised staff to update the system and carry out fault finding and self-checking routines.

All systems shall come with installation procedures and tools that shall allow AM, when required, to:

- Install a new software release;
- Install a software release on a brand new hardware configuration.

All the above software shall not be subject to license renewal / lease (annual or otherwise). This must be clearly stated in the technical data sheet or be certified by the manufacturer and copyright holder.

	<p align="center"><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p align="center"><b>Design, performance, material and workmanship specifications for:</b></p> <p align="center"><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p align="center"><b>RFP-384/20</b></p>
---	---	---

It is required that, for each Commercial Off-The-Shelf hardware and software components that shall be used in the system design, there is an acceptable level of confidence that compatible products may be found in the future if needed.

## **7.7 Fireman Box (FB)**

It shall be possible to activate predetermined fire scenarios concerning the local station from the Fireman Box to be installed at each Station.

In all new stations, the Fireman Box will be installed at the concourse level or at the street level of the Station easily accessible by the Fire Department.

The supply and complete installation of the FB, as well as the development of its software (hierarchy – priority, emergency scenarios), constitute a part of the scope of the Contractor who will supply and install BACS system.

The pre-determined scenarios shall be developed by the designers of the Tunnel Ventilation and HVAC systems and shall include all necessary procedures (tables with scenarios and lists of emergencies) for the activation or de-activation of all related tunnel ventilation equipment.

Upon activation of a scenario, an “FB – active” signal will flash on the respective local switchboard and the adjacent FB and a relevant message will be transmitted to the workstations in the SMR and the OCC.

The FB will be IP-54 wall-mounted type, as per the architectural philosophy of the surrounding area, its door should be lockable for safety reasons and its interior will be equipped with a panel with selective switches – buttons and indication lamps for all systems involved.

All the indication lamps and buttons shall have maximum diameter size of 16mm.

The exact layout of the FB, as well as the options for independent commands will be finalized during the DFD phase.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b>  <b>Design, performance, material and workmanship specifications for:</b>  <b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

## **8 BACS AND HUMAN-MACHINE INTERFACE (HMI) REQUIREMENTS**

### **8.1 OCC and SMR Operator Workstation (Operator Terminals)**

The Workstations shall be utilized as terminals for operators and shall be destined for the operators in the OCC and the SMR, so as to monitor and control the entire equipment of the Tunnel Ventilation and HVAC systems of the Stations and of the E/M systems of Stations and Tunnels.

The Workstation located with the SMR shall be PC based terminal of the state of the art.

The monitors shall be liquid crystal (LCD) type of high performance.

The size of the screen in the SMR shall be at least 20”.

Any change of state of the Tunnel Ventilation and HVAC systems and E&M systems shall be displayed with a complete graphic change on the operator workstations within the SMR and OCC within one (1) second.

The existing OCC-based EBI server shall directly communicate with the PLCs of the Tunnel Ventilation and HVAC systems and E&M systems via the WAN network which is connected via a node to the LAN network of each station.

The SMR-Workstation shall communicate with the PLCs of the Tunnel Ventilation and HVAC systems and E&M systems via the station based LAN network.

The OCC-based EBI servers shall be updated with all commands and controls issued/performed in the Ws within the SMR.

The SMR-Workstation (Server function) shall remain fully operational when there is a communication failure between the EBI BACS and the PLCs of a station (Failure on the high speed double OTN).

The MTBF of the Workstations shall exceed 60,000 hours.

The Workstations shall have a user-friendly graphical user interface (GUI) with screens displaying a graphical, animated presentation of the operation of the Tunnel Ventilation and HVAC systems and Station and Tunnel E&M systems within the station.

The following operation screen types, as a minimum shall be provided in sufficient quantities so as to offer a highly efficient working layout, grouping equipment to minimise delays in operation and having on screen navigation to other pages:

- A Station overview schematic from where an operator may drill down into lower system levels;
- Schematic diagrams for various systems;
- Schematic diagrams for the plant equipment;
- Tabular displays of alarms, alarm summaries;
- Tabular display of status or event messages;
- Tabular displays for sensor values;
- Display of all associated scenarios per station;
- Displays of all Emergency Scenario status;
- Mimic for the Fireman Box;
- Fire alarms and Fire Damper status information;
- Trends, historical data.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b>  <b>Design, performance, material and workmanship specifications for:</b></p> <p><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

Other features shall include the automatic navigation to the source of alarm upon detection, zoom in / out, scroll up / down.

## 8.2 User Interface Software Requirements

This section describes the various user interface functions of the BACS system. The BACS software shall be licensed to support the user interface in any combination as follows:

- Full function BACS Workstations for system operators;
- Additional connection of process data analysis Workstations for users who need to access BACS data and reports but do not need to view graphics.

The BACS operators shall be able to execute all monitoring and supervisory control functions from this Workstation. Typical operator commands shall include: modifying set points for control loops, alarm acknowledgment and set point adjustment, auto/manual switching and on/off control of field devices and taking points or devices on/off scan.

The OCC operator shall be able to access all Tag-names or graphic displays of Tunnel Ventilation and HVAC systems and Station and Tunnel E&M systems of the network without knowing which EBI server or data history recorder or PLC the point or display resides on.

The BACS operation software shall support the operator access to multiple displays at one time, including split screens where the operator may view more than one area at a time.

In addition, the BACS software shall support an indefinite number of secondary projected messages which include further assistance or diagnostic data. The operator shall be able to have access to context sensitive on-line help or instructions from any display at any time during operation of the system with a single keystroke or mouse click.

The operator shall be able to access displays via a pointing device and/or soft key menus with a choice of function keys, cursor control keys or any single key on the keyboard. Display navigation shall not require the use of typing text commands into an alphanumeric keyboard. Supported pointing devices shall include a mouse, touch screen or trackball.

The operator shall be able to easily identify which objects are selectable from any display by simply dragging the pointing device over the object. Typical objects include process device symbols (fans, dampers, MODs, pumps, motors etc.) controller faceplates.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p><b>Design, performance, material and workmanship specifications for:</b></p> <p><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

### 8.3 System Access Security

The BACS software shall include a security system to enable various operator tasks based on the user authority level and password. Access to all displays and to all command functions shall be based on the operator’s security level to protect against unauthorized use. After initial creation, only an assigned user with proper authorization or the system administrator shall modify the password.

Any command, which may result in changing the functional behaviour of the BACS such as the modification of software programmes, shall be password protected.

This password control shall be provided on a hierarchy basis providing varying degrees of access. A minimum of five (5) levels of password protected access control shall be provided.

Each level shall offer increasing degrees of functionality ranging from simple monitoring up to full administration rights and system building. The features and functions available within each level shall be selectable.

Visibility and operation of command buttons, set points, symbols or entire displays shall be enabled or disabled based upon the operator’s security level. The security level shall be activated during the operator log-on procedure.

All operator actions shall be logged to an event logger. The event logger shall keep track of each new operator log-on, log-off, set point change, or device control.

Each event log shall record the date, time, operator logged in and the type of action taken.

Once logged on to the system an operator may work from any terminal point until logged off.

The security system shall include an automatic logout after a period of inactivity.

### 8.4 System Integrity

The workstation system time at OCC and each SMR shall be synchronised with the main BACS time.

During start-up, the workstation shall perform a series of hardware and system software diagnostic checks. On successful boot up, the workstation shall automatically start all the software necessary to run the workstation application and shall perform time synchronisation with the Tunnel Ventilation and HVAC Systems PLCs and each Station and Tunnel E&M system PLCs.

### 8.5 Alarms and Events

Alarms and events shall be automatically time stamped and archived to a log file.

Alarms and events shall also be sent to the OCC-printers (depending on the data point configuration).

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b>  <b>Design, performance, material and workmanship specifications for:</b>  <b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

Alarms and Events shall be configured into a hierarchy of groups for simple filtering in the Alarms Summary display, and the Event Summary Display, respectively, for real-time printing and for processing of the Alarms and Event log file.

Events shall as a minimum include the following:

- change in equipment running status;
- change in equipment control status;
- change to alarm set-points;
- changes in key switch positions;
- changes in location of remote control;
- selecting or deselecting operational mode commands;
- change to the schedule/timetable;
- change to any system parameters;
- change in workstation operator.

The operator shall be able to view current and historical alarm information from a full screen alarm-summary display or on a small scrolling region at the bottom of any display. The alarm information shall be displayed in chronological and evaluation order with the most recent critical alarm at the top.

The information displayed for each alarm shall include the time and date, description, Tag-name, alarm state, value, priority level and class.

Alarms shall as a minimum include the following:

- Digital sensor alarm;
- Equipment alarms;
- System function alarms;
- Analogue value outside preset limit.

The system shall provide a method of notifying the user when a new alarm has occurred. The alarm display object shall automatically scroll to a new alarm when the user has scrolled down the alarm list from the top.

The operator shall be able to select and acknowledge alarms individually, by group or process area. The alarm display shall allow alarms to be selected by clicking on them with the mouse at runtime.

The operator shall be able to select an alarm from the alarm summary display and the system shall switch to the corresponding screen as to the particular section of the control system where the alarm originated.

It shall be possible to inform the operator of an alarm condition via an audible tone or any combination of animation types on the screen.

## **8.6 Workstation Screen Based Functions**

The SMR and OCC operator interface with the relevant systems shall consist of a number of screens with each screen dedicated to a particular set of functions.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b>  <b>Design, performance, material and workmanship specifications for:</b></p> <p><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

To assist in assessing the operability of the screens, the Contractor shall produce a screens navigation diagram for AM approval which shall detail the increasing levels of information available to an operator as the operator ‘drills down’ into the system.

Screens used shall have a common outline format based upon the existing types of the Base Project and/or the first phase of the extensions, as follows:

- Title Bar at the top of the screen, with the unique screen title;
- Display area containing Tunnel Ventilation, HVAC and E&M Systems equipment symbols and text;
- Function Bar at the bottom of the screen.

All set points and parameters of the Tunnel Ventilation, HVAC and E&M Systems shall be logged to disk within five (5) minutes after receiving a power failure signal from the station UPS.

#### **8.6.1 Workstation screens views, reviews**

AM shall approve all the SMR and OCC workstation screens views for the Tunnel Ventilation and HVAC Systems and E&M Systems.

There shall be at least four (4) stages to the review of the workstation screens, in accordance with the milestone dates established:

- Review and approval of the screen graphical symbols catalogue;
- Review and approval of the workstation screen layouts, including screen navigation structure;
- In progress stage review;
- Final review.

In order for AM to evaluate the screen operation (layout, symbols etc.) all links shall be fully established and the I/O points made dynamic by the use of a suitable simulation package.

After the review of the screen layouts, each subsequent review shall be conducted to present the functionality of the screens on the actual target hardware using the finally installed software.

For each review, six (6) colour copies of the screens shall be provided at least one (1) week prior to the actual review. During the review the Contractor shall record all comments made and present back to AM an accurate and concise record along with a programme to complete the activities.

#### **8.6.2 Mimic Screens**

A mimic screen shall be a schematic layout of an area of a station or tunnel showing relevant equipment and instruments on the WS screen. The representation of all equipment, instruments, status etc. shall be submitted for AM approval.

Mimic screens shall display at least the following information:

- The status of all equipment controlled for each item of equipment;
- Inputs from instrument sensors and their alarm status;
- The position of the selector key switches at the switchboards.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b>  <b>Design, performance, material and workmanship specifications for:</b></p> <p><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

The operator shall be able to control each item of controlled equipment displayed on a mimic screen.

In addition to the mimic screens there shall also be a tabular display of all equipment and sensors showing their current operating status.

Apart of the mimic screens where all equipment shall be displayed in separate screens, the following screens shall be delivered as a minimum:

**Station Overview Screen**

The Station Overview screen shall be provided for overall view of the station, identifying the various areas covered by individual mimic screens.

**Network Status Screen**

The Network Status Screen shall be provided as a schematic layout of the entire BACS system (LAN) and shall display:

- Each PLC-CP-processor communication status with the BACS;
- PLC-CPU Processor status.

**Fire Scenarios screens**

The fire scenarios screens shall display all fire scenarios regarding the station, as well as the status of the equipment involved.

**FB screens**

The FB screens at the WSS in OCC or the SMR shall have the same layout as the one for Fireman Box (FB)

**Time- and Event-table control screens**

The Time- and Event-table screen (where provided) shall be a table that will provide for the equipment operating under time- or event-table control the following:

- Equipment tag-number;
- Equipment Start and stop times for each timetable period;
- The time- / event-table displayed by default is the current operational timetable; The operator can also select to view the start/stop times of a different time- or event-table;

The authorised operator shall be able to:

- Load new time- / event-tables;
- Save to file, including saving to CD
- Download the time- / event-table to the processor;
- Construct time- / event-tables off-line.

The authorised operator shall be able to view the start/stop times of a different time- and event-table.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p><b>Design, performance, material and workmanship specifications for:</b></p> <p><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

### **Alarm summary screen**

The Alarm Summary Screen shall be a scrolling text display of the alarm banners for at least up to five hundred (500) current acknowledged and unacknowledged alarms. The banners shall be ordered chronologically. When there is no filtering of the alarm display, the banner in the function bar shall be identical to the latest critical alarm. The operator shall as a minimum be able to:

- Filter according to alarm priority or alarm group;
- Enable or disable the alarm buzzer;
- Acknowledge all or groups of alarms (the acknowledgement of alarms is a workstation event and will itself be logged);
- Configure real time printer output of alarms;
- Select the printer output.

### **Event summary screen**

The Event Summary Screen shall be a scrolling text display of the event banners for at least up to five hundred (500) events. The banners shall be ordered chronologically.

The operator shall as a minimum be able to:

- Filter according to event priority or event group;
- Configure printer output of events;
- Select the printer output.

### **Alarm history screen**

The Alarm History Screen shall be a scrolling tabular display of the alarms for the previous seven (7) days. This provides information on the recent operations of the BACS that can be of particular use to the maintenance team for fault diagnosis.

The operator shall as a minimum be able to:

- Filter according to alarm priority or alarm group;
- Configure printer output of alarms;
- Select the printer output.

### **Event history screen**

The Event History Screen shall be a scrolling tabular display of the events for the previous seven (7) days. This provides information on the recent operations of the BACS that can be of particular use to the maintenance team for fault diagnosis.

The operator shall as a minimum be able to:

- Filter according to event priority or event group;
- Configure printer output of events;
- Select the printer output.

### **Statistics and reports screen**

The operator shall as a minimum be able to generate report files from data maintained in the BACS.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p><b>Design, performance, material and workmanship specifications for:</b></p> <p><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

Reports available as a minimum shall include:

- Alarm Set points;
- Data point Parameters;
- Communications Failures and Failure Rates;
- Total Run Hours.

The facility for generating reports shall only be available to those operators with the appropriate access level.

The BACS shall have the capability to monitor and store selected analogue input values (e.g. temperature readings every thirty (30) minutes).

## **8.7 BACS Tools**

### **8.7.1 Real-time and historical trend analysis tool**

A client tool shall be included in the BACS software that allows users to view any or all of the Tunnel Ventilation and HVAC Systems or Station and Tunnel E&M systems process Tag names in either a trend chart or tabular format. The client tool shall have a user interface that allows for easy selection of process Tag names using a browser with a search filter to quickly find process Tag names in Data Historians with thousands of points.

The authorised operator shall be able to save trend files for recall at a later time. It shall be possible for the user to switch from the real time to the historical viewing mode using a simple check box.

The authorised operator shall be able to trend up to forty (40) different process Tag names in real time including analogue and discrete process Tag names within the same trend.

The authorised operator shall pick process Tag names from the browser. The time span and vertical range of the trend shall be user configurable at run time.

Standard time spans shall be configured for the last 5, 10, 30 or 60 minutes or the last 2, 4 or 8 hours. The user shall be able to adjust the range of the process Tag names in run time.

The authorised operator shall be able to plot historical data for any process tag name or groups of process Tag names in the database based any user-selected start and stop time.

The trend tool shall display statistical data for each trended analogue process tag name within the time period selected. Statistical values shall include the minimum, maximum, average and standard deviation. Icons or menu pull down commands shall be available for analysing the data such as horizontal, vertical band zooming, pan left or right and zoom between the hairline cursors.

It shall also be possible for the authorised operator to create text annotations anywhere on the trend. These annotations shall be visible from other workstations on the network with the same trend tool. It shall be possible to export the data in the trend area into a CSV file. Printing of the trends with all statistical data shall be supported.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p><b>Design, performance, material and workmanship specifications for:</b></p> <p><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

### **8.7.2 X-Y plotting tool**

A client tool shall be included in the BACS software that allows authorised operators to view two process Tag names in an XY Plot. The client tool shall have a user interface that allows selection of process Tag names and storage of the XY plot in a folder for re-selection at a later time. The user shall be able to create a background image of the expected XY plot so the user can see if the current values are outside of the expected values.

### **8.7.3 Alarm summary object**

Alarms shall be displayed by configuring a user-defined alarm summary object, which may be placed by itself in a window.

Alarms shall be presented with an indication for an acknowledged alarm, unacknowledged alarm and an alarm that has returned to normal but is not yet acknowledged.

### **8.7.4 Message summary object**

Messages e.g. status messages, maintenance messages etc. shall be displayed by configuring a user-defined message summary object, which may be placed by itself in a window.

### **8.7.5 Filter for Alarm and Message objects**

The OCC or SMR operator shall have the possibility to filter the alarm or message summary to display alarms or messages that match the filter criteria and hide alarms or messages that do not match the filter criteria.

### **8.7.6 Data Historian**

The BACS software shall provide a real-time database historian for long-term storage of process data. The data historian shall provide for the storage of real-time and historical data for each analogue, discrete or string process Tag-name. The historian shall also store summary, event, alarm and configuration data.

While there are always physical limiting factors such as disk space, there shall be no programmatic limit to the amount of data that may be stored on-line. Additionally, there shall be no performance penalty for long-term data storage.

There shall be no discernable difference in retrieval speed of data based on the age of the data. For example, the retrieval of two hours data stored two years prior shall be the same as for two hours of data stored one day ago.

## **8.8 Printers**

General-purpose network printers shall be provided, serving the BACS subsystems in each SMR.

The printers used shall be of high speed, high-quality and heavy-duty type and be state-of-the-art, at the time when the DFD for the BACS system is prepared.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b>  <b>Design, performance, material and workmanship specifications for:</b></p> <p><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

The following printers shall be provided as a minimum:

SMR            One (1) Laser printer for on line printing alarms and messages.

### **8.9 Equipment and finishes**

All equipment supplied under this Contract shall be in compliance with the Material and Workmanship Specifications.

All equipment shall be designed, manufactured and installed for a service life of at least ten (10) years, subject to the maintenance as required by the General Specifications. Where any equipment is not expected to conform to this requirement and where it is not a consumable spare item, then the Contractor shall list that equipment, its expected service life and any further support that he will provide to ensure that the system may be fully operative for a minimum of ten (10) years.

All equipment supplied under this Contract shall at a minimum, carry the manufacture’s name or identification mark and at least the year of manufacture. All equipment shall carry a permanent identification label in a form approved by AM. All portable or removable items of equipment shall carry a permanent identification label in a form approved by AM. This will identify uniquely the type of equipment and carry a serial number.

All equipment supplied under this Contract shall be finished to the highest standards for continuous usage for its full service life. All finishes shall be selected and applied to reduce the maintenance requirements to a minimum during the service life.

All corrosive metal parts shall be protected, as appropriate, against corrosion by dipping, plating, painting or similar process to a standard that shall be subject to approval by AM.

All electrical or electronic equipment shall be constructed on a modular basis with high quality connections for easy and reliable replacement of faulty modules. Plug-in units shall be designed with restraining devices to hold them in place and shall include a system to allow modules to be interchanged only with another of the same type. All modules shall be clearly and correctly identified.

In order to achieve the maximum service life with the minimum maintenance efforts, the number of different types of units and components shall be minimized.

Systems (groups of equipment) shall be capable of operating to full specification with a total maximum variance in power supply voltage and frequency and simultaneous maximum cable voltage drop. Equipment shall be capable of operating to full specification with an AC mains power fluctuation of +/-10% of the nominal declared voltage and within a frequency range between 47Hz and 53Hz (50Hz nominal).

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b> Design, performance, material and workmanship specifications for:</p> <p><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

## 9 DOCUMENTATION

### 9.1 General

All the documents submitted shall be in accordance with AM’s Drawing Office Manual regarding the drawings, documents’ codification etc.

All documents and information shall be submitted in the required format and number of copies to AM at the various defined stages.

To assist AM establish its library of documents to be submitted, the Contractor shall provide in advance a list of all documents to be submitted.

### 9.2 Detailed Final Design (DFD)

The following documentation, as a minimum, shall be submitted in accordance with the milestone dates established:

- Project Quality Plan;
- Project Programme;
- Software Development Plan;
- Comments – clarifications regarding Software Development
- Catalogue of all documents to be submitted;
- System Architecture Drawings, with description of equipment and operation;
- Design of the ring network (LAN) and interfacing networks;
- Description of interface development with other systems.
- Detailed Final Design – system description, operation analysis, spatial arrangement of equipment, interfaces with equipment, cable routing;
- System and equipment functional characteristics;
- Lists of all hardware or material to be used;
- List of all software to be used;
- List of workstation screens to be produced;
- Catalogue of workstation screen graphical symbols etc.;
- Workstation Graphical layouts;
- Details of the Software simulation platform;
- RAMS analysis;
- Material Submission Sheets (MSS) for equipment and materials;
- FAT, SAT, SIT test procedures, including software simulation tests;
- Catalogue of software tools and hardware required for the tests and subsequent operation;

### 9.3 Other documentation

Other documentation to be provided:

- BACS Hardware test records and protocols, including Factory acceptance test;
- BACS Software test records;
- As-built documents;
- On Site Test and Commissioning Procedures including detailed test sheets for the SAT and SIT;

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p><b>Design, performance, material and workmanship specifications for:</b></p> <p><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

- Operation and Maintenance manual;
- Training manuals and training requirements.

Submission of as-built documentation shall include the following documents, as well:

- I/O lists;
- Functional design software;
- Signed test sheets and acceptance test certificate.

AM reserves the right to request additional documents, within the framework of the lump sum price.

#### **9.4 Manuals**

The Contractor shall supply all the manuals in an approved format, before the commissioning of appropriate equipment. The Contractor shall revise any or all the manuals as required to incorporate any modifications or changes found necessary during installation or commissioning, delivering the revised version of all the manuals to the AM.

The documentation to be supplied in hard and/or soft copies shall be in accordance with the General Specification.

In general, manuals shall include sufficient information and details to enable efficient operation and maintenance for the service life of the supplied BACS equipment.

Manuals shall be supplied in Greek and/or English languages.

Manuals shall include, but not limited to, the following:

- Systems Manuals - comprehensive description of all system principles to block diagram format;
- Software Manuals - shall be provided for each piece of equipment or system, which contains software (firmware) programmable devices. These manuals shall contain all software principles, application software code listings adequately supplied with comments, communication protocols and operating instructions.
- Testing and Commissioning Manual – shall provide all information including test sheets for the required tests as outlined in section 11;
- Training Schedules – shall provide all information regarding the required training as described in section 10;
- Operation and Maintenance Manuals - shall provide sufficient information to enable non-technical staff to operate the BACS and convey sufficient information on equipment diagnostic principles and maintenance practices to enable first line fault diagnosis and rectification by the technical staff.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b>  <b>Design, performance, material and workmanship specifications for:</b>  <b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

## **10 TRAINING REQUIREMENTS**

### **10.1 General**

Training shall be carried out in accordance with AM’s General Specifications.

The scope of training includes, but not limited to, the training of AM engineering and STASY’s maintenance and operations staff to ensure full familiarity with the design, maintenance, operation and the methods/principles to develop skills for future expansion of the facilities.

AM shall determine at a later stage the identity and the final number of the personnel to be trained.

Prior to the courses, the Contractor shall deliver a training schedule for AM approval. The training schedule shall include the required number of training courses (the same subject courses shall be repeated several times to train a required number of staff).

Before any training commences the Operating and Maintenance manuals shall have been delivered for approval and approved by AM as these documents will provide the base reference for the training.

Different training courses shall be provided to engineering design and maintenance staff and operations staff.

Training courses shall include classroom lectures with site visits and instructions to demonstrate and explain the equipment and system and also hands on applications training with the software programming packages.

All of the material to be used for the training shall be approved by AM at least one (1) month before training commences.

The content of each training course shall be developed according to the course content and shall be approved by AM. Each course shall be well structured, commence with a top down review of the systems and be complete with training materials and training aids to ensure that the required level of knowledge is imparted.

Training activities shall be of sufficient size, content and scope to enable the engineers, technicians and specialists to reach the level of knowledge required for continuous operation of existing lines and for opening new lines of the AM.

The contractor shall provide a detailed programme for the training schedule, which shall detail the topics to be presented during each training session. Each session shall not exceed two (2) hours duration before a break, with a minimum of three (3) sessions per day.

Only trainers having knowledge and practical experience of the equipment and systems shall provide training. Their CV’s shall be provided for AM approval. Normally trainers shall not be selected from the installation, testing or commissioning teams. Specialist engineers shall supplement training courses, where required. The Contractor shall submit in advance a detailed description of all the courses for approval by AM. The Contractor shall propose details of the courses and reach agreement on the number of classes for each course with the AM.

	<p align="center"><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p align="center"><b>Design, performance, material and workmanship specifications for:</b></p> <p align="center"><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p align="center"><b>RFP-384/20</b></p>
---	---	---

## 10.2 Engineering design and technical assistance training

The training shall be arranged to provide to the staff the knowledge and skills of the BACS Software so as to be able to provide technical support after completion of the works.

Upon completion of the training the engineering and mechanical staff shall be able:

- ⇒ to completely understand the system functionalities;
- ⇒ to use all the application software design and verification tools;
- ⇒ to perform changes in the software after any BACS plant modification or expansion of the metro system;
- ⇒ to maintain the BACS.

This training shall include:

- Hardware and software overview and functional concepts;
- Hardware and software design and control philosophy;
- Design data and parameters; setting and changing parameters;
- Monitoring and Control philosophy;
- Knowledge of the Interfaces with other systems;
- To perform system modifications and upgrades;
- Identification and correction of software faults;
- Changing, customising or generating of new report templates;
- Maintain and modify user interface screen to add, remove or amend screen and database details;
- System database management and control;
- System backup and restoration especially from system corruption and loss;
- Corrective actions as well as routine maintenance;
- Use of Diagnostic tools for Troubleshooting and fault identification and isolation;
- Procedures to replace defective modules;
- Preventative maintenance.

## 10.3 Operation training

The training should, as minimum, include:

- Hardware and software systems overview;
- The control philosophy and functionality;
- User interfaces;
- Messages, events and alarms;
- Operation under normal conditions;
- On screen commands and operations;
- Operation and actions under emergency conditions;
- Generating and printing of reports;
- Start up and shutdown procedures.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b>  <b>Design, performance, material and workmanship specifications for:</b></p> <p><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

## 11 SYSTEM TESTS AND INSPECTIONS

Test and commissioning shall be performed in accordance with the General Specifications. The Contractor shall perform the necessary testing in order to verify correct function and safety of each part of the system as well as the safety and function of the entire system.

The Contractor shall not offer any equipment, module, component or system for inspection or witness testing by AM which has not been pre-tested and is known to be satisfactory.

All testing shall demonstrate that the individual equipment and systems meets with the specified requirements. Testing and inspection shall include but not limited to:

- Hardware and software factory acceptance inspections and tests;
- PLC tests;
- Communications testing;
- Interface testing;
- Local, Remote, Manual and Automatic controls testing of plant and equipment;
- Individual plant controls;
- Test of emergency scenarios using the Fireman Box;
- Time- and Event-table controls (as applicable).

Fully detailed inspection and test plans shall be provided for BACS, which shall be submitted for AM review and approval prior to the commencement of the subject testing phase.

These plans shall address:

- Design reviews;
- Factory Acceptance Testing (FAT);
- Site Acceptance Test (SAT);
- System Integration Test (SIT).

SAT and SIT test procedures shall be created in close cooperation and coordination with the Tunnel Ventilation and HVAC and E&M systems suppliers.

The information to be provided within each test plan shall include, but not limited to, the following for each test:

- Test commencement;
- Test duration;
- Test location;
- Type of test (FAT, SAT, SIT etc.);
- Details of the equipment to be tested;
- Details of the test equipment required;
- Acceptance criteria;
- Reference to all test and inspection procedures;
- Non-conformances and re-test procedures.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b>  <b>Design, performance, material and workmanship specifications for:</b>  <b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

For each test performed, a test report shall be produced which shall as a minimum include:

- Details of the test performed;
- Results obtained with values as applicable;
- Failures and details of re-tests;
- Aspects of Non conformances.

### **11.1 Factory Acceptance Test (FAT)**

The FAT shall be carried out in the manufacturer’s premises before the BACS delivery to the site; This test shall demonstrate that the BACS hardware and software meets the specified requirements.

For the FAT, the Contractor shall assemble at the factory a fully structured model of the Tunnel Ventilation PLCs, HVAC-PLCs and E&M systems PLCs, complete with SMR and OCC workstations and FO transmission system.

The Contractor shall generate a FAT procedure in accordance with the guidelines set forth in the contract documents. The procedure for the FAT shall be approved by AM before the testing phase commences.

The result of the FAT shall be successful in order to install the system on site. Any unsolved or open items shall be written into the FAT test report and shall be resolved prior to shipment of equipment on site. Equipment with unsolved or open items shall not be shipped to the site without prior approval from AM.

### **11.2 Start-up Testing and Commissioning**

The Start-up Test and Commissioning schedules have to be developed in close cooperation and coordination with the “Lead Contractor” of each extension and to be submitted to AM for approval.

After installation and connection of the BACS with the Tunnel Ventilation and HVAC and E&M systems of Tunnels, Stations and Shafts on site Start-up testing and Commissioning shall be performed according to Start-up and Commissioning schedule approved by AM.

The start-up Tests shall verify that all Tunnel Ventilation, HVAC and E&M equipment is supplied and installed according the contractual specifications and requirements and is ready for start-up and commissioning.

During the Commissioning of the BACS-PLCs (point-to-point test to the connected I/O signals of the Tunnel Ventilation, HVAC, E&M systems etc.), the Contractor shall invite AM to witness full testing of all signals of the BACS-PLCs, to be displayed on the SMR workstation. The tests shall be exhaustive to demonstrate that the system meets with the specified functionality.

	<p align="center"><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p align="center"><b>Design, performance, material and workmanship specifications for:</b></p> <p align="center"><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p align="center"><b>RFP-384/20</b></p>
---	---	---

### **11.3 Site Acceptance Test (SAT)**

Upon installation of the BACS and completion of system installation tests, the Site Acceptance Test (SAT) in each Station shall be performed.

The SAT Test schedules have to be developed by the Contractor and to be submitted to AM for approval.

The SAT test shall verify, but not limited to, the following:

- Correct installation of all BACS, Tunnel Ventilation, HVAC and E&M systems;
- Verification that all I/O signals of the Tunnel Ventilation and HVAC systems, the Station and Tunnel E&M systems are properly connected to the BACS-PLCs and correctly displayed on the OCC-WS and SMR-WS.
- All Tunnel Ventilation and HVAC systems and Station and Tunnel E&M systems are fully operational from the local switchboards as well as from the OCC-WS and SMR-WS under normal and emergency operation mode.

### **11.4 System Integration Tests (SIT)**

The SITs shall be conducted after the successful execution of SATs in all stations and related tunnels on the completed systems.

The SIT Test schedules have to be developed by the Contractor and to be submitted to AM for approval.

These tests shall demonstrate that all equipment and systems supplied under the Contract are fully integrated, function correctly as integrated systems and satisfy the functional and performance requirements of the specifications when operated in the intended and predictable manner.

During these tests the Emergency Scenarios for the Tunnel Ventilation and HVAC systems shall be tested from the OCC-WS, the SMR-WS and the local Fireman Box and switchboards in the stations.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b>  <b>Design, performance, material and workmanship specifications for:</b>  <b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

## **12 RELIABILITY, AVAILABILITY, MAINTAINABILITY AND SAFETY (RAMS)**

The Contractor shall prepare a RAMS design for the safe and smooth operation of the BACS System.

### **12.1 Availability Analysis**

As required in the General Specification, an availability analysis shall be conducted for the system. The analysis shall be fully supported by the models used for the analysis and all related calculations.

The Contractor shall quote figures derived from previous service experience on similar systems, on the operation and their source and shall deliver the analysis to AM in order to prove the availability of the system, based on the following:

- Mean time between failures for the entire system;
- Mean time between failures of all individual parts of the installation, such as loss of central control;
- Availability of the completed system;
- Availability of all individual parts of a system to be installed.

The BACS shall have an overall availability of not less than 99.95%.

The Contractor shall include details of his proposals for meeting these requirements and shall state whether the system is capable of detecting other faults.

### **12.2 Protection against internal failures**

The system shall be able to automatically return to full service and performances, after any single software or processing unit failure, within a limited time (ten (10) minutes maximum), without any loss or corruption of data.

The system shall be able to suffer a software failure related to a given line without any interruption of system services for the other line. A failure occurring on one of the workstation processing units shall not cause disruption of the system services or any loss or corruption of data, except the VDU on the workstation.

Each display shall include a permanent colour spectrum and time display to confirm correct operation of the system. The source of the time display (central or local) shall be synchronised with master clock with 1-sec accuracy.

The Contractor shall prove in his design report how he shall match the above requirements.

### **12.3 Protection against internal mutual perturbations**

The Contractor shall be fully responsible to design the system in order to offer protection against mutual perturbations within the system that could degrade or interrupt the service.

The Contractor shall be fully responsible to identify the potential sources of mutual perturbations, estimate their potential effects and apply appropriate design solutions to avoid degradations due to such phenomenon.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p><b>Design, performance, material and workmanship specifications for:</b></p> <p><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

This requirement encompasses without, however, being limited to, the following. Screens layout shall not be degraded by electromagnetic influence. Processor connection inputs shall be "isolated" to avoid spurious operation. For clock display and time stamping, the system shall ensure error less than one (1) second, even under adverse conditions (MTBF to be specified).

All processors including memories shall not be corrupted by the loss or momentary interruption of power supply and shall be capable of automatically restarting when power is reapplied. No essential memory shall be lost during any loss of power supply.

#### **12.4 Protection against external perturbations**

The system shall be protected against external perturbations. This includes without, however, being limited to, the protection against the effects of lightning, where the need arises.

#### **12.5 Safety Assessments**

A safety assessment shall be conducted.

The aim of this assessment is that the Contractor demonstrates that the BACS shall have a level of safety, which is as a minimum equivalent to that of an SIL 2 system.

This assessment shall be conducted in accordance with the requirements of the standards listed in the Section 3 of this Specification, and shall be based on the activities undertaken and the documentation produced by the Contractor.

The conditions for acceptance of the BACS shall be structured in accordance with requirements of the standards, namely based on the:

- Evidence of quality management;
- Evidence of safety management;
- Evidence of functional and technical safety.

	<p align="center"> <b>“PROCUREMENT AND INSTALLATION OF THE BUILDING  AUTOMATION AND CONTROL SYSTEM (BACS) OF  PIRAEUS EXTENSION PHASE B”</b>  <b>Design, performance, material and workmanship  specifications for:</b>   <b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b> </p>	<p align="center"><b>RFP-384/20</b></p>
---	---	---

### **13 QUALITY ASSURANCE**

The process of manufacturing and installation of equipment on site shall be certified in accordance with recommendations of the standard ISO 9001:2000.

AM shall be informed at least two (2) weeks prior to every Quality test that takes place in the Factory and reserves the right to witness any and all such tests.

The Contractor shall record the results of these Quality tests on the appropriate Factory Test Report forms. For each subsystem, cabinet or piece of equipment such test reports shall be organized and grouped in binders/folders and shall be present during the Factory Acceptance Tests.

The Contractor shall provide and maintain up-to-date diary or log, containing a detailed description of all changes made to the system hardware and software from the time of their approval by AM until the final acceptance by the STASY S.A., when the log shall be delivered to AM. This record form used in the log shall conform to typical requirements and standards for such documentation.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p><b>Design, performance, material and workmanship specifications for:</b></p> <p><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

## 14 SPARE PARTS, SPECIAL TOOLS AND TECHNICAL SUPPORT

### 14.1 Parts list and Spare Parts list

In accordance with the General Specification, the Contractor shall submit to AM:

- ⇒ a Parts lists, containing all major equipment of the BACS to be installed, with full data concerning each manufacturer
- ⇒ a list of Spare Parts for the major BACS equipment to ensure a safe and reliable operation of the BACS.

The list of spare parts shall be approved by AM.

AM shall be the owner of all delivered spare parts. The Contractor has the obligation to replace every spare part used with new spares or acceptable replacements during the warranty period.

The Contractor shall specify in the list of spare parts the ordering time and shall undertake the obligation to continue the supply of spare parts for a period of ten (10) years after the completion of the last, in terms of time of construction, station, or acceptable and compatible replacements for the minimum service life of the system. Sufficient spare parts of the major BACS equipment shall be provided, based on the Contractors experience from similar projects, - an average minimum of 10% of the installed parts shall be provided - including the parts as listed below.

Part description	Quantity
Server and PC Communication Processor	Minimum 1
SMR client/server	Minimum 1
PLC Power Supply Units	Minimum 1 of each type
PLC-CPU	Minimum 1 of each type
PC Communication Processors	Minimum 1 of each type
I/O modules	Minimum 1 of each type
Optical Link Modules	Minimum 1 of each type

### 14.2

#### 14.2 Special Tools and Test equipment

In accordance with the General Specification, the Contractor shall provide a list of all special tools and test equipment necessary for preventative maintenance and basic fault repair of all equipment. The type and quantity of special tools and test equipment to be supplied shall be sufficient to ensure the efficient operation of the system.

Where equipment is not considered to be maintainable by AM, e.g. PC-Workstations, computer processors etc, then the Contractor shall specify maintenance / repair facilities available in the Athens area. If no facilities exist in the Athens area then the Contractor shall propose how such equipment shall be maintained.

The list of special tools and test equipment shall contain the following information:

	<p align="center"> <b>“PROCUREMENT AND INSTALLATION OF THE BUILDING  AUTOMATION AND CONTROL SYSTEM (BACS) OF  PIRAEUS EXTENSION PHASE B”</b>  <b>Design, performance, material and workmanship  specifications for:</b>   <b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b> </p>	<p align="center"><b>RFP-384/20</b></p>
---	---	---

- A serial number for the purpose of identification;
- A description of the tool/test equipment;
- The recommended quantity;
- Full data for the manufacturer.

Special attention shall be paid to the provision of portable test equipment to determine for example system parameters. This equipment shall be capable of being used during service without affecting the safety related nature of circuits or equipment. In this context, portable shall be taken to mean that the equipment can be carried, connected and operated by one man carrying all associated equipment.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b>  <b>Design, performance, material and workmanship specifications for:</b>  <b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

**APPENDIX A – New tunnel and station ventilation systems I/O point list – general requirements**

This Appendix is provided only in English due to the terminology related to electronic systems and the abbreviations included herein.

Table Legend:

DI – Digital Input, DO – Digital Output, AI – Analogue Input, AO – Analogue Output.

**BLAST SHAFT SWITCHBOARD / PLC-PANEL**

Equipment Designation	Equipment Type	Control & Monitoring	Link to PLC				Remarks
			DI	DO	AI	AO	
BSF SWB	Switchboard	Incoming Switch ON	1				Status
		Incoming fault	1				Alarm
		General fault	1				Alarm
	Selector switch	Remote	1				Status
		Local Normal	1				Status
		Local Emergency	1				Status
	Selector switch	Supply	1				Status
		Exhaust	1				Status
	Fireman Box	Active		1			Indication Lamp
	Push Button	Lamp test	1				Status
Acknowledge		1				Status	

BSF-1 Inverter	Frequency Converter	Fuse disconnecter Off	1				Status
		Inverter ready	1				Alarm
		Inverter electrical fault	1				Alarm
		Inverter Running	1				Status
		Running Speed			1		4 to 20mA / RPM
		Fan Current			1		4 to 20mA / A
	BSF-1	Stop		1			Commands to Inverter
		Run					
		High Speed/ Low Speed		1			
		Start Supply		1			
BSF-1-SWB	Push Button	Start Exhaust		1			
		Stop	1			Status	
		Low Speed	1			Status	
BSF-1 DPS	Air flow verification	High Speed	1			Status	
		Running in Supply	1			Status	
BSF-1 Motor	BSF-1	Running in Exhaust	1			Status	
		DE Bearing Temp	1			Alarm	
BSF-1 Vibration Sensor	BSF-1	NDE Bearing Temp	1			Alarm	
		Winding Temp	1			Alarm	
		Vibration			1	4 – 20mA	



**“PROCUREMENT AND INSTALLATION OF THE BUILDING  
AUTOMATION AND CONTROL SYSTEM (BACS) OF  
PIRAEUS EXTENSION PHASE B”**  
Design, performance, material and workmanship  
specifications for:

**RFP-384/20**

**BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)**

Equipment Designation	Equipment Type	Control & Monitoring	Link to PLC				Remarks
			DI	DO	AI	AO	
Maintenance switch BSF-1	BSF-1	In Maintenance	1				alarm
BSF-1-SWB	BSF-1	Vibration		1			Status / Alarm Indication lamps
		Air Flow		1			

Equipment Designation	Equipment Type	Control & Monitoring	Link to PLC				Remarks	
			DI	DO	AI	AO		
BSF-2 Inverter	Frequency Converter	Fuse disconnecter Off	1				Status	
		Inverter ready	1				Alarm	
		Inverter electrical fault	1				Alarm	
		Inverter Running	1				Status	
		Running Speed			1		4 to 20mA / RPM	
		Fan Current			1		4 to 20mA / A	
	BSF-2	BSF-2	Stop		1			Commands to Inverter
			Run					
			High Speed/ Low Speed		1			
			Start Supply		1			
BSF-2-SWB	Push Button	Start Exhaust		1				
		Stop	1				Status	
		Low Speed	1				Status	
BSF-2 DPS	Air flow verification	High Speed	1				Status	
		Running in Supply	1				Status	
		Running in Exhaust	1				Status	
BSF-2 Motor	BSF-2	DE Bearing Temp	1				Alarm	
		NDE Bearing Temp	1				Alarm	
		Winding Temp	1				Alarm	
BSF-2 Vibration Sensor	BSF-2	Vibration			1		4 – 20mA	
Maintenance switch BSF-2	BSF-2	In Maintenance	1				alarm	
BSF-2-SWB	BSF-2	Vibration		1			Status / Alarm Indication lamps	
		Air Flow		1				

MOD *)	Air Relief Damper	Close		1			Command	
		Open	1				Command from SWB	
		Closed	1					
		Open	2				Status *)	
	BSF-1 Fan Damper	BSF-1 Fan Damper	Closed	2				Status *)
			Close		1			Command
			Open	1				Command from SWB
			Closed	1				
		Open	2				Status *)	

 <b>ATTIKO METRO S.A.</b>	<b>“PROCUREMENT AND INSTALLATION OF THE BUILDING  AUTOMATION AND CONTROL SYSTEM (BACS) OF  PIRAEUS EXTENSION PHASE B”</b> <b>Design, performance, material and workmanship  specifications for:</b>  <b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b>	<b>RFP-384/20</b>
---	--	-------------------

Equipment Designation	Equipment Type	Control & Monitoring	Link to PLC				Remarks
			DI	DO	AI	AO	
		Closed	2				Status *)
		Close		1			Command
	BSF-2 Fan Damper	Open	1				Command from SWB
		Closed	1				
		Open	2				Status *)
		Closed	2				Status *)

\*) Note: Depending on the size of the MOD there can be up to 4 MOD sections i.e. 4-open and 4-closed status signals.

Hardwired Signals from the FB of Station “N” to the BSF-PLCs of Station “N”

Equipment Designation	Equipment Type	Control & Monitoring	Link to PLC				Remarks
			DI	DO	AI	AO	
Hardwired Signals from the FB to the PLC	Selector switch **)	Remote	1				Status
		Scenarios	1				Status

\*\*Note: The above signals from the FB of Station „N“ to the BSF-PLCs of Station „N+1“ and „N-1“ shall be transmitted via PLC-peer-to-peer communication.

**Hardwired Signals from/to the FB of Station “N” to/from the BSFs of Station “N”**

I= Input from FB;      O= Output to FB

Equipment Designation	Equipment Type	Control & Monitoring	From/to SWB		Remarks	
			I	O		
Hardwired Signals from/to the FB to/from the SWB	BSF-1, 2	Stopped		2	Indication lamps on FB	
	BSF-1, 2	running in Supply		2		
	BSF-1, 2	running in Exhaust		2		
	Push Button	-scenario platform		1		FB Commands
		scenario concourse		1		

The exact number of control and monitoring data points necessary shall be determined during the detailed design phase of the Tunnel and Station Ventilation and HVAC Systems.



**“PROCUREMENT AND INSTALLATION OF THE BUILDING  
AUTOMATION AND CONTROL SYSTEM (BACS) OF  
PIRAEUS EXTENSION PHASE B”**  
Design, performance, material and workmanship  
specifications for:

**RFP-384/20**

**BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)**

**SAF / PLC SWITCHBOARD**

Equipment Designation	Equipment Type	Control & Monitoring	Link to PLC				Remarks
			DI	DO	AI	AO	
SAF SWB	Switchboard	Incoming Switch ON	1				Status
		Incoming fault	1				Alarm
		General fault	1				Alarm
	Selector switch	Remote	1				Status
		Local Normal	1				Status
		Local Emergency	1				Status
	Fireman Box	Active		1			Indication Lamp
	Push Button	Lamp test	1				Status
Acknowledge		1				Status	
SAF-1 Inverter	Frequency Converter	Fuse disconnecter Off	1				Status
		Inverter ready	1				Alarm
		Inverter electrical fault	1				Alarm
		Inverter Running	1				Status
		Running Speed			1		4 to 20mA / RPM
		Fan Current			1		4 to 20mA / A
	SAF-1	Stop		1			Commands to Inverter
		Run					
		High Speed/ Low Speed		1			
	SAF-1-SWB	Push Button	Start supply		1		
Stop			1			Status	
Low Speed			1			Status	
SAF-1-DPS	Air flow verification	High Speed	1			Status	
		Running in Supply	1			Status	
SAF-1 Motor	SAF-1	DE Bearing Temp	1			Alarm	
		NDE Bearing Temp	1			Alarm	
		Winding Temp	1			Alarm	
SAF-1 Vibration Sensor	SAF-1	Vibration			1	4 – 20mA	
Maintenance switch SAF-1	SAF-1	In Maintenance	1			alarm	
SAF-1-SWB	SAF-1	Vibration		1		Status / Alarm Indication lamps	
		Air Flow		1			



**“PROCUREMENT AND INSTALLATION OF THE BUILDING  
AUTOMATION AND CONTROL SYSTEM (BACS) OF  
PIRAEUS EXTENSION PHASE B”**  
Design, performance, material and workmanship  
specifications for:

**RFP-384/20**

**BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)**

Equipment Designation	Equipment Type	Control & Monitoring	Link to PLC				Remarks
			DI	DO	AI	AO	
SAF-2 Inverter	Frequency Converter	Fuse disconnecter Off	1				Status
		Inverter ready	1				Alarm
		Inverter electrical fault	1				Alarm
		Inverter Running	1				Status
		Running Speed			1		4 to 20mA / RPM
		Fan Current			1		4 to 20mA / A
	SAF-2	Stop		1			Commands to Inverter
		Run					
		High Speed/ Low Speed		1			
		Start Supply		1			
SAF-2-SWB	Push Button	Stop	1			Status	
		Low Speed	1			Status	
		High Speed	1			Status	
SAF-2 DPS	Air flow verification	Running in Supply	1			Status	
SAF-2 Motor	SAF-2	DE Bearing Temp	1			Alarm	
		NDE Bearing Temp	1			Alarm	
		Winding Temp	1			Alarm	
SAF-2 Vibration Sensor	SAF-2	Vibration			1	4 – 20mA	
Maintenance switch SAF-2	SAF-2	In Maintenance	1			alarm	
SAF-2-SWB	SAF-2	Vibration		1		Status / Alarm Indication lamps	
		Air Flow		1			

MOD *)	SAF-1 Fan Damper	Close		1			Command
		Open	1				Command from SWB
		Closed	1				
		Open	2				Status *)
		Closed	2				Status *)
	SAF-2 Fan Damper	Close		1			Command
		Open	1				Command from SWB
		Closed	1				
		Open	2				Status *)
		Closed	2				Status *)

\*) Note: Depending on the size of the MOD there can be up to 4 MOD sections i.e. 4 open and 4 closed status signals.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b>  <b>Design, performance, material and workmanship specifications for:</b>  <b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<b>RFP-384/20</b>
---	--	-------------------

**Hardwired Signals from the FB of Station “N” to the SAF-PLC of Station “N”**

Equipment Designation	Equipment Type	Control & Monitoring	Link to PLC				Remarks
			DI	DO	AI	AO	
Hardwired Signals from the FB to the PLC	Selector switch **)	Remote	1				Status
		Scenarios	1				Status

**\*\*)** Note: The above signals from the FB of Station „N“ to the SAF-PLCs of Station „N+1“ and „N-1“ shall be transmitted via peer-to-peer communication.

**Hardwired Signals from/to the FB of Station “N” to/from the SAF of Station “N”**

I= Input from FB; O= Output to FB

Equipment Designation	Equipment Type	Control & Monitoring	From/to SWB		Remarks	
			I	O		
Hardwired Signals from/to the FB to/from the SWB	SAF-1, 2	Stopped		2	Indication lamps on FB	
	SAF -1, 2	running		2		
	Push Button	scenario platform		1		FB Commands
		scenario concourse		1		

The exact number of control and monitoring data points necessary shall be determined during the detailed design phase of the Tunnel and Station Ventilation and HVAC Systems.



**“PROCUREMENT AND INSTALLATION OF THE BUILDING  
AUTOMATION AND CONTROL SYSTEM (BACS) OF  
PIRAEUS EXTENSION PHASE B”**  
Design, performance, material and workmanship  
specifications for:

**RFP-384/20**

**BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)**

**OTE / PLC SWITCHBOARD**

Equipment Designation	Equipment Type	Control & Monitoring	Link to PLC				Remarks
			DI	DO	AI	AO	
OTE SWB	Switchboard	Incoming Switch ON	1				Status
		Incoming fault	1				Alarm
		General fault	1				Alarm
	Selector switch	Remote	1				Status
		Local Normal	1				Status
		Local Emergency	1				Status
	Fireman Box	Active		1			Indication Lamp
	Push Button	Lamp test	1				Status
Acknowledge		1				Status	
UPE/OTE-1 Inverter	Frequency Converter	Fuse disconnecter Off	1				Status
		Inverter ready	1				Alarm
		Inverter electrical fault	1				Alarm
		Inverter Running	1				Status
		Running Speed			1		4 to 20mA / RPM
		Fan Current			1		4 to 20mA / A
	UPE/OTE-1	Stop		1			Commands to Inverter
		Run					
High Speed/ Low Speed			1				
UPE/OTE-1-SWB	Push Button	Start Exhaust		1			
		Stop	1			Status	
		Low Speed	1			Status	
		High Speed	1			Status	
UPE/OTE-1 Motor	UPE/OTE-1	Running in Exhaust	1			Status	
		DE Bearing Temp	1			Alarm	
		NDE Bearing Temp	1			Alarm	
UPE/OTE-1	UPE/OTE-1	Winding Temp	1			Alarm	
		Vibration			1	4 – 20mA	
Maintenance switch UPE/OTE-1	UPE/OTE-1	In Maintenance	1			alarm	
UPE/OTE-1-SWB	UPE/OTE-1	Vibration		1		Status / Alarm Indication lamps	
		Air Flow		1			



**“PROCUREMENT AND INSTALLATION OF THE BUILDING  
AUTOMATION AND CONTROL SYSTEM (BACS) OF  
PIRAEUS EXTENSION PHASE B”**  
Design, performance, material and workmanship  
specifications for:

**RFP-384/20**

**BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)**

Equipment Designation	Equipment Type	Control & Monitoring	Link to PLC				Remarks
			DI	DO	AI	AO	
UPE/OTE-2 Inverter	Frequency Converter	Fuse disconnecter Off	1				Status
		Inverter ready	1				Alarm
		Inverter electrical fault	1				Alarm
		Inverter Running	1				Status
		Running Speed			1		4 to 20mA / RPM
		Fan Current			1		4 to 20mA / A
	UPE/OTE-2	Stop		1			Commands to Inverter
		Run High Speed/ Low Speed		1			
Start Exhaust			1				
UPE/OTE-2-SWB	Push Button	Stop	1			Status	
		Low Speed	1			Status	
		High Speed	1			Status	
		Running in Exhaust	1			Status	
UPE/OTE-2 Motor	UPE/OTE-2	DE Bearing Temp	1			Alarm	
		NDE Bearing Temp	1			Alarm	
		Winding Temp	1			Alarm	
UPE/OTE-2 Vibration Sensor	UPE/OTE-2	Vibration			1	4 – 20mA	
Maintenance switch UPE/OTE-2	UPE/OTE-2	In Maintenance	1			alarm	
UPE/OTE-2-SWB	UPE/OTE-2	Vibration		1		Status / Alarm Indication lamps	
		Air Flow		1			

MOD *)	UPE/OTE-1 Fan Damper	Close		1		Command
		Open	1			Command from SWB
		Closed	1			
		Open	2			Status *)
	UPE/OTE-2 Fan Damper	Closed	2			Status *)
		Close		1		Command
		Open	1			Command from SWB
		Closed	1			
	Platform Smoke Exhaust Damper Track 1	Open	2			Status *)
		Closed	2			Status *)
		Close		1		Command
		Open	1			Command from SWB
	Closed	1				
	Platform Smoke Exhaust Damper Track 2	Open	2			Status *)
		Close		1		Command
		Open	1			Command from SWB
Closed		1				
Open	2			Status *)		

 <b>ATTIKO METRO S.A.</b>	<b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b> <b>Design, performance, material and workmanship specifications for:</b>  <b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b>	<b>RFP-384/20</b>
---	---	-------------------

Equipment Designation	Equipment Type	Control & Monitoring	Link to PLC				Remarks
			DI	DO	AI	AO	
		Closed	2				Status *)
		Close		1			Command
MOD *)	UPE/OTE Smoke Exhaust Damper Track 1	Open	1				Command from SWB
		Closed	1				
		Open	2				Status *)
		Closed	2				Status *)
		Close			1		Command
	UPE/OTE Smoke Exhaust Damper Track 2	Open	1				Command from SWB
		Closed	1				
		Open	2				Status *)
		Closed	2				Status *)

\*) Note: Depending on the size of the MOD there can be up to 4 MOD sections i.e. 4 open and 4 closed status signals.

**Hardwired Signals from the FB of Station “N” to the UPE/OTE-PLC of Station “N”**

Equipment Designation	Equipment Type	Control & Monitoring	Link to PLC				Remarks
			DI	DO	AI	AO	
Hardwired Signals from the FB to the PLC	Selector switch **)	Remote	1				Status
		Scenarios	1				Status

**Hardwired Signals from/to the FB of Station “N” to/from the UPE/OTE of Station “N”**

I= Input from FB; O= Output to FB

Equipment Designation	Equipment Type	Control & Monitoring	From/to SWB		Remarks	
			I	O		
Hardwired Signals from/to the FB to/from the SWB	UPE/OTE-1, 2	Stopped		2	Indication lamps on FB	
	UPE/OTE-1, 2	running in Exhaust		2		
	Push Button	-scenario platform		1		FB Commands
		scenario concourse		1		

The exact number of control and monitoring data points necessary shall be determined during the detailed design phase of the Tunnel and Station Ventilation and HVAC Systems.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b> Design, performance, material and workmanship specifications for: <b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	---	--------------------------

**JET-FAN / PLC SWITCHBOARD**

Equipment Designation	Equipment Type	Control & Monitoring	Link to PLC				Remarks
			DI	DO	AI	AO	
JF SWB	Switchboard	Incoming Switch ON	1				Status
		Incoming fault	1				Alarm
		General fault	1				Alarm
	Selector switch	Remote	1				Status
		Local Normal	1				Status
		Local Emergency	1				Status
	Selector switch	Supply	1				Status
		Exhaust	1				Status
	Fireman Box	Active		1			Indication Lamp
	Push Button	Lamp test	1				Status
Acknowledge		1				Status	
JF	Jet Fan 1, 2	Running in Supply	2				Status
		Running in Exhaust	2				Status
		Fault	2				Alarm
		DE Bearing Temp	2				Alarm
		NDE Bearing Temp	2				Alarm
		Winding Temp	2				Alarm
		Vibration			2		4 to 20mA
		In Maintenance	2				Alarm
		Start		2			
		Stop		2			
JF-SWB	Jet Fan 1, 2	Vibration		2			Status / Alarm Indication lamps
		Air Flow		2			

The exact number of control and monitoring data points necessary shall be determined during the detailed design phase of the Tunnel and Station Ventilation and HVAC Systems.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b>  <b>Design, performance, material and workmanship specifications for:</b>  <b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

**RSD/ PLC SWITCHBOARD**

Equipment Designation	Equipment Type	Control & Monitoring	Link to PLC				Remarks
			DI	DO	AI	AO	
RSD SWB	Switchboard	Incoming Switch ON	1				Status
		Incoming fault	1				Alarm
		General fault	1				Alarm
	Selector switch	Remote	1				Status
		Local Normal	1				Status
		Local Emergency	1				Status
	Fireman Box	Active		1			Indication Lamp
	Push Button	Lamp test	1				Status
		Acknowledge	1				Status
RSD	Roller Shutter Door	Open	1				Status
		Closed	1				Status
		Open		1			Command
		Close		1			Command

The exact number of control and monitoring data points necessary shall be determined during the detailed design phase of the Tunnel and Station Ventilation and HVAC Systems.

**FB SWITCHBOARD**

Equipment Designation	Equipment Type	Control & Monitoring	Link to PLC				Remarks
			DI	DO	AI	AO	
FB	Selector switch (**))	Remote	1				Status
		Scenarios	1				Status
							Status
	FB “N-1“ Active		1			Indication Light on FB	
	FB “N-2“ Active		1				
	Scenarios		2	2			FB Scenario Commands and Indication Lights
General Alarm			1			Indication Light on FB	
FB	Indication lights	Tunnel fans - Start		n			FB Indication Lights
		Tunnel fans - Stop		n			

The exact number of control and monitoring data points necessary shall be determined during the detailed design phase of the Tunnel and Station Ventilation and HVAC Systems.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b>  <b>Design, performance, material and workmanship specifications for:</b>  <b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<b>RFP-384/20</b>
---	--	-------------------

**APPENDIX B – HVAC and E&M systems equipment list of new tunnels/stations**

This Appendix is provided only in English due to the terminology related to electronic systems and the abbreviations included herein.

Table Legend:

DI – Digital Input, DO – Digital Output, AI – Analogue Input, AO – Analogue Output.

**HVAC and E&M Systems Switchboard / PLC-Panel**

Equipment Designation	Equipment Type	Control & Monitoring	Link to PLC				Remarks
			DI	DO	AI	AO	
SWB	Switchboard	Incoming Switch ON	1				Status
		Incoming fault	1				Alarm
		General fault	1				Alarm
	Push Button	Lamp test	1				Status
		Acknowledge	1				Status
SAF-E	Selector switch	Remote	1				Status
		Local	1				Status
	Supply Air Fan for Technical Rooms	Stop		1			Command
		Run		1			Command
		Stopped	1				Status
		Running	1				Status
		Fault	1				Alarm
		DE Bearing Temp	1				Alarm
		NDE Bearing Temp	1				Alarm
		Winding Temp	1				Alarm
		Vibration			1		4 to 20mA
in Maintenance	1				Alarm		
EXF (large kW)	Selector switch	Remote	1				Status
		Local	1				Status
	Exhaust Fan	Stop		1			Command
		Run		1			Command
		Stopped	1				Status
		Running	1				Status
		Fault	1				Alarm
		DE Bearing Temp	1				Alarm
		NDE Bearing Temp	1				Alarm
		Winding Temp	1				Alarm
		Vibration			1		4 to 20mA
In Maintenance	1				Alarm		
EXF (Small kW)	Selector switch	Remote	1				Status
		Local	1				Status
	Exhaust Fan	Stop		1			Command
		Run		1			Command
		Stopped	1				Status



**“PROCUREMENT AND INSTALLATION OF THE BUILDING  
AUTOMATION AND CONTROL SYSTEM (BACS) OF  
PIRAEUS EXTENSION PHASE B”**  
Design, performance, material and workmanship  
specifications for:

**RFP-384/20**

**BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)**

Equipment Designation	Equipment Type	Control & Monitoring	Link to PLC				Remarks
			DI	DO	AI	AO	
		Running	1				Status
		Fault	1				Alarm
		In Maintenance	1				Alarm

MOD	Motorised Damper	Open		1			Command
		Close		1			Command
		Open	1				Status
		Closed	1				Status
RTS	Temperature Sensor	Room / Space Temperature			1		4 to 20mA. Temperature
RT	Thermostat	Room Temperature	1				Temperature
AF	Air Filter	Filter Clogged	1				Alarm
DPS	Air Flow	Fan proving	1				Status

SPF	Selector switch	Remote	1				Status
		Local	1				Status
	Staircase Pressurisation Fan	On		1			Command
		Stop	1				Command
		Stop	1				Status
		Running	1				Status
		DE Bearing Temp	1				Alarm
		NDE Bearing Temp	1				Alarm
		Winding Temp	1				Alarm
		Vibration			1		4 to 20mA
		Diff Pressure	1				Alarm
		in Maintenance	1				Alarm

ACC	Air Cooled Chiller	Run		1			Command
		Stop		1			Command
		Running	1				Status
		Stopped	1				Status
		Fault	1				Alarm
CHP	Selector switch	Remote					Status
		Local					Status
	Chiller Pump	Run		1			Command
		Stop		1			Command
		Running	1				Status
		Stopped	1				Status
		Fault	1				Alarm

ACU / AHU	Air Handling Unit	Run		1			Command
		Stop		1			Command
		Running	1				Status
		Stopped	1				Status
		High Pressure	1				Alarm
		Low Pressure	1				Alarm
		Filter Clogged	1				Alarm



**“PROCUREMENT AND INSTALLATION OF THE BUILDING  
AUTOMATION AND CONTROL SYSTEM (BACS) OF  
PIRAEUS EXTENSION PHASE B”**  
Design, performance, material and workmanship  
specifications for:

**RFP-384/20**

**BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)**

Equipment Designation	Equipment Type	Control & Monitoring	Link to PLC				Remarks
			DI	DO	AI	AO	
		Fault	1				Alarm
		In Maintenance	1				Alarm

FCU	Fan Coil Unit	Stop		1			Command
		Run		3			Command 3 speed
		3 way valve				1	4 to 20mA
		Room Temperature			1		4 to 20mA
		Stopped	1				Status
		Running	3				Status 3 speed
		Fault	1				Alarm
HP	Heat Pump	Off		1			Command
		On		1			Command
		Off	1				Status
		On	1				Status
		Filter Clogged	1				Alarm
		Fault	1				Alarm

Lighting (Normal)	SWB	Incoming Switch ON	1				Status
		Voltage Supervision	1				Status
		General Fault	1				Alarm
	Selector Switch	Remote	1				Status
		Local	1				Status
	Normal Lighting	Off					Command per section
		50%					Command per section
		100%					Command per section
		Photo sensor	1		1		Auto control. - As required per section

Lighting (Emergency)	Emergency Lighting	On		1			Command
		Off		1			Command
		On	1				Status
		Off	1				Status

Escalator	Escalator	Stop		1			Command
		On	1				Status
		Power Failure	1				Alarm
		Motor overload	1				Alarm
		Emergency Stop	1				Alarm
		Running Up	1				Status
		Running Down	1				Status
		Over Speed	1				Alarm



**“PROCUREMENT AND INSTALLATION OF THE BUILDING  
AUTOMATION AND CONTROL SYSTEM (BACS) OF  
PIRAEUS EXTENSION PHASE B”**  
Design, performance, material and workmanship  
specifications for:

**RFP-384/20**

**BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)**

Equipment Designation	Equipment Type	Control & Monitoring	Link to PLC				Remarks
			DI	DO	AI	AO	
		Water in escalator pit	1				Alarm
		Global Alarm	1				Alarm
		Comb switch operated	1				Alarm
		Hand rail entry switch operated	1				Alarm
		Broken or stopped hand rail	1				Alarm

DEV	Deluge Valve	Valve actuation		1			Command
		Water flow	1				Status – Water flow switch

Lift	Lift	Power Failure	1				Alarm
		Global Alarm	1				Alarm
		Stop		1			Command
		On	1				Status
		Emergency Stop	1				Alarm
		Doors NOT closed	1				Alarm
		Voice communications activated	1				Alarm
		Go to Platform	1				Status
		Go to Concourse	1				Status
		Speed limit device fault	1				Alarm
		Highest lift car position exceeded	1				Alarm
		Call button de-energised	1				Alarm

PPS	SWB	Incoming Switch ON	1				Status
		Voltage Supervision	1				Status
		General Fault	1				Alarm
	Pump 1	Running	1				Status
		Fault	1				Status
	Pump 2	Running	1				Status
		Fault	1				Status
	Pumps	Flow switch	1				Status
		Sump level Low	1				Status
		Sump Level Low (Dry)	1				Alarm
		Sump level High	1				Status
		Sump Level High (Overflow)	1				Alarm

	<p align="center"><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p align="center"><b>Design, performance, material and workmanship specifications for:</b></p> <p align="center"><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p align="center"><b>RFP-384/20</b></p>
---	---	---

Equipment Designation	Equipment Type	Control & Monitoring	Link to PLC				Remarks
			DI	DO	AI	AO	
UPS	Uninterruptible Power Supply Unit	On	1				Status
		On Batteries	1				Alarm
		On Bypass	1				Status
		Common Alarm	1				Alarm
		Operation during net supply	1				Status
		Low battery	1				Alarm

The exact number of control and monitoring data points shall be determined during the detailed design phase.

Secondary systems, such as the FCU, shall transfer to the OCC only the fault indication, while the escalators and lifts shall transfer one collective fault and the emergency button for each supervised system.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b>  <b>Design, performance, material and workmanship specifications for:</b>  <b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

**APPENDIX C – FDS interface with the HVAC systems of the new stations – I/O point list**

This Appendix is provided only in English due to the terminology related to electronic systems and the abbreviations included herein.

Table Legend:

DI – Digital Input, DO – Digital Output, AI – Analogue Input, AO – Analogue Output.

**I/O Signals from the FAP to the HVAC System PLC-Panel**

Equipment Designation	Equipment Type	Control & Monitoring	Link to PLC				Remarks
			DI	DO	AI	AO	
FDS	FAP	Power supply fault	1				Alarm
		Global Detector fault	1				Alarm
		Operation ON	1				Status
		Operation OFF	1				Status
		Reset of FAP	1				Status
	Fire Alarm	Under Platform	1				Alarm
		Platform	1				Alarm
		Concourse	1				Alarm
		Shafts	1				Alarm (1 per shaft)
		Technical rooms	1				Alarm (1 per room)
		Staff rooms	1				Alarm (1 per room)
		Escalators	1				Alarm, (1 per Escalator group)
		Lifts	1				Alarm, (1 per Lift group)
	Pump room	1				Alarm	
	Fire Damper	FDTM closed	1				Alarm (1 per Fire Damper)
		FDETM closed	1				Alarm (1 per Fire Damper)

**Hardwired Signals from the FAP to the Switchboard**

Equipment Designation	Equipment Type	Control & Monitoring	to SW B	Remarks
FDS	FAP	Stop EXF- ...	1	Command (per Fan)
		Stop SAF-E	1	Command (per Fan)
		Stop HP	1	Command
		Stop ACU ...	1	Command (per ACU)
		Stop FCU ...	1	Command (per FCU)
		Close MOD ...	1	Command (per MOD)
		FD Closed	1	Alarm (per Fan system)

	<p align="center"> <b>“PROCUREMENT AND INSTALLATION OF THE BUILDING  AUTOMATION AND CONTROL SYSTEM (BACS) OF  PIRAEUS EXTENSION PHASE B”</b>  <b>Design, performance, material and workmanship  specifications for:</b>   <b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b> </p>	<p align="center"><b>RFP-384/20</b></p>
---	---	---

The exact number of control and monitoring data points shall be set during the detailed design phase of the FDS system.

	<p><b>“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”</b></p> <p><b>Design, performance, material and workmanship specifications for:</b></p> <p><b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b></p>	<p><b>RFP-384/20</b></p>
---	--	--------------------------

**APPENDIX D – Intrusion detection system interface with the BACS system – I/O Point List**

Equipment Designation	Equipment Type	Control & Monitoring	Link to PLC				Remarks
			DI	DO	AI	AO	
IDS	SWB	Power supply fault	1				Alarm
		Global Detector fault	1				Alarm
		Operation ON	1				Status
		Operation OFF	1				Status
	Intrusion Alarm	Ticket Issuing Booths	1				Alarm
		PSN Area	1				Alarm
		Platforms (Platform End Doors)	1				Alarm
		Technical Rooms	1				Alarm
		Tunnel Ventilation Plant Room	1				Alarm
		LAS Room	1				Alarm
		Telecom Room	1				Alarm
		Signaling Room	1				Alarm
		Battery Room	1				Alarm
		UPS Room	1				Alarm
		Rectifier Substation	1				Alarm
		Depot Offices	1				Alarm

	<p align="center"> <b>“PROCUREMENT AND INSTALLATION OF THE BUILDING  AUTOMATION AND CONTROL SYSTEM (BACS) OF  PIRAEUS EXTENSION PHASE B”</b>  <b>Design, performance, material and workmanship  specifications for:</b>   <b>BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)</b> </p>	<p align="center"><b>RFP-384/20</b></p>
---	---	---

**APPENDIX E: Architecture of the already installed EBI r410.2 system of control and monitoring in the OCC**



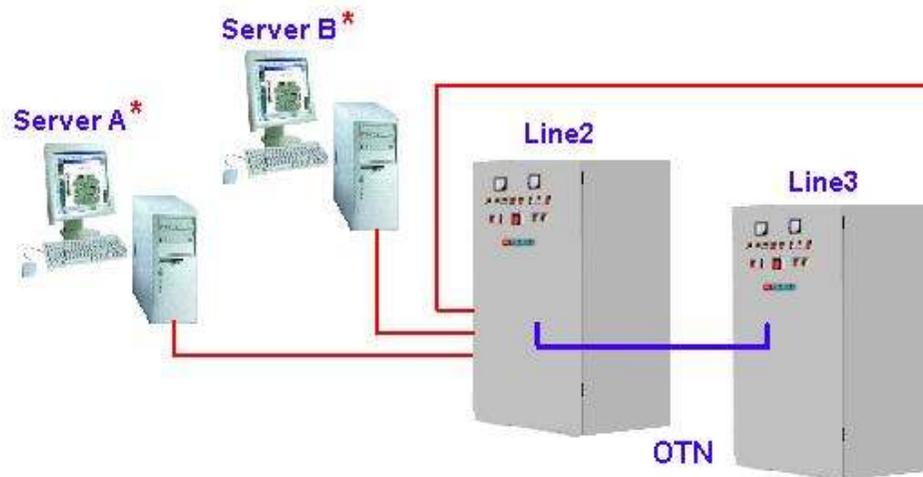
**“PROCUREMENT AND INSTALLATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEM (BACS) OF PIRAEUS EXTENSION PHASE B”**  
Design, performance, material and workmanship specifications for:

**RFP-384/20**

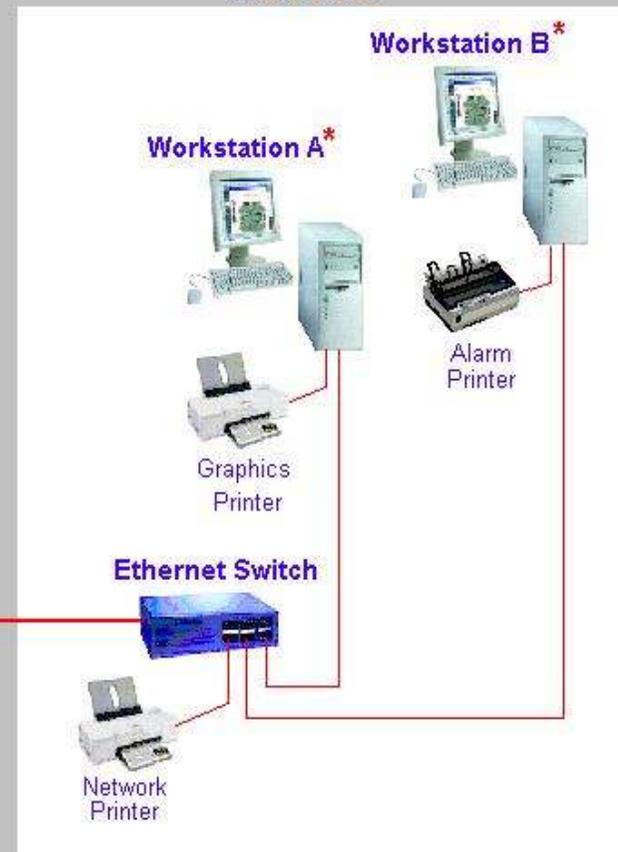
**BUILDING AUTOMATION AND CONTROL SYSTEM (BACS)**

## Honeywell Network in Syntagma Station

Telecom Room



OCC Room



**\*Servers and workstations are supplied from UPS**