



**BUILDING AUTOMATION AND CONTROL SYSTEM  
(BACS) OF PHASE A' OF THE EXTENSION TO  
PIRAEUS**

**RFP-370/19  
Α.Σ. 75588**

**TECHNICAL DESCRIPTION**

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**TECHNICAL DESCRIPTION**



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## **1. INTRODUCTION**

This document provides the Bidders with the technical description of the BACS system of the Metro Phase A' Extension to Piraeus. It includes information and the technical requirements that have to be met regarding the design and construction of the Project; it also specifies and clarifies the scope of the Project to be read in conjunction with the contract documents and drawings handed over by ATTIKO METRO AE (henceforth called AM).

Phase A' of Piraeus extension includes three (3) new Stations:  
Aghia Varvara Station, Korydallos Station and Nikea Station.

## **2. SCOPE OF THE PROJECT**

The scope of the Project includes the supply, design, installation and commissioning of a Building Automation and Control System (BACS), which shall monitor and control the ventilation system of the tunnels, the HVAC system and the building electromechanical systems in Stations, shafts and tunnels of the Phase A' Extension to Piraeus, both locally from the workstation in the Station Master Room (SMR) in each Station, as well as centrally from the existing and operating workstations in the Operation Control Center (OCC) at SYNTAGMA and from the maintenance workstation located in Sepolia area.

The Project shall also include the design, construction, supply and commissioning of the Fireman Boxes (FB), as well as the design, construction, supply and installation of the PLC panels related to the E/M systems covered by this Contract.

This Technical Description is presented in more detail in the Design, Performance, Materials and Workmanship Specifications.

The term "Contractor" refers to the contractor of this contest for the BACS system of Piraeus extension. Also the term "Lead Contractor" refers to the contractor that has been assigned with the entire project of the Piraeus extension (civil and electromechanical works).

## **3. ATTIKO METRO PROJECTS – INSTALLATION OF BACS SYSTEM**

### **3.1 General**

In view of providing a comprehensive description of the contractual works, this chapter provides information about AM's Projects. More specifically, it provides a general description of the operating Athens Metro Lines, as well as of the sections under construction and those to be tendered, which are related to the BACS system.

### **3.2 Metro Projects in operation**

The Metro Projects for Lines 2 and 3 which have already been completed, as well as the relevant commissioning dates are as follows:

### 3.2.1 Base Project

	Project	Description	Commissioning Date
Base Project	Line 2: Sepolia – Syntagma and Line 3: Ethniki Amyna - Syntagma	Line 2 – 4.9 km., 7 Stations, 1 Depot (Sepolia) Line 3 – 6.2 km., 7 Stations	January 2000
	Line 2: Syntagma - Dafni	4.6 km., 5 Stations	November 2000
	Line 3: Syntagma - Monastiraki	1.6 km., 1 Station	April 2003

The monitoring and control in the Base Project is performed centrally via the ECS system (SICLIMAT X of Siemens).  
Signals are collected through the PLC SIMATIC S5 of Siemens.

### 3.2.2 First Phase of the Extensions

	Project	Description	Commissioning Date
First Extension of the Metro	Southbound Extension of Line 2, Dafni – Aghios Dimitrios	1.1 km., 1 Station	June 2004
	Northbound Extension of Line 3, Ethniki Amyna – Doukissis Plakentias Stavros Depot	6 km., 2 Stations and 1 Depot	July 2004
	Westbound Extension of Line 2, Sepolia – Aghios Antonios	1.4 km., 1 Station	August 2004
	Westbound Extension of Line 3: Monastiraki – Egaleo, Eleonas Depot	4.3 km., 3 Stations and 1 Depot	May 2007, Depot: May 2010

The monitoring and control in the first phase of the Metro extensions is performed centrally and locally via the ECS/BMS system (EBI R410.2 of Honeywell).  
Signals are collected by the PLC HC 900 (of Honeywell) – mainly for the tunnels' ventilation system – and by DDC EXCEL 5000 as regards the remaining systems under control.



### 3.3 Metro Projects Extensions

#### 3.3.1 Second Phase of the Extensions

The extensions of Lines 2 and 3 are included in the following table:

	Project	Description	Commissioning Date
1	Southbound Extension of Line 2: Aghios Dimitrios - Elliniko Elliniko Depot	5.5 km., 4 Stations and 1 Depot	July 2013
2	Northbound Extension of Line 2: Aghios Antonios - Anthoupoli	1.5 km., 2 Stations	April 2013
3	Eastbound Extension of Line 3: First Phase: Egaleo - Haidari	1.4 km., 1 Station	December 2013
4	Completion of Line 3: Stations: HOLARGOS, NOMISMATOKOPIO, AGHIA PARASKEVI	3 Stations	July 2010 September 2009 December 2010 respectively

Every project presented above had been awarded to a "Lead Contractor", responsible for all Civil Works and E/M and Railway Systems related works, except for the works concerning:

- Fare Collection Systems
- BACS
- Signaling System
- Automatic Train Supervision and Passenger Information Systems
- Digital Radio Communication System, Tetra
- New Series III Trains.

The aforementioned works were executed in accordance with the respective six (6) independent contracts for all Extensions, while AM was responsible for the overall coordination of the works. However, as regards the BACS system, the initial design was modified and the scope of the works was awarded to the Main Contractor of each of the Projects mentioned above, as additional work to his initial contract, and it was executed by the main contractor as such.

The monitoring and control is performed centrally and locally via the EBI R410.2 system of Honeywell.

Signals are collected by the PLC HC 900 (of Honeywell) both for the tunnels' ventilation system and for the remaining systems under control.

#### **4. DESCRIPTION OF WORK OF THE BACS SYSTEM CONTRACTOR**

The Contractor's scope of work, as regards the BACS system, shall include, without being limited to them, the following works:

- Preparation of the Detailed Final Design for the necessary works concerning the installation and commissioning of the new BACS system, so as to ensure that the Metro revenue service is not disrupted; the aforesaid DFD shall comply with the time schedule.
- In particular, part of the Detailed Final Design is the design for the interface between the BACS system to be installed and the already installed equipment at a local and central level, as required.
- Provision of all data and information required on the communication protocols and parameters of the entire software which are needed for the interface between the Contractor's systems and equipment and the systems and equipment of other Contractors, as required for the execution of the Project.
- Coordination, as regards all works, including the interfaces, as well as timely provision of information for any relevant clarifications to AM, if requested.
- Supply, installation, testing and commissioning of the entire BACS equipment.
- Supply, installation, testing and commissioning of all the necessary equipment for the interface between the BACS system and the currently operating central servers of the EBI system, as it is detailed in the Technical Specifications.
- As part of the Detailed Final Design (DFD) the Contractor is required to precisely determine the energy consumption requirements of the entire BACS equipment, so that the BACS system can be fed by the Station's UPS.
- Design, construction, supply and commissioning of the Fireman Boxes.
- Design, construction, supply, internal wiring and commissioning of the PLCs controlling the operation of the foreseen E/M systems in each station and shaft of the second and third phases of the extension to Piraeus.
- Supply and installation of fiber optics of the ring topology local LAN network in each Station, Shaft and Tunnel.
- Site Acceptance Tests and commissioning of the BACS systems.
- Participation in the Tests and the Commissioning of E/M systems belonging to other Contractors, as required.
- Participation and Support of the Trial Run.
- Maintenance related activities covering the entire Warranty Period.
- Provision of the necessary spare parts, tools and equipment related to the performance of tests.
- Training of the maintenance and operation personnel, including the provision of a certification that the said personnel can operate, maintain the system and intervene in its software, on an as required basis.



- Provision of the necessary documentation with the appropriate structure, including the operation and maintenance manuals, as well as the “as built” documentation.

Additionally, the Contractor:

- During the preparation of the Detailed Final Design (DFD) and construction, testing, installation and commissioning of the equipment, he shall participate in all meetings with AM, as required.
- Shall make a risk assessment and safety assessment, validate the safety of the BACS system to be provided by himself, including all related interfaces; shall provide evidence that the system is in compliance with the safety integrity level (SIL), as required for the purposes of the system under any potential operation conditions; shall provide the general and special safety analyses for any application regarding the systems to be provided by the Contractor.
- Shall certify the RAMS performance, in accordance with the European Standard EN50126.
- Shall compile and follow a Health and Safety Plan.

## **5. GENERAL DESCRIPTION OF THE BACS SYSTEM**

### **General**

The existing central computerized facilities for the Control Systems (SICLIMAT X and EBI R410.2) currently housed at the OCC at Syntagma station, control all the Tunnel Ventilation and HVAC systems of the Base Project and the first and second phases of the Metro Extensions, through two independent systems, provided by independent manufacturers (SIEMENS for the Base Project and HONEYWELL for the first and second phases Metro extensions). In the first and second phases of the Metro extensions, these control systems also control the E/M systems in buildings (lifts, escalators, pumps, lighting, etc.).

As far as ventilation is concerned, individual fan and other HVAC equipment controls are also fitted in each station on the local ventilation switchboards (with integrated PLC's), on the Fireman Boxes (FB) and in the Station Master Room (SMR).

From the FB located in the stations, predetermined scenarios can be activated for a fire in the local station and in the two adjacent tunnels.

### **5.1 Base Project**

The Base Project's predetermined fire scenarios are pre-programmed in the SIEMENS's PLCs incorporated in the local tunnel SAF fan switchboards SBS3.1. Also, just a few common alarms are indicated in the SMR and only operations for selected fans can be executed (STOP UPE-Fan and SAF, START SAF in reverse mode). The Monitoring and the limited control of the related E&M equipment in the station (e.g. pumps, escalators) is integrated in the Power Remote Control System (PRCS), which is a separate system installed in the OCC.

## **5.2 First and Second Phases of the Extensions**

For the first and second phases of the Metro Extensions, the predetermined fire scenarios are pre-programmed in the HONEYWELL PLCs, which are incorporated in the local UPE/OTE ventilation switchboards. Also, for the first and second phases of the Metro Extensions, all Tunnel Ventilation and HVAC equipment as well as the station related E&M equipment (e.g. lifts, escalators, lighting, fire fighting valves and pumps) can be monitored and controlled from the local ECS/BMS system, located in each SMR, also connected with the central ECS/BMS system in the OCC.

## **5.3 Phase A' Extension to Piraeus**

For the Extension to Piraeus, the monitoring and control shall be executed locally by the new BACS System, and, centrally, by the control and monitoring system (EBI) already installed.

The exact number of the necessary control and monitoring digital/analogue points for the extension to Piraeus shall be finalized during the Detailed Final Design by the Contractor, in cooperation with the Main Contractor. It is clarified that the cabling and connections of all auxiliary power and control cables from the local ventilation switchboards and E/M equipment switchboards to all respective field equipment and to the PLC terminal strips are already included in the scope of works of the Main Contractor.

A Fireman Box (FB) shall be installed at the concourse or street level of every station easily accessible by firemen. The supply and installation of the FB falls within the scope of works of this Contractor. From the FB it shall be possible to activate the "Fire at Platform" and "Fire at Concourse" scenarios only. The involved ventilation systems of the local station shall be controlled through cabling (hardwired). In case the above mentioned scenario also necessitates the activation of equipment located in a neighbouring shaft, the activation will be achieved via the communication network.

It shall be possible to activate predetermined fire scenarios from the workstation in the SMR and/or the OCC, depending on the nature and location of the emergency incident, using combined actions of several fans for optimized response.

The predetermined scenarios shall be developed by the designers of the ventilation system and shall contain all the necessary procedures (Scenario and Emergency Mode Tables) for the activation or deactivation of all related fans.

The BACS Contractor shall have the obligation to implement all the scenarios mentioned above in the system software and to ensure that the software logic of the emergency scenarios will be always available (backed-up) in case of loss of any PLC, of any Workstation and any Server.

With regard to the interface scenarios between operating stations and the extension to Piraeus, a concurrent software modification shall be also required ensuring activation of the equipment of the operating stations and of the equipment of the stations under construction.





#### **5.4 PLC Panels**

The Contractor shall be responsible for the design, construction, supply, wiring and commissioning of the PLC panels, which shall control the operation of the foreseen E/M systems in the station and shafts of Piraeus Extension.

PLCs shall be equipped with all I/O modules necessary for the monitoring and control of the entire equipment connected to this module.

PLCs and the related equipment shall be housed in a metal panel with protection rating no less than IP 54. PLCs panels shall be installed next to the switchboards of the controlled systems (HVAC, Ventilation systems, E/M systems).

The operational plan (Normal operation and predetermined fire/emergency scenarios) for a typical station-tunnel-station configuration shall be developed by the designer of the ventilation system, in order to be incorporated by the Contractor into the System's software.

### **6. TECHNICAL DESCRIPTION OF THE BACS SYSTEM**

#### **6.1 General**

The purpose of the BACS is to control and monitor all Tunnel Ventilation systems, station HVAC systems and E&M systems within each station, shaft and in the Depot of the Phase A' Extension to Piraeus, under all normal and emergency conditions for the following systems:

Tunnel Ventilation System:

- Blast Shaft fans (BSF)
- Under & Over Track Exhaust fans (UPE)
- Tunnel ventilation Jet fans (JF);
- Roller Shutter Doors (RSD);
- Motorized Dampers (MOD);
- Fireman box (FB);

HVAC System:

- Exhaust Fans (EXF)
- Air Supply Fans (SAF)
- Motorized Dampers (MOD)
- Chillers, their pumps and associated installations
- Heat Pumps (HP)
- Fan Coil Units (FCU)

E/M Systems:

- Uninterruptible Power Supplies (UPS);
- Normal and Emergency Lighting;
- Pumping and drainage systems;
- Hydrants, hose reel systems and deluge valves (DEV);
- Lifts;



- Escalators
- Interface with the Fire Detection Switchboards
- Interface with the CCTV System
- Intrusion Detection Systems
- Interface with the AFCS – Passenger Access Gates

The central control and monitoring of all the above systems in the entire Metro network shall be conducted from the workstations in OCC, while the local control and monitoring shall be conducted from the workstations in the Station Master Rooms.

## **6.2 Structure of the BACS to be provided by the Contractor**

The Contractor shall install systems in the following Rooms:

### **6.2.1 Operation Control Center (OCC)**

The Contractor shall perform all necessary upgrading-modification works – at the extent required - in the Central Control and Monitoring System, so that the new stations of the extension can be integrated in the said system.

All control points shall be transmitted to OCC over the WAN (Wide Area Network).

The Contractor should take into consideration the fact that works inside OCC should be carried out having obtained the pertinent permit by STASY S.A.

### **6.2.2 Station Master Room (SMR)**

The Contractor shall supply and install in the Station Master Room (SMR) one complete workstation, in order to control and monitor the station and the tunnels, in accordance with the Technical Specifications.

The Contractor should also supply and install the necessary printers, as per the Technical Specifications, inside the Station Master Room in each Station.

### **6.2.3 Technical Rooms in Stations and Shafts**

In technical rooms of the Stations and Shafts, next to the switchboards of the controlled systems (HVAC, Tunnel Ventilation Systems, E/M Systems), the Contractor shall install an appropriate panel, fitted with the all necessary PLC equipment, in order to group all control points (I/O).

The Contractor shall be responsible for the design, construction, supply, internal wiring and commissioning of PLC panels.

Moreover, the Contractor shall be responsible for the design, construction, supply, internal wiring and commissioning of the Fireman Boxes, whose location inside the Stations shall be defined by AM.

### 6.2.4 Lines 2 & 3 Network - Communication Networks

The Contractor shall install communication-data transmission networks as presented in detail below:

#### Wide Area Network (WAN)

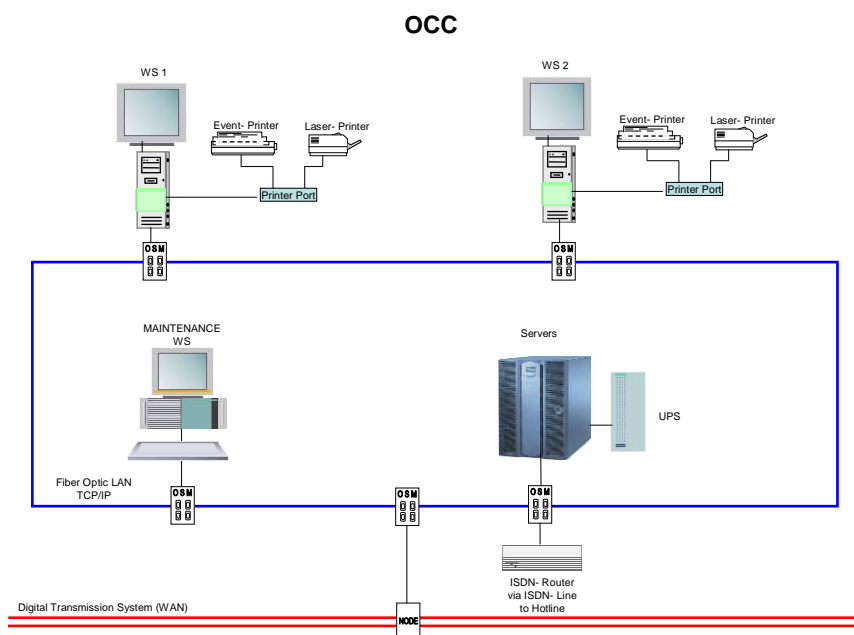
The WAN network in Lines 2 & 3 is used for the transmission of data to/from the stations, as well as to/from the OCC. The works for the its installation **fall under the Main Contractor's responsibility**. This network has already been installed in the existing sections of Lines 2 & 3 (OTN network). WAN is a fiber optic network with a stand-by ring layout, used by other systems as well, such as Signaling and Fare Collection, etc. via the respective communication ports.

The Contractor shall define the number and the type of the communication ports as regards the specific project of the extension to Piraeus.

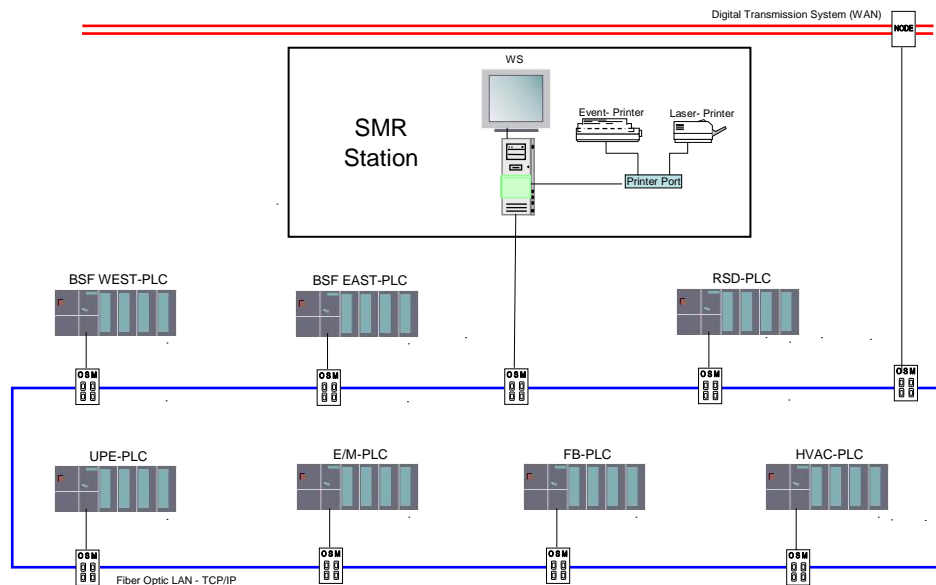
#### Local Area Network

The Contractor shall be responsible for the supply, installation and commissioning of a ring-layout fiber optics local area network (LAN) in the stations and the adjacent shafts of the Phase A' extension to Piraeus for communication among the PLCs, for communication with the local workstations as well as for transmission from control points to the OCC via WAN network.

An indicative general layout of LAN network in the OCC, in a typical station, is presented below; its precise architecture shall be designed by the Contractor.



**Typical Station**



**6.2.5 Software Development**

The Contractor shall be responsible for the development and proper operation of the software at local level (PLC) as well as at the level of monitoring and control (workstations in the OCC and the SMR) for all controlled systems (HVAC, Tunnel Ventilation System, E/M Systems).

The BACS shall have a level of safety, which is as a minimum equivalent to that of an SIL 2 system.

AM shall confirm to the Contactor the Detailed Final Designs of the extension to Piraeus which shall form the basic source for the development of the software

**7. IMPLEMENTATION AND SCHEDULING**

The Contractor shall submit a complete plan for the development of an implementation procedure, clearly defining the detailed stages of works, including the necessary pre-conditions and works to be provided according to the contract documents and the project time schedule.

The Contractor's scope shall include all necessary temporary and permanent works, testing, commissioning, training and documentation for the various completion stages.



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The Contractor is requested to perform all works within the operating Metro system, in a manner not disrupting revenue service, as well as to always ensure a safe and reliable operation after modifications to already operating equipment.

The Contractor shall coordinate his tasks and he shall consider in his implementation strategy and work planning, the scheduled activities and work progress, as necessary for the successful execution of his works.

**8. TECHNICAL DATA DELIVERABLE TO THE CONTRACTOR BY AM**

AM shall make available to the Contractor the technical data presented below. More precisely:

1. Technical Description of the BACS System
2. Technical Specifications of the BACS System
3. A CD with all the architectural and E/M drawings of Phase A' extension to Piraeus.