



**TITLE OF THE TENDER: “PROCUREMENT OF EQUIPMENT FOR THE MODIFICATION OF THE BUILDING AUTOMATION AND CONTROL SYSTEMS IN THE METRO STATIONS ON LINES 2 AND 3 EXTENSIONS AND THEIR INTERFACE WITH THE AUTOMATIC FARE COLLECTION SYSTEM (AFC) – OASA”**

**RFP-319/17 A.Σ. 41381**

## **TECHNICAL DESCRIPTION - SPECIFICATIONS**

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### **GENERAL FRAMEWORK OF THE PROJECT**

#### **1.1 New AFCS - OASA**

The Athens Urban Transport Organization (OASA) is currently running a PPP Contract for a project that embodies the design, funding, installation, testing, operation, operation support, maintenance and technical management of a Unified Automatic Fare Collection System (AFCS) which will cover all transport modes of Athens (buses, trolley buses, tramway, Metro Lines 1, 2 and 3 and suburban railway). The system's key feature is the electronic ticket, which will give a decisive push to the public transport system, shall minimize ticket evasion and shall offer a substantial assistance to all transport studies and activities by providing a detailed record of passenger trips.

In particular, OASA's Contractor – Private Sector Partner (PSP), has undertaken the following tasks:

- Design, installation, ensuring the full / uninterrupted operation and technical management of the system
- Preparation of the necessary designs for the installation of the new equipment needed for the smooth operation of the system and the integration of the existing infrastructure into the new complete AFC System.
- Ensuring the correct and reliable operation of the new equipment, at specific availability rates
- Maintenance of the system and its components
- System and equipment customization in view of implementing the applicable fare types and the policies related to fare pricing, control and distribution, as decided by OASA.
- Technical support of the system, which shall address the periodical system upgrades, as well as the staffing of the system control centers throughout the contract duration
- Personnel training on system operation
- Procurement / printing of the initial quantity of the electronic “card”, as well as initial procurement of the “Multiple” ticket, either pre-loaded or not
- Insurance coverage for the equipment and other installations and systems comprising the AFC System and forming the PPP Contract scope, covering the project both during its design and construction stage, as well as during its operation maintenance period.

More specifically, for each station on the Metro Lines 2 and 3 the Contractor – PSP shall install:

- Access control Gates
- Station Management Center (SMC)
- In parallel, the existing ticket issuing machines shall be upgraded so as to accept smart cards – electronic tickets.

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### **1.2 E/M Metro Systems interoperability with OASA’s AFCS**

In this framework and in order to ensure interoperability among:

- the new systems of the AFCS (mainly the access control gates)
- the local (in stations) and central (in the OCC) gate control systems
- the already installed (earlier contracts) in the stations E/M systems for fire detection, Building Control & Automation Systems (BACS), direct telephones (DLT), data transmission (OTN), cameras (CCTV), clocks and power supply system

the aforementioned existing and operating E/M systems in the stations along Lines 2 and 3 must be amended and upgraded, with the view of finally achieving the smooth and safe operation of OASA’s AFCS, ensuring primarily the safety of the passengers both during normal operating conditions, as well as in emergency conditions which will likely call for passenger evacuation.

Specifically :

- The fire detection systems must be interfaced with the new AFCS, so that - in case of an emergency – the gates will open automatically in order to facilitate passenger evacuation procedures. It is stressed that the Metro network is served by five distinct providers / installers of fire detection systems, each one being responsible for a distinct geographical area of the Lines 2 & 3 network; even though the general architecture and operational requirements are similar, a different technical approach is generally required in terms of DFD, required new equipment and implementation, as well as different software for each case. Certainly, any amendments to existing E/M system shall be carried out in a manner not affecting their existing functions and capabilities. Among the amendment will be the interfacing between the fire detection systems with the stations BACS. The scope of the amendment also includes the relevant preliminary safety assessment on a design level, so as to ensure that the combined AFCS, Fire Detection and BACS systems achieve the required SIL levels.

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- The BACS systems must be interfaced with the new AFCS, so that in case of an emergency (e.g. activation of fire scenarios) the gates will open automatically in order to facilitate passenger evacuation procedures. It is stressed that the Metro network is served by two distinct providers / installers of the BACS systems, each one being responsible for a distinct geographical area of the Lines 2 & 3 network, namely one for the Base Project (Sepolia – Dafni on Line 2 and Ethniki Amaryna on Line 3) and one for all other extensions. Even though the general architecture is different, the operational requirements are similar in the two BACS systems. A different technical approach is generally required in terms of DFD for the required new equipment and implementation, as well as different software for each case. Certainly, any amendments to existing E/M system shall be carried out in a manner not affecting their existing functions and capabilities. Among the amendments will be the interfacing between the BACS and the respective fire detection systems in the stations. The scope of the amendments to the BACS systems also includes the relevant preliminary safety assessment on a design level, so as to ensure that the combined AFCS, Fire Detection and BACS systems achieve the required Safety Integrity Levels (SIL)

The amendment of the BACS system for the extensions and its connection with the AFCS shall take place with the present contract. The BACS system of the Base Project is not part of this contract.

- The direct telephone system is mainly required for the normal operation of the stations and is related to the option that must be provided to the passengers to immediately communicate with the personnel of each station at the gate control line area, whenever the passengers are unable to pass through the gates to either enter or exit the station (faulty electronic tickets or cards, inability to exit from the gates etc.). One DLT shall also be installed near the Fireman Box in each station.
- The data transmission system is mainly required in order to serve the great number of new telephones to be installed in the stations and their connection to the OCC.
- The cameras – CCTV system is mainly required in order to provide the capability for automatic activation of the surveillance cameras at the control line area of the access gates in each station and, thus, to provide the capability to the Station Master and the OCC for immediate surveillance on the line, in case one or more gates fail.
- The Clock system must be connected to the AFCS system so as the new AFCS system is synchronized with the existing E/M systems in each station, in order to provide a more precise recording of the time of all events and functions, especially in case of failures or incidents that require special addressing and/or subsequent investigation.

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- The power supply system must be expanded/amended so as to feed the new AFCS system without affecting the operation of the existing E/M systems. These amendments shall be carried out by the PSP – OASA’s existing Contractor.

This system shall be supplemented, amended and connected with AFCS by OASA’s AFCS Contractor.

Before any works are executed, the required interfaces, the methodology for their implementation, the new software and all relevant tasks must be designed at a DFD level, in cooperation with the original suppliers of the operating E/M systems.

All the above works shall require the cooperation with the PSP Contractor of OASA, at a technical and operation level, as well as with STASY S.A., because the systems to be amended must not lose their functionality at any given time period other than the night time engineering hours, after a detailed planning in terms of time and technical matters.

The amendments to the above E/M systems and to their connections with the AFCS system will be followed by individual and combined tests, which will demonstrate that the original function of each E/M system has not been altered, but also that the new operational requirements are met after each system is connected with the AFCS.

Finally, in parallel to the above activities and until their completion, an overall and independent safety assessment shall be required (by a specialized independent safety assessor) for the entire combined AFC system – E/M systems for:

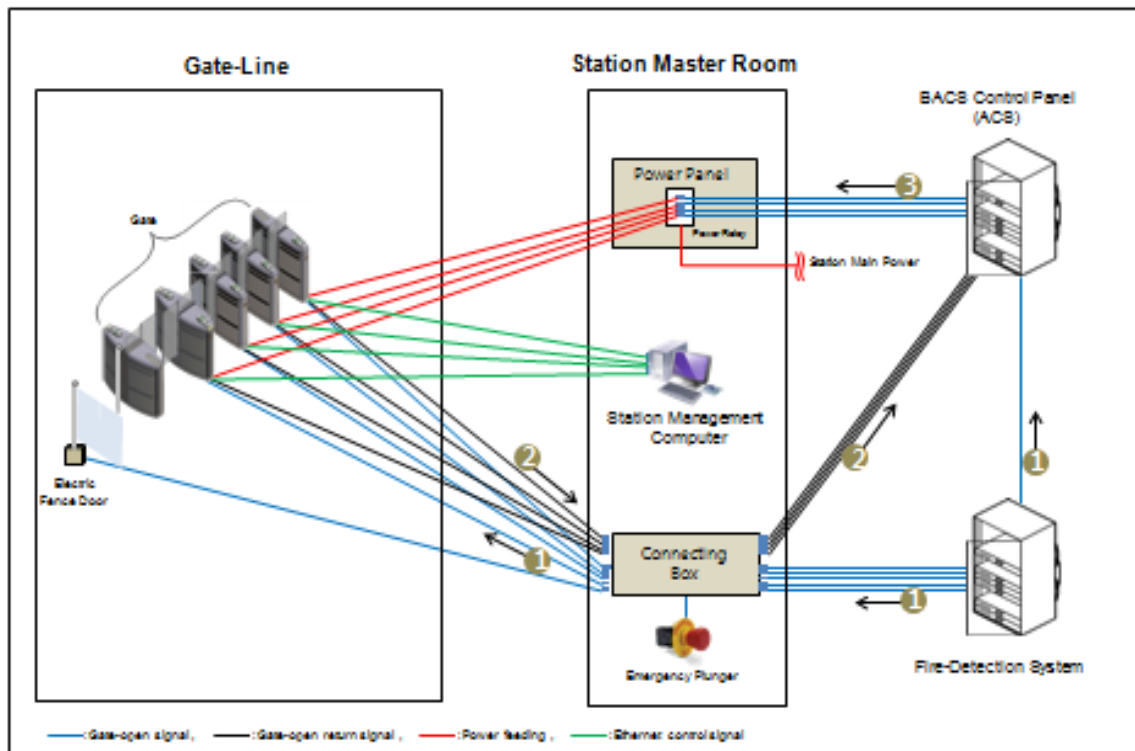
- The layout of the gates in the stations and their operation both during normal and emergency conditions;
- The safety and compliance with the required SIL levels as regards the connections and the combined operation of the AFCS with the E/M systems of the stations.

The following Figure is a schematic diagram of the interfaces among gates – fire detection – BACS:

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**● BACS & Fire-Detection Interface**

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### **SCOPE OF THE PROJECT**

#### **2.1 Purpose**

The scope of the Project embodies the design, supply, installation and commissioning leading to the implementation of all necessary upgrades, amendments/additions – to the extent required- to the existing operating equipment, the BACS system within the Metro stations on Lines 2 and 3 extensions, for their interface with the new Automatic Fare Collection system - OASA and, more specifically, of the new Automatic Access Gates foreseen to be installed in the stations.

The purpose of this interface is the automatic opening of the AFCS gates, in case a emergency scenario (detection of smoke or fire) is activated by BACS, both in any station or in the adjacent tunnels. This will be implemented either from the graphic environment of the central BACS system in the OCC, or from the graphic interface of the local BACS servers in the stations, or even from the wall mounted Fireman's Box in each station.

Moreover, for redundancy reasons as regards gate opening via the fire detection system, the BACS system shall be also interfaced with the fire detection system; the command for gate opening activation shall be also given by the BACS system, whenever a fire detection signal (for a fire in public areas or in special technical areas adjacent to public areas) is transmitted to the BACS system by the station's fire detection – FAP system.

#### **2.2 Designs**

The Contractor shall be responsible for the Detailed Final Designs dealing with all necessary upgrades, amendments and additions to the equipment, new interfaces, software amendments or new software, as required, new materials, new cable routing, installation procedures, test procedures and safety assessment of the BACS Systems for their interface with the Automatic Fare Collection system of OASA and, more specifically, with the access gates. The requirements set forth in this specification must be viewed as the minimum requirements.

In order to prepare the above designs, the Contractor's immediate cooperation with the following agents must be ensured:

- OASA's Contractor (TERNA – LG) who installs the access gates and the AFC system;
- An independent Contractor who shall amend the Fire Detection FAP system in the stations;
- The original suppliers of the operating BACS systems;



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- The Operations Company STASY S.A., because the existing operating E/M systems may need to be amended in time windows to be specified by STASY S.A. without loosing the functionality of the original systems during the Metro service hours;
- An independent safety assessor who shall evaluate the overall combined system of gates – fire detection – BACS and who shall play a decisive role in the design and the final configuration of the overall system, since the suggestions of this assessor must be adopted by all involved Contractors and the Contractor of this contract as well.

This cooperation shall be achieved through AM and OASA as required.

The designs shall incorporate the adopted standards, design reports, operational analysis of the amended system, calculations, single/multi line diagrams, connection diagrams, plan views of routing in each station (at a grid to be provided by AM), MSSs for each piece of material and equipment to be incorporated in the Project, installation and testing procedures and methodologies, and all other items required at a design level for the Project's implementation, and shall be submitted to AM for approval. All employed symbols, abbreviations and code names shall be described in the drawings. The designs shall be precise, concise, easily understood, with sufficient information to provide a full understanding of the functionalities and the characteristics of the new combined system. After the implementation and successful testing of this system, the “AS Built” drawings shall be submitted.

The design approval codes are the following:

- Code 1 : “APPROVED” or “APPROVED AS NOTED”:  
The design is approved, the works can be executed. In case the submittal receives comments of minor importance, AM can approve it with Code 1 – “Approved as noted” without the need for resubmission, but these comments shall be incorporated in the “As Built” drawings.
- Code 2 : “REVISE AND RESUBMIT”:  
Works cannot be executed. The design shall be revised and resubmitted incorporating the comments, corrections and remarks of AM.
- Code 3: “REVIEW NOT NECESSARY”:  
Review of the submittal is not necessary.

Each design shall be submitted in three (3) copies and in a digital form (CD or DVD) in two (2) copies.

The designs shall be submitted within a thirty (30) – day period upon Contract signing. AM shall review and return comments – if any – on the subject designs within a fifteen (15) – day period. The designs shall be re-submitted for final approval also within a fifteen (15) – day period.

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Once the designs are approved, any design changes shall be submitted for approval and, after approval by AM, they shall be incorporated in the “As built” drawings.

### **2.3 Existing BACS Systems installed in the Metro Network**

This unit provides brief information on the BACS system installed in Metro Lines 2 and 3 extensions in order to understand better the works required to be implemented by the Contractor who shall implement the entire scope of the Project.

As regards the 17 stations of the Metro extensions (Line 2 from Agios Antonios to Anthoupoli and from Agios Dimitrios to Elliniko and Line 3 from Keramikos to Egaleo and Nomismatokopio to D. Plakentias), the installed BACS system is “EBI R410” by Honeywell, which is made up by two central workstations in the OCC, which communicate - via servers located in a technical room in Syntagma Station - with the Programmable Logical Controllers (PLCs) HC900 (Honeywell), installed on switchboards at various geographical locations in stations and shafts. Each PLC is autonomous and communicates with all other PLCs in each station and associated shafts via a fiber optics network and Modbus TCP protocol.

Communication between individual PLCs of adjacent stations and the servers in Syntagma is realized via a WAN network of a spare ring topology.

Each Station Master Room is fitted with a local workstation which controls and monitors the station’s E/M systems controlled by BACS.

Each station is fitted with a Fireman Box for manual (via buttons) activation of the emergency scenarios in stations and adjacent tunnels. These scenarios are also controlled via the respective graphic environment on the workstations in the OCC.

More information regarding the BACS system of the extensions is attached to an information document that accompanies the DFD for the said system.

Any additional information shall be provided by AM to the Contractor if available.

### **2.4 Works that need to be implemented for interfacing the BACS System with the AFCS**

The bidders can submit their offer for the amendment/upgrading/interfacing of the BACS System of the extensions as this is described above in article 2.3.

The scope of the present Metro stations interface project includes:

- The DFD

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- The supply of the necessary new interface equipment, (New PLCs, I/Os, Racks etc)
- The amendment – upgrading of the existing BACS equipment, as required,
- The software and its necessary amendments, additions and upgrades,
- New cabling connecting the BACS system with the gates system at a local level,
- Ensuring reliable communication among these systems,
- All power and control cables on the BACS system side,
- Testing and commissioning of the combined system of gates/fire detection/BACS
- Preliminary safety/RAMS analysis
- Preparation of the “As Built” drawings.

The information from the preliminary safety analysis shall include quantified information and data for redundancy ensurance and reliability/availability as regards the BACS system and specifically its internal architecture and connections with the interfaced fire detection and gates systems. This information shall be passed to an independent safety assessor who shall undertake the task of assessing the safety of the entire AFCS system, in combination with the E/M Metro systems.

The aforementioned works are considered as the minimum required. If additional works become necessary during the DFD stage, then they must be implemented in order to ensure the safe functionality of the interface.

The main requirements concerning the interface are the following:

1. Whenever the fire detection system detects a fire in station public areas, or in case a fire scenario is activated by BACS, the BACS system must transmit the appropriate command signal to the local control panel of the gates which shall be subsequently transmitted to the controller of each gate, in order for the gates to open automatically and facilitate the swift and safe passenger (and personnel, if required) evacuation.

Each command from the BACS is connected via a dry contact with a 2-cable connection AWG #18 24V DC (I/O and input ground) with the gate control panel which will be installed by the gate Contractor; this panel shall distribute the incoming (from the BACS system) signal for gate opening to all gates. The Contractor shall be responsible for the cable routing running from the BACS equipment to the gate control panel, while the interface between each gate and the gate control panel is the scope of the Contractor for the gates. All cable terminations from the BACS to the terminal blocks on the gate control panel fall in the scope of the AFCS-OASA Contractor.

When the gate controller receives the aforementioned 24V DC signal, the gate operation mode shall switch from normal operation to emergency operation (gate open).

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2. The BACS activation for gate opening shall be implemented whenever a fire scenario is activated,
  - a. from the mimic screens of the BACS system in the OCC,
  - b. from the mimic screens of the BACS system in each station's SMR (Station Master Room),
  - c. from the local Fireman Box in each station,
  - d. whenever the BACS system receives the relevant information from the station's Fire Detection – FAP system.

There must be automatic digital recording and filing of all commands issued by the BACS System to the gate system. These commands must be always retrievable and shall contain all associated technical information, such as fire detector(-s) that have been activated, the time of activation, acknowledgement of signal transmission to the gates etc.

3. In each Station SMR, a new P/C shall be installed (by the gates-AFCS Contractor), which shall monitor and control the gates. The relevant gate opening command issued by the BACS system shall be also transmitted to this computer. The precise layout and connections of the BACS system/gate controllers/gate computer shall be defined at the DFD in cooperation with the gates Contractor.
4. Apart from the commands or data ensuring the communication between the BACS and the gates system, as well as the gate activation commands, the gate system must also acknowledge to the BACS system that the gates are open.
5. Whenever no acknowledgment from the gate system is received within a specified time period, the BACS system shall issue a new command to the power supply switchboard to cut off the power to the gates, in which case the gates will open automatically and will remain open until power is restored. The gates computer shall be fed by the UPS, and thus communication between the BACS (also fed by UPS) and the gates computer shall be possible. All possible operation modes under power loss must be addressed (in the form of indications to the user) in the special software to be developed for the implementation of the interface.
6. The procedure for the exchange of all required commands/data between gates and BACS system must be fail-safe. SIL2 (as specified by CENELEC - EN 61508 and EN 62279) is considered as the minimum safety level. The BACS Contractor must certify that his system – consisted of the central monitoring system and the PLCs – is at least SIL-2 safety level.
7. All cables connecting Fire Detection/gates/BACS systems shall be fire resistant and halogen free, FE180/E30 (fire resistance for one hour and keeping the circuit alive for ½ hour). Cables shall be routed either within the

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existing embedded ducts, or on the LV trays. Should new independent and exposed cable routing becomes necessary, this routing shall be implemented within new galvanized metal ducts. No visible cable routing in station public areas is permitted. Whenever cable routing passes through fire resistant walls, the drilled holes shall be sealed again using a special fire resistant mortar. Cable routing shall be coordinated with the gates Contractor who shall implement the pertinent architectural interventions in the stations to install the gates (e.g. removal and re-arrangement of the floor granites at specific locations).

8. Any interventions/extensions/modifications to equipment and/or software shall not affect to the least the operability and capabilities of the BACS system in its current form. In particular, it must be also ensured that any interventions or modifications to equipment or software shall have absolutely no effect on the procedure for the activation of fire scenarios in stations/tunnels, and on the electrical equipment in stations.
9. After the implementation of the interfaces, tests shall follow (see articles 2.6 and 2.7), which will cover the independent as well as the combined operation of the two systems. As regards the independent BACS system, the tests shall also cover all tests conducted when the system was initially installed (i.e. without interface with the gates).
10. The entire design and implementation procedure shall also “incorporate” a independent safety assessor, who shall be selected by AM by means of a separate tender. This assessor shall review and comment -in terms of safety assurance- all detailed designs (down to the level of circuit diagrams and physical/operational interfaces among the Fire Detection/gates/BACS systems), so as to achieve the required safety level SIL2 for the entire AFCS. The said safety assessor must be provided with the preliminary safety analysis to be prepared by the Contractor of this contract.
11. The hours during which work is permitted to be executed for the implementation of the Project on the operating Metro network are the following:
  - Any works on equipment and software of the operating BACS and Fire Detection systems shall be carried out during the night time engineering hours (00:30 – 04:30),
  - Any works in technical rooms of the stations can be carried out any time and day,
  - Works in public areas (e.g. cable pulling/routing) shall be carried out during night-time engineering hours (00:30 – 04:30),
  - The possibility to close down the stations for short periods of time (few days) for the safe and swift execution of the works for gates installation is open to examination.

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In any case, access to the operating Metro network takes place after communication STASY S.A. and after obtaining its permission.

12. Upon completion of the Project, the following items must be delivered to AM:
- a) All functional information of the new modified BACS system, which may eventually lead to amended operating procedures of the Operations Company, as regards the operation of the BACS system;
  - b) Modifications/upgrades to the Operation and Maintenance Manuals of the BACS system, as required, possibly in the form of an Appendix to the original Manuals. The requirements of the above point (a) can be included in these Manuals;
  - c) “As Built” drawings of the new/additional routing cable layouts and new cable layouts, as well as single/multi-line diagrams for each station;
  - d) A list with the required spare parts;
  - e) There will be a 3-year good performance guarantee and any failures during this period shall be at the Contractor’s cost.

### **2.5 Operation Principles for Systems Integration**

#### **2.5.1 Fire scenario activation by the BACS system**

- When the fire scenario is activated either from the workstations in the OCC / the SMR in a station or from the wall-mounted Fireman’s Box, then the BACS system shall issue a command to the Gate Control Panel for opening this station gates.
- If a tunnel fire scenario is activated, the BACS system shall issued the appropriate commands to open the gates at the two pertinent stations.
- Implementation of the gate opening action shall be carried out using all necessary information from the installed PLCs involved in the activation of the scenario and the subsequent issuing of the command to the gate control panel to open the station gates.
- The command shall be recorded in the files of the BACS system and shall be printed with all necessary information, such as time stamp, date etc.
- Acknowledgement by each gate of its open state (or the signal that a gate has not opened) shall be re-directed from the gate control panel initially to the local gate control computer in the station (in the SMR), but also to the BACS system, where it shall be logged in a file along with the date, time stamp etc.
- In addition, the BACS Contractor must also create a graphic view of the gate status. This graphic view shall be displayed at all workstation in the OCC and in the SMRs.



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- If the BACS system does not receive the gate open acknowledgment and after a predefined delay, it shall intervene through a SIL-2 relay to the power supply switchboard of the gates to cut off the power to the gates, so that they open via their fail-safe mechanism (mechanical springs in case of power failure). Such a command – if activated - must be also recorded in the BACS files along with all necessary information.
- The supply of the SIL-2 relay, as well as cables and cabling work from the BACS PLC up to the terminal blocks of the power supply switchboard fall under the scope of works of the BACS Contractor, while the installation of the SIL-2 relay and the cabling work within the switchboard fall under the scope of works of the Gates' Contractor.

All details pertaining to the operation, sequence and characteristics of the signals, commands, indications and response times shall be decided in the DFD in cooperation with the Contractors for the gates and the BACS.

### **2.5.2 Fire detection by the Fire Detection System (FAP)**

In case a detector detects a fire, for example in a station public area, then:

- The FAP system, concurrently to the command to the gate control panel to open the station gates, shall update the BACS system by wire that a fire was detected and the open gate command was issued. This update shall be recorded in the files of BACS system, along with all necessary information, such as time stamp, date, etc.
- The BACS system, having received an update by the FAP system that the gate open command was issued and having not received the signal that the gates have opened within a specified time period, shall be capable to automatically issue a second command for gate opening within a predefined time delay. Should such a command be issued, it must be also recorded in the BACS files along with all necessary information.
- Acknowledgement by each gate of its open state (or the signal that a gate has not opened) shall be re-directed from the gate control panel initially to the local gate control computer in the SMR, but also to the BACS system, where it shall be recorded, along with the data, time stamp, etc.

In addition, the BACS Contractor must also create a graphic view of the gate status. This graphic view shall be displayed at all workstation in the OCC and in the SMRs.

- If the BACS system does not receive the gate open acknowledgment and after a predefined delay, it shall intervene through a SIL-2 relay to the power supply switchboard of the gates to cut off the power to the gates, so that they

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open via their fail-safe mechanism (mechanical springs in case of power failure). Such a command – if activated - must be also recorded in the BACS files along with all necessary information.

The supply of the SIL-2 relay, as well as cables and cabling work from the BACS PLC up to the terminal blocks of the power supply switchboard fall under the scope of works of the BACS Contractor, while the installation of the SIL-2 relay and the cabling work within the switchboard fall under the scope of works of the Gates' Contractor.

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

Upon completion of all required works of the Contractor for the interface between the BACS system and the AFCS system and the conduct of the Installation Tests, the Site Acceptance Test (SAT) shall be carried out in each station.

The purpose of these tests is to verify that in case a fire scenario is activated by the BACs system, or there is an update by the FAP system that a fire was detected, all necessary actions shall be executed towards the AFCS system, as described above.

The time schedules of the SAT tests shall be developed by the Contractor and submitted to AM for approval.

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

The System Integration Tests (SIT) shall be carried out after the successful completion of the SAT tests in all stations and associated tunnels on the complete system.

The time schedules of the SIT tests shall be developed by the Contractor in cooperation with the other involved Contractors and submitted to AM for approval,

These tests shall demonstrate that all equipment is fully integrated with the access gates – AFCS and Fire Detection systems and that it operates properly as an integrated system, fully satisfying the specified operation and performance requirements.