



ATTIKO METPO A.E.

TITLE OF THE TENDER:

**LINE 4 – SECTION A’
“ALSOS VEIKOY – GOUDI”**

RFP-308/17

INFORMATION DOCUMENT

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1 Introduction

This document gives a general description of the Project: Line 4 - Section A’ “Alsos Veikou – Goudi” and provides information to the bidders regarding its design, characteristics and implementation.

2 Transportation planning of Line 4

In the framework of the further development of the Metro network in Athens, AM has incorporated in its planning the design and construction of a new **Line 4**, which shall supplement the existing 3 lines (line 1 – former ISAP and lines 2 & 3 of Attiko Metro).

According to the Metro Development Study (1996 – 2000) and other subsequent studies and surveys prepared by AM, Line 4 took finally the form of a new independent U-shape Line 4 that will incorporate two radial branches (towards Galatsi and towards Maroussi) and one central part connecting the aforesaid branches - via intermediate stations – with busy and densely populated areas, such as Kypseli, Exarchia, Kolonaki, Kaissariani, Ilissia, Zografou and Goudi. As far the transferring facilities are concerned, the new line will be connected with Line 2 at PANEPISTIMIO Station and with Line 3 at the existing EVANGELISMOS Station.

Finally, a new branch of the line to be linked - via grade-separated railway connections (turnouts) – with the main branch of Line 4 will be directed from EVANGELISMOS Station to Pangrati, Vyrona and Ano Ilioupoli and will constitute in essence a part of the future Line 5; moreover, the 3 central stations, namely AKADEMIA, KOLONAKI and EVANGELISMOS, shall be common in both lines.

The subject Section A’ “Alsos Veikou – Goudi” has been designed with the purpose to:

- Serve a great number of densely populated areas of the city (Veikou, Galatsi, Kypseli, Kaissariani, Zografou, Ilissia, Goudi, etc.);
- Serve the centre of Athens offering 4 new Stations (Exarchia, Akademia, Kolonaki, Evangelismos);
- Serve a great number of important buildings and facilities such as
 - Hospitals (Evangelismos, Children’s Hospital, Laiko Hospital, etc.),
 - Educational Institutions (University / Technical University Campuses, Medicine School and Dentist School in the area of Goudi, as well as the University and the Technical University downtown Athens and many schools),
 - The Courts Complex – former Sxoli Evelpidon (Military Cadets),
 - Large Public Building complexes housing various Public Organizations or Ministries,
- Increase the metro lines grid by adding 2 transfer stations (Panepistimio/Akademia, Evangelismos);
- Relieve the already operating central Metro stations from the constantly increasing ridership demand (Syntagma, Omonia, etc.).

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It is estimated that this first section of Line 4 will serve at least 220,000 passengers on a daily basis, while when fully developed, section “A” will serve approximately 310,000 passengers on a daily basis. It is estimated that the overall number of citizens residing within a distance of 500m. from the 14 stations will be 295,000, while the respective work positions located within the same distance will be approximately 120,000.

3 Line 4 – Section A’ “Alsos Veikou – Goudi”, Basic Characteristics

This Tender shall result in the implementation of the first section of Line 4, Section A “Alsos Veikou – Goudi”, approximately 13km long, to accommodate 14 new stations, along with their ventilation shafts, as follows: Alsos Veikou, Galatsi, Kypseli, Dikastiria, Alexandras, Exarcheia, Akademia, Kolonaki, Evangelismos, Kessariani, Near East, Zografou, Ilissia, Goudi.

In addition, in order to serve the needs for the construction of Line 4, Section A “Alsos Veikou – Goudi”, the following features must be constructed:

- A double-track tunnel, approximately 10km. long, using TBM machines;
- A connecting single – track tunnel, approximately 840m. long, including start-end turnouts, (to connect Line 4 with the existing connecting tunnel of lines 2 and 3);
- Ten (10) shafts along Section A’ of Line 4, i.e. EYDAP, Veikou - Washing Plant – Maintenance, Parnithos, Vivliothikis, Evangelismos Turnout, Formionos, Panepistimioupolis, Dikaiosynis, TBM-Katehaki, GNA;
- A new Operation Control Center (OCC) for Line 4 with the perspective to incorporate the operation control of lines 1, 2, 3 and the future automated new lines, as well as the Tramway lines. The new Operation Control Center will be located at a new building to be constructed in an area within Sepolia Depot.
- A new maintenance and repair building for the new trains, to be also located in an area within Sepolia Depot.
- The two forestations of the Line before Alsos Veikou Station (underneath Veikou Avenue) and past Goudi Station (underneath Katehaki Avenue) will accommodate technical works with the appropriate layout of the railway crossovers/turnouts so as to achieve stabling, washing and maintenance of the new trains.

The construction methods to be followed for the several structures of the project, i.e. stations, shafts, tunnels, etc., shall be as follows:

- Cut and Cover method (C/C)
- Underground boring of tunnels using conventional mechanical means and/or controlled blasting activities
- Boring of tunnels using mechanical means: depending on the anticipated geological, hydro-geological and geotechnical conditions, suitably selected and equipped TBM machines shall bore tunnels and line it using precast reinforced concrete segments that form the tunnels’ permanent lining.

All fourteen (14) stations shall have side platforms up to 110m. long and from 4.00m. to 5.50m. wide, on a per case basis, to be separated from the tracks by

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means of Platform Screen Doors (PSDs) of appropriate height, in line with the Tendering Design of AM. The stations shall accommodate one, two or three entrances and shall be fully accessible to Persons with Special Needs.

The stations shall be approximately from -20m. to -34m. deep, as to the TOR from the ground surface.

Where necessary for the construction of the stations, the required properties shall be expropriated.

The basic features of the new line that differentiate same from the existing lines shall be referred to in other units; the new features are as follows:

- Automated driverless train operation;
- Signalling and train control system based on CBTC (Communications Based Train Control) technology;
- Central control of the trains and stations operation exclusively from the new Operations Control Center;
- Up to 110m long stations equipped with Platform Screen Doors;
- A smart-card fare collection system of closed type, mobile telephones & other devices, etc.;
- Traction substations with the option to re-feed the energy generated by the trains braking to the 20KV PPC Medium Voltage network;
- Application of new technologies to the telecommunications and weak current systems, such as digital cameras with increased processing options, state-of-the-art telecommunications systems, “Wi-Fi” for the provision of services to the passengers or other similar systems, etc.
- Design of all individual systems aiming at maximizing safety and minimizing the consumed power.

4 Scope of the Project

The Scope of the Project shall include the preparation by the Contractor of the General Final Designs and the Detailed Final Design (DFD) on the basis of Attiko Metro’s Specifications, the remaining Contract Documents, the design of his Offer and AM’s Tendering Design, to be provided to him at Phase B’ of the Tender, along with the respective works.

In addition, the scope of the Project shall include any adjustments of the General Final Designs and the Detailed Final Designs that may be required due to differences between the foreseen and the actual conditions of the construction of the Project.

4.1 Civil Works

Civil works include *inter alia* in brief the following:

- Investigation and examination of land uses - in the wider area of the Project - which might have an impact on the Project construction and operation (e.g. gas station, rooms intended for safeguarding, storing, distributing hazardous chemical substances and any pollution/leakages induced from these areas)
- Topographical works and surveys, cadastral diagrams/charts
- Inventory of existing features

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- Actions, expenses and works required for temporary occupations, as well as topographical surveys and works and preparation of cadastral diagrams and charts for any additional expropriations to be required
- Worksite installations
- The necessary archaeological works. These works include: fencing and safeguarding of the areas where archaeological works are being executed, investigation works (investigation trench, etc.) for identifying archaeological finds including the required retaining works, archaeological excavations, recording and surveying of finds, as well as temporary conservation and safeguarding of antiquities. Archaeological works shall be executed under the supervision of the Departments concerned of the Ministry of Culture
- Demolition/dismantling of the existing structures that may be required for the needs related to the construction of works and their transport to areas obtained environmental permits
- Geological, engineering-geological, hydro-geological surveys and studies
- Investigation of geological, hydro-geological, geotechnical, hydrological, topographical, urban, environmental, meteorological and traffic conditions prevailing in the area
- Investigation works for identifying old shafts, ground voids and excavation conditions ahead of the tunnel excavation front (either from inside the tunnel or from the surface), filling and sealing of shafts and voids which might be encountered during the construction of the Project, addressing any over-excavation, collapse and failures, as well as the relevant remedial measures
- Layout and longitudinal profile of the line alignment
- The required investigation works for identifying PUO networks (PPC, OTE, EYDAP, Natural Gas, etc.) and preparation of all designs regarding all PUO networks relocation and/or diversion works (provisional and/or permanent), except in cases that these designs are compiled by the PUO Organizations, as well as their implementation
- Coordination and provision of any assistance required to Public Utility Organizations, municipality departments, etc. executing works falling within the scope of their competence in the framework of this Project
- Designs for traffic diversions, road works and signaling (temporary and/or permanent) and the relevant works
- Geotechnical designs for excavation and temporary retaining
- Geotechnical designs for the excavation and support of the tunnels to be bored by the underground method using conventional mechanical means and those to be bored using TBM machines
- Inventory, Recognition and Assessment of the Importance and Special Vulnerability of buildings and structures, Special Vulnerability and Relative Risk Design for buildings and structures within the influence zone of the Project
- Designs concerning soil improvement measures and measures for the protection of buildings, structures, etc.. Soil improvement works, introducing of measures for the direct support of the tunnels, etc., as and where required
- Designs concerning the Geomechanical and Structural Monitoring of the project. The Geomechanical and Structural Monitoring of the Project structures, the buildings/structures and the sub-soil of the influence zone of the Project before and during the execution of the construction works, as well as during the Project maintenance – guarantee period
- Architectural designs (architectural layout and finishes). Works for architectural finishes at stations, crossovers and shafts, station entrances/exits, works for the reinstatement of stations', crossovers and shafts surrounding areas

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- Structural designs concerning all permanent structures of the Project (stations, tunnels, shafts, etc.)
- Building designs concerning the extension and configuration of Sepolia Depot (OCC, Repairing Building)
- Construction of stations, tunnels, crossovers and shafts, as these are described in brief in the present document, and as to be designed by the contractor (temporary and permanent works) and approved by Attiko Metro
- The preparation of designs and the implementation of temporary and permanent drainage works and flood protection activities during the execution and the operation of the project
- Designs for the reinstatement of the worksite and other areas and structures. The reinstatement of the occupied worksite areas, PUO networks diversions and traffic diversions upon completion of the construction works, ensuring full integration with the surrounding area
- Passive Fire Protection designs
- Acoustic Designs for Stations
- Designs for the coordination among Civil Works, E/M and Railway Systems
- Preparation of the Health and Safety Plan and File (HSP and HSF)
- Environmental Studies concerning modifications of the Project (including noise and vibration studies) should it be required
- All necessary designs and works related to the implementation of preventive, protective measures or even repair works for all buildings/structures affected by the Project, including structures and/or E/M and Railway Systems of the existing Athens Metro network, due to failures to eventually occur during Project construction
- The preparation of the General Final Design and the Detailed Final Design, the supplementary designs, surveys, as foreseen by the Contract, as well as the designs and works required to ensure the compatibility of this Project with the existing Athens Metro network
- Designs for the coordination among Civil Works (structural, geotechnical and architectural works), E/M and Railway Systems, Rolling Stock and Commissioning. The subject designs shall include all necessary procedures for the comprehensive Building Information Modeling – BIM of the Metro Projects - in three or more dimensions – to be correlated with all Project information (designs, networks, equipment, specifications, materials, suppliers, test reports, etc.) through well-organized and interdependent databases. The final Project Log (as built) shall be in BIM format

The designs shall be approved by AM and – if required – by the relevant Services and Organizations concerned (e.g. PPC, etc.) prior to their implementation.

4.2 Electromechanical and Railway Systems related Works

The designs of the electromechanical and railway systems and the relevant works that are included in the scope of the Project are in brief as follows:

1. Tunnel ventilation
2. Ventilation/ Heating/Air-Conditioning (HVAC)
3. Power supply - 20kV AC
4. Traction Power System 750 V DC
5. Low Voltage Distribution (400/230V AC)
6. Control and Supervision System in the Station Master Room (SMR) of the Traction Power Equipment of the Rectifier Substations

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7. Extension of the Control and Supervision System of the Traction Power Equipment in the existing Sepolia Depot in Line 2
8. 110V DC Auxiliary Power Supply
9. Release system of the Rectifier Substation in Emergencies
10. Intertripping System along the Line
11. General Release System of all Rectifier Substations of the Line
12. Measuring and Supervision System of the Energy Quality
13. System for Returning the non-used Re-generated Energy to the 20KV Medium Voltage network
14. Earthing and stray-current protection
15. Lighting
16. Lifts
17. Escalators - Travellators
18. Fire detection, Fire fighting, Fire protection (passive and active)
19. Drainage, Sewage, Pumping Stations
20. Water supply – Irrigation
21. Platform Screen Doors (PSD)
22. Automatic Telephone System (PABX)
23. Direct Line Telephone System (DLT)
24. Radio Communication System (TETRA)
25. Digital Data Transmission System (DTS)
26. Closed Circuit Television System (CCTV)
27. Public Announcement System (PA)
28. Passenger Information System (PIS)
29. Passenger Information Network (PIN)
30. Automatic Fare Collection System (AFC)
31. Radio Broadband Data Transmission System
32. Clocks System
33. Traction Current Removal System (TCR)
34. Intercommunication System – intercom
35. Fibre Optics Network (FO)
36. Interior structured cabling for the transmission of digital data
37. Uninterruptible Power Supply Systems (UPS)
38. Building Automation and Control System (BACS)
39. Power Remote Control System (PRCS)
40. Safety Management Systems (SMS) - Access Control System (ACC) - Intrusion Detection System (IDS)
41. Car Loading Information System (CLIS)
42. Signaling and Train Control System - of CBTC technology - including *inter alia* the installation of the following systems: Electrical Interlocking, (E-IXL), Automatic Train Operation (ATO), Automatic Train Protection (ATP), Automatic Train Supervision (ATS) and Data Transmission System (DCS)
43. Trackwork, including 3rd Rail and floating slabs
44. Equipment intended for the Station Master Room (SMR)
45. Equipment intended for the Operation Control Centre (OCC)
46. Compressed air System (in the Depot and the shafts accommodating maintenance facilities)
47. Equipment intended for Repair and Maintenance activities in the Depot (in the Depot and the shafts accommodating maintenance facilities)
48. Natural Gas Facilities (in Sepolia Depot)
49. Furniture for personnel areas at Stations, Shafts, in the OCC and in the Repairing Building at Sepolia Depot
50. Door Keys System
51. Signage

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- 52. Reliability – Availability – Maintainability and Safety Design (RAMS)
- 53. Operation related Designs (Line, Stations, Shafts, Maintenance, Operation, Depots, OCC).

4.3 Establishment of the Project’s Log

Once the Project is completed, the Contractor shall prepare and submit to Attiko Metro the Project Log incorporating all the “as-built” drawings of the Project in BIM format, the Operation and Maintenance Manuals of all Systems and all other necessary information, in digital copies and in a printed form.

5 Description of the Project

5.1 Location and brief description of the Stations

A brief description of each station along with its location, as well as its basic and specific characteristic features are presented below:

The first Station, “Alsos Veikou”, is located on Veikou – Omorfoklissias Avenue next to the intersection with Tralleon street and constitutes a terminal station, next to which bus lines shall terminate for the transfer to the Metro network. This station shall be constructed by the underground method using conventional mechanical means.

The second Station, “Galatsi”, is located at the intersection of Veikou and Galatsiou Avenues. The relevant design has taken into consideration the probable future conversion of Galatsiou Avenue into an underground structure. This station shall be constructed by the underground method using conventional mechanical means. Special Item of consideration: During the construction of this station, special consideration must be given to the existence of PPC 150 kV High Voltage network and the 19bar Natural Gas EPA network, in combination with the relevant unit (valve room) next or on the structures required for the subject station.

The third Station “Kypseli” is located at Kypseli square. Provision is made for the major part of this station to be constructed on the square using the cut and cover method and a part of the platform level to extend beyond the square limits is to be constructed by the underground method using conventional mechanical means.

The fourth Station “Dikastiria” is located in a free space, to the south of the Court building complex at the intersection of Moustoxydi and Evelpidon Streets. It will be constructed using the cut and cover method, while both ventilation shafts will be located within the station.

The fifth Station “Alexandras” is at the intersection of Alexandras Avenue and Moustoxydi Street and will be constructed by the underground method using conventional mechanical means.

The sixth Station “Exarchia” is located on Exarchia square and will be constructed using a combination of cut and cover (C/C) method – as concerns its central part – and by the underground method using conventional mechanical means – as concerns the platform terminations.

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The seventh station “Akademia” is an important transfer station with a direct underground connection with PANEPISTIMIO Station in Line 2. It will be constructed by the underground method using conventional mechanical means. It is located under Akademias street, in the area of the “Three Landmark Buildings In a Row (“Trilogy”), between the central building of Athens University and the Cultural Center of Athens Municipality. The platforms of this Station will be 5.5m. wide, i.e. they will be greater than those of a typical station, so as to withstand the increased passenger flow from / to the adjacent PANEPISTIMIO Station of Line 2.

The eighth station “Kolonaki”, at Kolonaki square will be constructed using a combination of cut and cover (C/C) method – as concerns its central part – and by the underground method using conventional mechanical means – as concerns the platform terminations in a limited worksite area. Special Item of consideration: During the construction of this station, special consideration must be given to the relocation of the PPC 150 kV High Voltage network and of the OTE two waterproof ducts located within the outline of the structures required for this station. A part of the main C/C shaft of this station shall be deepened to constitute the access shaft for the construction of the single-track connecting tunnel, to link Line 4 with the existing Athens Metro Lines 2 and 3.

The ninth Station “Evangelismos” is located adjacent to the existing Metro Station and within the adjacent park, offering direct transfer to/from Metro Lines 3 and 4. The exact location of this Station, its layout and connection with the existing Metro Station, its construction method combining the cut and cover (C/C) method as concerns its main part and the underground method as concerns the platform terminations have been selected in order to maximize transfer to/from the existing Metro Line 3 Station in due consideration of the restrictions of the alignment of Line 4 (in terms of horizontal and longitudinal profile).

The tenth Station “Kaissariani” is located at the junction area of Ethnikis Antistasseos and Vassileos Alexandrou Avenues and Damareos and Missountos Streets. It will be constructed by the underground method using conventional mechanical means. The main structure of the platforms is located underneath Ethnikis Antistasseos Street.

The eleventh Station “Near East” is located at the geographical center of Kaissariani region, underneath Ethnikis Antistasseos Street, in the area of NEAR EAST sports center, it shall be constructed by the underground method using conventional mechanical means.

The twelfth Station “Ilissia” is located in the area of Aornou Square on Indou Street and on Kyprou Square in the region of Ano Ilissia. It will be constructed using a combined method, namely the C/C method and by the underground method using conventional mechanical means as concerns a small section of the platforms.

The thirteenth Station “Zografou” is located in the area of Gardenias Square in the region of Zografou and shall be constructed by the underground method using conventional mechanical means.

The fourteenth Station “Goudi” is located in the area of Eleftherias Square and Loch. Spiliopoulou Street and shall be constructed using the combined method, namely the C/C method and by the underground method using conventional mechanical means as concerns a great section of the platforms. As far as the construction of Goudi Station is concerned, a special consideration must be made to maintaining and not

disturbing – during the execution of works – the existing storm duct of the buried gorge – tributary of Ilissos river.

5.2 Train Stabling, Cleaning and Maintenance Facilities in Katehaki Area

A Train Stabling, Cleaning and Maintenance area shall be constructed -independent from the line- underneath Kanelopoulou (Katehaki) avenue. This approx. 371m long triple-track tunnel shall be constructed through the underground method using conventional mechanical means.

After the 82m long “Katehaki Branching Tunnel”, a single track tunnel will follow constructed through the underground method using conventional mechanical means. This tunnel will be approx. 151m long and shall head to the triple track tunnel.

The transition from the single track access tunnel to the triple track tunnel shall be performed through an approx. 78m long tunnel of variable cross section to be constructed through the underground method using conventional mechanical means.

5.3 Train Stabling, Cleaning and Maintenance Facilities in Veikou Area

A Train Stabling, a Washing Plant and Track Maintenance facilities shall be constructed underneath Veikou Avenue, to accommodate Veikou-Washing Plant-Maintenance Shaft approximately 210m. long and 31m. wide, to be constructed by C/C method and the triple track tunnel approximately 300m. long to be constructed by the underground method using conventional mechanical means. The subject shaft shall be equipped with all necessary facilities (technical rooms, equipment, etc.) to be placed at all its level, in order to ensure maintenance and washing of Line 4 trains - inner and outer.

5.4 Tunnels

Section A’ of Line 4 starts from the forestation tunnel of ALSOS VEIKOU Station, approximately at KP 9+774, and ends (in the framework of this project) at the forestation tunnel of GOUDI Station, approximately at KP 22+638.

The chainage system of Line 4 has been selected taking also into account the extension of the Line to the opposite direction of the chainage of this Project (i.e. to Perissos and, finally, to Petroupoli).

The tunnel of the main line of the Project shall be constructed mainly using the mechanical boring method with two TBMs, sections constructed using the conventional underground boring method.

In the area before the existing EVANGELISMOS Station, the section of the Project’s tunnel between “Kolonaki” and (new) “Evangelismos” Stations shall pass underneath the Metro tunnel in operation (Line 3). All necessary measures must be introduced in terms of both designs and construction, so as not to disturb the smooth operation and the safety of the Metro system already in operation.

5.4.1 Underground Tunnels bored using Tunnel Boring Machines (TBM)

The main tunnel of the entire Project shall be a double track tunnel (of an inner diameter of approximately 8.5m and an outer diameter of 9.5m) and shall be designed to be constructed **using at least two (2) brand new** and not used **TBMs**, which will be designed and equipped with state of the art technology and will satisfy all requirements of AM Specifications.

The TBMs shall be designed and configured so as to have the ability:

- to excavate in all anticipated ground conditions
- to excavate in areas where ground improvement measures shall be implemented
- to safely break through the walls of the trenches.

In addition, the TBMs' design and configuration shall also take into account the requirements that may emerge due to encountering hard rock, karstic voids, mixed conditions at the fronts, presence of cobbles and boulders, wells, man-made voids, etc.

Due to the extensive length of the tunnel and the importance placed on its timely completion in view of the **quickest possible completion** of the Project, AM's strategic selection regarding the Time Schedule is **to place the priority on the construction of the tunnels using TBMs**.

In view of the above, the tunnel boring is foreseen to take place from the most appropriate start up/entrance points, the decisive factor being:

- the Time Schedule
- the distance of the tunnels from sensitive areas
- convenience to supply materials using the existing road network
- whether the tunnel at that location is on a straight line or not, etc.

Based on the above, at the current design phase, the lowering of the TBMs and the commencement of the main tunnel boring works are foreseen to be implemented from **shafts with dimensions appropriate** to support the TBM operation and to extract the excavation spoil, which will be located as follows:

a) a TBM startup shaft (Veikou Shaft – Washing Plant – Maintenance), located on the east side sidewalk of Omorfoklissias (Veikou) Avenue and constructed using the cut and cover method,

b) a second TBM startup shaft, located on the east side of Messogion Av. at its intersection with Katehaki Av., Athens Municipality, near the existing Line 3 Katehaki Metro Station (Katehaki TBM Shaft), and constructed using the cut and cover method,

c) or alternatively, a third TBM shaft, which – if necessary – could be located at a suitable spot within the outline of the new Evangelismos Station in the area of Rizari park, near the intersection of Vas. Konstantinou and Rizari streets in Athens Municipality, near the existing Line 3 Evangelismos Station.

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Moreover, and should it be dictated by technical reasons or by reasons related to the time schedule, the option is provided to utilize either as a TBM backup operations relocation area and excavation spoil removal area, or as a TBM startup area in special cases, other areas as well, such as:

- Dikastiria station, which is located at the intersection of Evelpidon and Moustoxydi streets, to the west of the Athens Court complex, Municipality of Athens.
- Panepistimioupoli shaft in Kessariani Municipality.

TBM extraction and disassembly at the current design stage is foreseen to be implemented – depending on the progress of the works – at various locations, such as:

- the area of Rizari Park near Evangelismos station
- the area of Dikastiria station
- any other appropriate for this purpose area, depending on the construction requirements and the time schedule.

In addition to the currently available and environmentally cleared areas, the option could be examined alternatively to dump the TBM tunnel excavation spoil in old inactive quarries in Attica region, with a view of reconfiguring them as green areas.

5.4.2 Branches/Turnouts

As mentioned above, Akademia – Kolonaki – Evangelismos section of the Line is foreseen to be common to Line 4 and the future Line 5 and includes the following branches:

The Akadimias branching tunnel shall be located near Akademia station and shall serve as the connection between Line 4 and the future Line 5.

The Amerikis branching tunnel shall be located between Akademia and Kolonaki stations and shall connect the main Line 4 via a single track tunnel with the existing tunnel connecting Lines 2 and 3 in Syntagma area. This connection shall be realized by means of National Garden branch located underneath the National Garden and near the boundaries of the Greek Parliament. Of course, all the above must be preceded by communications with the Operations Company and proper scheduling, because it will not be possible for trains to travel between Lines 2 and 3 using the current connecting tunnel during the construction of this branch.

With regard to the service rail connection between Section A of Line 4 and the current network, this connection is necessary in order for the trains to access the Depots on the network, as well as for other operational reasons.

The Evangelismos branching tunnel shall be located between Evangelismos station and the shaft at Evangelismos branching area underneath the Ilissos technical project, and it will serve as a connection tunnel for Line 4 and the future Line 5.

Line 4 section A and the train stabling, cleaning and maintenance facilities at Katehaki, which is located in the forestation area of Goudi station, are connected by means of Katehaki branching tunnel.

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The main Line 4 and the train stabling, cleaning and maintenance facilities at Veikou, which is located after Veikou shaft – washing plant - maintenance, are connected by means of the branching tunnel.

The above branches are constructed using the conventional underground excavation method.

5.4.3 Cumulative lengths of tunnels

The tunnels of the Project are the following (approximate lengths):

- double track TBM tunnels, approximately 10km.
- double track tunnels to be constructed by the underground method using conventional mechanical means, approximately 180m.
- triple track tunnels to be constructed by the underground method using conventional mechanical means, approximately 670m.
- tunnels to be constructed by the underground method using conventional mechanical means with variable/widened cross section, approximately 530m.
- single track tunnels to be constructed by the underground method using conventional mechanical means, approximately 860m.

The length of the TBM tunnels and the tunnels, to be constructed by the underground method using conventional mechanical means, may vary (+/-) as the construction methods of the various sections of the Project are finalized, as it shall be determined in the DFD and in accordance with the Project's time schedule.

This Project also includes the construction of the necessary CW provisions (to be determined in Stage B' of the Tender), i.e. the required structures in the main tunnel in anticipation of future Line 4 extensions.

5.5 Shafts

The Project incorporates the Station ventilation shafts, as well as the intermediate or terminal shafts. These shafts shall be constructed using the C/C method and will be connected with the main tunnel to be constructed by the underground method using conventional mechanical means.

5.6 New Operations Control Centre (OCC)

In the framework of this Project, **a New Operations Control Center (OCC) shall be constructed and equipped as a building structure**, in order to serve the entire Metro and Tramway networks.

In particular, the new OCC shall cover the following needs:

- It shall serve the operation of Line 4,
- Buildings shall be provided for in order to accommodate all central control systems, enabling the OCC to serve Lines 2 & 3 as independent Metro lines,
- Buildings shall be provided for in order to accommodate all central control systems, enabling the OCC to serve Line 1,
- Buildings shall be provided for in order to accommodate all central control systems, enabling the OCC to serve the Tramway network,
- Buildings shall be provided for in order to serve the future Line 5, which shall coincide with Line 4 on Evangelismos – Kolonaki – Akademia section,

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- Buildings shall be provided for to accommodate and control the Fare Collection equipment for all fixed route modes (i.e. at least Metro and Tramway).

The option shall be provided for independent control and surveillance of each Line.

The control, surveillance and management equipment to be installed shall be only for Line 4.

The transfer or the new installation of central control equipment for Lines 1, 2, 3 and the Tramway or for the Fare Collection system shall be implemented in the future by means of separate contracts.

The new OCC shall be constructed within a building complex of a total area of approx. 4600 m² in a building with a ground floor and two floors, which shall be located in an unbuilt available area approx. 2500 m² property of AM within the boundaries of Sepolia Depot. The new building shall have 2 basements (equipment rooms at -1, car parking areas at -2) of an area approx. 2300 m² and 2200 m² per basement.

The scope of the Project includes the construction of the new OCC building, the construction of the EM building installations and systems, the incorporation of the building into the environment of Sepolia Depot, the connections of the new building with the PUO networks, as well as the entire equipment for the control and surveillance of all EM and railway systems and the operation on Line 4.

5.7 Emergency OCC at “Dikastiria” Station

An Emergency OCC (ECR – Emergency Control Room) for Line 4 is required and has been designed to be installed within Dikastiria Station.

More information on the functional and technical characteristics of the systems, their location and other details shall be provided at a subsequent phase of the Tender.

5.8 The New Repair Workshop at Sepolia Depot

In the framework of the heavy maintenance and repair of the new trains for section A of Line 4, as well as of expanding the maintenance capabilities of Sepolia Depot, a new train maintenance and repair workshop shall be constructed within Sepolia Depot, in a available area located to Sepolia Depot Gate on the side of Sepolia Station.

The building shall be on the ground floor, unified, shall be constructed as a composite structure (the bearing structure made of reinforced concrete and steel structure) and its total area shall be approx. 5500 m². A first and a second floor shall be constructed above a part of the building which shall serve as office area, while a spare parts storage area, approx. 1500 m² equipped with a special cargo elevator shall be constructed at level -1. This storage area shall be fitted with industrial type racks.

The Project's scope also includes:

- The construction of the new repair workshop and the new guardhouse at the entrance to the Depot.

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- The construction of the building E/M installations and systems for the aforementioned buildings (repair workshop and guardhouse).
- The modification and extension of the existing trackwork and railway systems of Sepolia Depot.
- The modification and extension of the existing Depot operation systems.
- The connections of all E/M networks in the Depot and PUO networks for the two new buildings.
- The supply and installation of a new equipment for train diagnostics maintenance and repair operations, which shall be installed in the new building, including the tower cranes and special service vehicles to facilitate maintenance.

5.9 Unified Project Technology

As regards the technologies to be implemented in this section “A” of the Line, i.e. Alsos Veikou – Goudi (signaling, fare collection, digital data transmission, automatic control systems, etc.), AM reserves the right to have them expanded at the later sections and phases of Line 4, for obvious reasons having to do with compatibility, safety and cutting down operational costs.

Dimensioning and features of the equipment installed in the framework of this Project shall also take into account the expansion of the same technologies to the other Project construction phases (the remaining section of Line 4). System interfaces for the future sections of Line 4 shall be of the “open architecture” type to the extent this is practicable, ensuring thus expandability.

5.10 E/M and Railway Systems – Operation

The basic and special operational characteristics of Line 4, which differentiate it from the existing Lines 2 & 3 and their systems, are the following:

- Automatic train operation. The design operational headway shall be 90 sec on the Line, 120 sec for normal reversing in forestations and 90 sec for reversing before the station (or moving on alternative tracks). It is stressed that during phase A of the Project’s operation, the foreseen headway shall be 240 sec and in the short-term 180 sec.
- Independent (from Lines 2 & 3) signaling and train control system supporting the automated train operation. The said system, which is directly related to the automatic train control, shall be of the CBTC type technology.
- Central control of the stations and train operation exclusively from the new Operation Control Room (OCC).
- Up to 110m long stations with platform screen doors (PSD). The doors shall have the appropriate height and shall be interlocked with a number of other systems ensuring the operation of the Line (train control systems, intrusion control systems, telecommunication systems etc.).
- Tunnels and stations ventilation systems along with the necessary ventilation shafts for each station and emergency fans, taking into consideration the platform screen door (PSD) system in each station.

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- Automatic Fare Collection System (AFC) of the closed type with access gates and contactless smart cards and central control from OCC and/or via smart devices technology.
- The traction system shall be 750 V DC, with bimetallic third rail and a full central control from the OCC.
- Upgraded and modern communication and data transfer systems, of “full IP” technology, high availability and redundancy for the backbone network, utilizing the fast evolving technology in the field and ensuring the necessary redundancy in terms of E/M and railway systems operation.
- Closed Circuit TV (CCTV) systems with high definition cameras and capable to blow out pictures in order to maximize safety in stations and trains.
- Wireless Broadband Data Transmission systems (e.g. wi-fi) covering all station and tunnel areas.
- Lighting fixtures with low consumption bulbs and extensive use of LED lights, for reduced costs and increased life expectancy, which in turn means reduced maintenance costs.
- Smart operation management systems for the maximization of the safety level and minimization of the consumed power.
- The minimization of the energy consumed by the traction system and the E/M systems in stations, tunnels, shafts, etc. (e.g. escalators, lifts, fans, lighting, etc.).
- The requirements pertaining to the maintenance of the permanent installations of Line 4 (e.g. stations, tunnels, etc.) shall be designed taking into account the existing organization and staffing of the Operations Company with Sepolia Depot as the main base.

6. Geological – Geotechnical Conditions of the Project

The geological environment of the Project consists of Alpine geological formations, post-alpine deposits of Hymettus alluvial fans, fluvio-torrential deposits and superficial artificial deposits of a small thickness. The alpine geological formations are (from bottom to top) the Alepovouni Formation, Ultrabasic Rocks, the Athens Schist, the Sandstone - Marl Sequence and the Crest Limestone. It is stressed that all KPs quoted in the following paragraphs are approximate.

6.1 Geological Units

The following geological units are encountered in the Project:

Alepovouni Formation: It is encountered only locally down to the TBM tunnel depth at two locations: Near East Station (mica and calcareous schists) and Ilissia Station (dolomite).

Ultrabasic Rocks: They are encountered only at Ilissia Station at the tunnel profile and consist of serpentinites.

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Athens Schist: This formation consists of two sub-formations: the Upper and the Lower. The *Upper Formation* mostly consists of alternations of metasandstones and metasiltsstones, as well as limestones, schists and phyllites. The *Lower Formation* consists of clayey shales, metasiltsstones and metasandstones. The Athens Schist is consistently encountered from the area of “Kypseli” Station (KP 12+990) to a short distance before the end of the Project (KP 22+080). After “Ilissia” Station and up to KP 22+080, it is mainly encountered in the tunnel profile the Project, while at limited stretches the Schist plunges below it.

Sandstone - Marl Sequence: The Sandstone - Marl Sequence comprises marly limestones and alternations of sandstone, claystone, as well as of limestone, breccia, siltstone and locally calcareous marl. The Psammitic-Marly Series is encountered from the beginning of the Project up to just before “Kypseli” Station (KP 12+990).

Crest Limestone: This formation consists of limestone and occupies a portion of the overburden zone of the tunnel in the area around Parnithos Shaft (from KP 12+220 to KP 12+370).

Alluvial Fan Deposits: Alluvial Fan Deposits originated from the nearby Mount Hymettus. These deposits in the hills from KP 19+450 to KP 20+810 are mostly made up of breccia and intercalations of claystones, while in the lower areas, from KP 20+810 to the end of the Project, these deposits transform into alternations of clayey or sandy gravels, gravelly clays, breccia and claystones.

Fluvio-torrential Deposits: This formation mainly consists of sandy gravels, clayey gravels and sandy-gravelly clays of a low plasticity and is encountered at surface beds of a small thickness (generally <3m). Fluvio-torrential Deposits of a significant thickness are encountered where the alignment intersects Ilissos River (KP 17+270, maximum thickness ~10m) and the other hydrographic axes.

Artificial Deposits: This formation consists of soil materials and structures of variable composition and is encountered in urban areas. The thickness of the Artificial Deposits is generally of the order of 1 meter. Artificial Deposits of a significant thickness are expected to be encountered in the area of Alexandras Avenue, where the alignment intersects Kyklovoros torrent, as well as in the area of V. Konstantinou Avenue, where the alignment intersects Ilissos River.

In the connecting tunnel area, formations of the Upper and Lower Formations of Athens Schist are encountered, as well as surface Artificial Deposits of a small thickness.

In the area of Sepolia Depot, Fluvio-torrential Deposits are encountered, deposited on the Alpine bedrock, which in this particular area consists of formations of the Upper unit of Athens Schist.

In the area of the train stabling tunnel at Katehaki, Alluvial Fan Deposits are encountered.

6.2 Hydrogeology

The hydrographic network in the entire broader area of the Project is covered, with the main hydrographic axes now constituting the main sewers and culverts which receive the area’s precipitation.

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The Project intersects Ilisos river and its tributaries, as well as the torrents from Tourkovounia in the area of Galatsi, Kypseli and Alexandras. With the exception of Ilissos, which has a permanent flow, the other hydrographic axes do not have a permanent flow. It is pointed out that the Project also intersects ancient hydraulic structures (Aqueduct of Pissistratos).

Generally, the groundwater level is above the tunnel crown. Exceptions to this rule are certain short sections where the groundwater level is within or below the tunnel profile. There is a great fluctuation of the groundwater level from one location to another, since it is related to the elevations of the topography and the permeability of the formations.

7. Commissioning – Headways

The system shall be capable to commission trains depending on the passenger flow. During the first years of operation, it is expected that the trains shall operate on a 240 sec. headway (4 min) along the Line, while in the short term the trains shall operate on a 180 sec. headway (3 min - headway based on which the train fleet is dimensioned). The scheduled headways can be reduced in the future to ninety (90) sec. depending on the strategic planning of the network and the passenger service requirements at the central section of Line 4 (Akademia – Kolonaki – Evangelismos), which shall be common with the future Line 5.

For System design and dimensioning reasons, headways shall be scheduled as follows:

- Operation design headway : 90 sec
- Traction power design headway : 60 sec
- Signaling design headway : 60 sec under ATO
- Ventilation design headway : 100 sec

8. Trackwork – Track Layout - Crossovers

Line 4 tracks shall be of a standard gauge, i.e. 1435mm, and shall consist of UIC 54 tracks, fixed on twin sleepers –with micro-cellular pads and rubber boots– semi-embedded on trackbed concrete.

9. Rolling Stock

The scope of the Project includes the designs, the supply, tests and commissioning of up to 18 automatic trains, to be required for the operation of section “A” of the new Line, in order to cover the foreseen ridership of 8,000 passengers at peak hours on the section with the highest passenger load per direction (Evangelismos – Kolonaki section) in year 2030, as well as those foreseen to be required in the long run up to a ridership of 13,000 passengers/peak hour/direction.

Each train shall consist of the appropriate number of cars capable to transport the required number of passengers with the aforementioned headways with a passenger load of 5 passengers/m².

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The overall length of the train shall take into account the length of the platforms of the new Line Stations, which shall be up to 110m maximum, the width of the train between the external side panels of the car-body shall be approximately 2.80m, while the train floor height from TOR shall be approximately 1.10m.

The new trains shall be capable - in terms of geometry (envelopes), third rail gaps, traction power - of running on the existing tunnels of Lines 2 & 3 during their travel to the existing Depots.

Their characteristics shall be determined in Stage B’ of the Tender.

Moreover, a compatible signaling system must be ensured for the section of the existing network where the new trains shall travel.

The overall passenger carrying capacity of the trains shall be concluded from the required operational headway (from 90sec to 240 sec), while the overall availability of the system shall be at least 99%.

10. Environmental Study and Permits

The Environmental Impact Assessment Study has been submitted and currently is in the consultation stage. The relevant environmental studies shall be prepared by the Project Contractor for any necessary modification to the Project during its construction, or for the renewal of the Environmental Terms, Environmental Permits of associated Projects during construction, etc.

The approved environmental terms of the Project must be respected by the Contractor.

11. List of drawings

4G00CW203B101A	General Horizontal Layout
4G00CW203B401A	General Longitudinal Profile
4T00CW403B301A	Typical Cross Sections of the Tunnel.