

ANNEX II + III: TECHNICAL SPECIFICATIONS + TECHNICAL OFFER

Contract Title: Supply of Road Weather Information System (RWIS) equipment, software and training

Publication Reference: EuropeAid/137118/IH/SUP/RS

Abbreviations

| No | Acronym | Description |
|-----------|----------------|---|
| 1. | ASP | Application Service Provider |
| 2. | CAL | Client Access License |
| 3. | CE | CE Certification |
| 4. | CFCU | Central Financing and Contracting Unit |
| 5. | CPU | Central Processing Unit |
| 6. | DB | Data Base |
| 7. | DBMS | Database Management System |
| 8. | DDR3 | Double Data Rate 3 (memory) |
| 9. | EC | European Commission |
| 10. | EMC | Electromagnetic Compatibility |
| 11. | EU | European Union |
| 12. | EUD | Delegation of the European Commission to the Republic of Serbia |
| 13. | Gbps | Gigabits Per Second |
| 14. | GHz | Gigahertz |
| 15. | GIS | Geographic Information System |
| 16. | GPRS | General Packet Radio Service |
| 17. | GSM | Global System for Mobile Communications |
| 18. | GUI | Graphical User Interface |
| 19. | HDD | Hard Disk Drive |
| 20. | HW | Hardware |
| 21. | IPA | Instrument for Pre-Accession Assistance |
| 22. | I/O | Input/Output |
| 23. | IP | International Protection Code |
| 24. | ISO | International Standard Organization |
| 25. | IT | Information Technology |
| 26. | LAN | Local Area Network |
| 27. | MB | Megabyte |
| 28. | Mbps | Megabits Per Second |
| 29. | MCU | Micro Controller Unit |
| 30. | MW | Middleware |
| 31. | ODBC | Open Database Connectivity |
| 32. | PBC | Performance Based Contracts |
| 33. | PBRMC | Performance Based Road Maintenance Contracts |
| 34. | PC | Personal Computer |
| 35. | PCI | Peripheral Component Interconnect |
| 36. | PERS | Public Enterprise "Roads of Serbia" |
| 37. | PLC | Programmable Logic Controller |
| 38. | RDMS | Relation Database Managemet System |

| No | Acronym | Description |
|-----------|----------------|---|
| 39. | RH | Relative Humidity |
| 40. | ROM | Read Only Memory |
| 41. | RRSP | Road Rehabilitation and Safety Project |
| 42. | RTXC | Real Time Clock. A clock circuit retaining date and time data even in case of power failure |
| 43. | RTXCio | Real-Time eXecutive in C io system. Architecture for I/O-handling in RTXC. |
| 44. | RTXCfile | Real-Time eXecutive in C file system. File system for RTXC |
| 45. | RWIS | Road Weather Information System |
| 46. | RWS | Road Weather Station |
| 47. | SA | Service Agreement |
| 48. | SEIO | Serbian European Integration Office |
| 49. | SI | Le Systeme international d'unités (International System of Units) |
| 50. | SIDA | Swedish International Development Agency |
| 51. | SMS | Short Message Service |
| 52. | SW | Software |
| 53. | SQL | Structured Query Language |
| 54. | TRP | Transport Rehabilitation Project |
| 55. | TB | Terabyte |
| 56. | TCP/IP | Transmission Control Protocol/Internet Protocol |
| 57. | UMTS | Universal Mobile Telecommunications System (a third generation mobile cellular system for networks based on the GSM standard) |
| 58. | USB | Universal Serial Bus |
| 59. | VPN | Virtual Private Network |
| 60. | WB | World Bank |

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Columns 1-2 should be completed by the Contracting Authority

Columns 3-4 should be completed by the tenderer

Column 5 is reserved for the evaluation committee

Annex III - the Contractor's technical offer

The tenderers are requested to complete the template on the next pages:

- Column 2 is completed by the Contracting Authority shows the required specifications (not to be modified by the tenderer),
- Column 3 is to be filled in by the tenderer and must detail what is offered (for example the words “compliant” or “yes” are not sufficient)
- Column 4 allows the tenderer to make comments on its proposed supply and to make eventual references to the documentation

The eventual documentation supplied should clearly indicate (highlight, mark) the models offered and the options included, if any, so that the evaluators can see the exact configuration. Offers that do not permit to identify precisely the models and the specifications may be rejected by the evaluation committee.

The offer must be clear enough to allow the evaluators to make an easy comparison between the requested specifications and the offered specifications.

Annex II.A General Technical Specifications

Contract Title: **Supply of Road Weather Information Systems (RWIS) equipment, software and training**

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1. Introduction

In the period from 2004-2008, the Transport Rehabilitation Project (TRP), financed by the World Bank, included a Pilot Project of Performance Based Road Maintenance Contract (PBRMC) related to routine (summer and winter) maintenance in two regions (Mačva and Kolubara) covering the total length of app. 1,200km. This pilot project included a new approach to winter road maintenance through the implementation of the first Road Weather Information System (RWIS) in Serbia.

The implemented RWIS is composed of six (6) Road Weather Stations (RWS) equipped with sensors for surveying the meteorological events and placed along the most critical roads. They are linked to a central server and client stations through specific software for collection, monitoring, processing and storage of data with additional modulus for calculation of winter maintenance costs. These six RWS were installed during the period from 2004-2005. As a result, in the regions of Mačva and Kolubara since 2005 it has been possible to start the winter maintenance based on RWS data.

In the period from 2009 in Belgrade were installed tree (3) Road Weather Stations (RWS) equipped with same sensors like stations in Mačva and Kolubara district.

Public Enterprise “Roads of Serbia” (PERS) intends to continue with this innovative approach for winter maintenance and extend it to additional approx. 3,000 km of national road sections in other Serbian regions (the “Project”) in phase of identification by PERS.

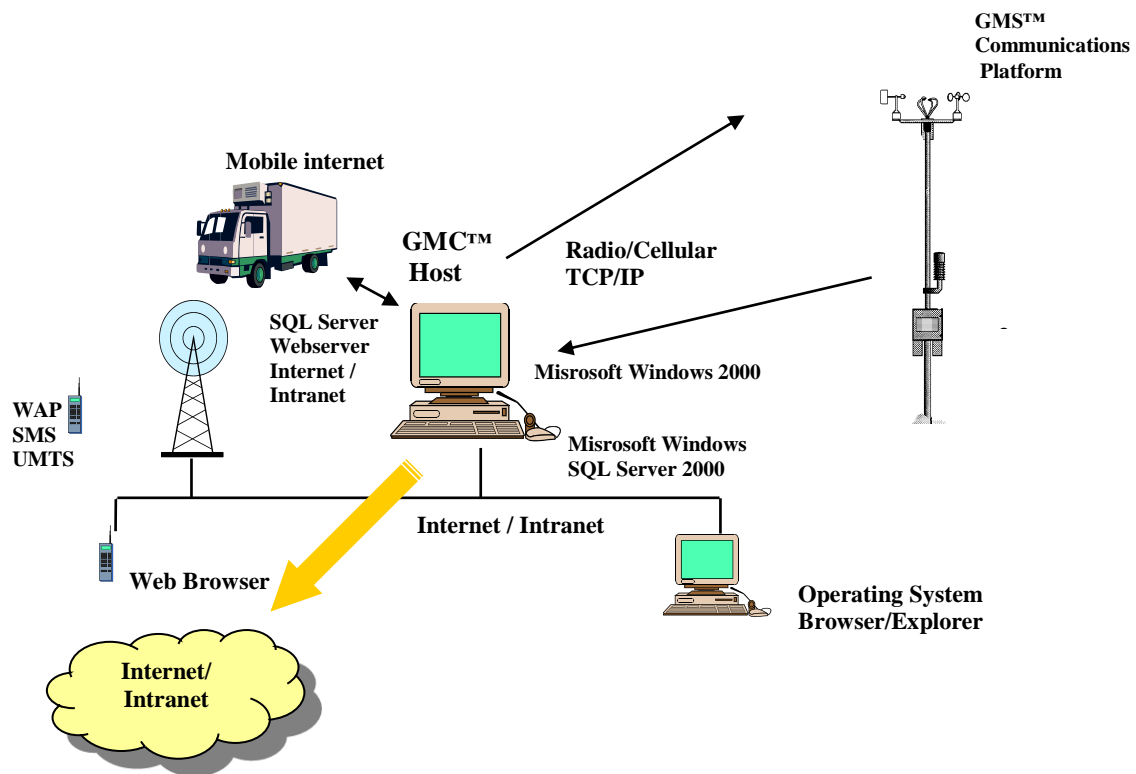
For the needs of this Project, which covers 3,000 km of state road network, eighteen (18) Road Weather Stations (RWSs) will be purchased with related communication and application software and training.

2. Description of the existing RWIS in Serbia managed by PERS

The existing RWIS system in Serbia has been in use since 2005, and up to date, its primary role is to support winter road maintenance.

This system in its present form consists of:

- Central “GMCTM” Server (Database and Web Server) located in Belgrade;
- Six (6) “GMSTM” (General Monitoring Station) road weather stations (RWSs) equipped with sensor units (measuring air and pavement temperature, wind, humidity and precipitation) located in the Mačva and Kolubara region;
- Tree (3) “GMSTM” (General Monitoring Station) road weather stations (RWSs) equipped with sensor units (measuring air and pavement temperature, wind, humidity and precipitation) located in the Belgrade region;
- Communication system.



Scheme of the existing RWIS system in Serbia managed by PERS
(Source: PERS ITS Dept.)

Data from sensors is first collected and stored locally in the GMS™ field stations. The GMC™ (General Monitoring Computer) central system contacts the field stations regularly and collects data. This data is processed and stored in a central SQL database. The information can be made available to end users as web applications on Internet/Intranet or as subscribed SMS messages.

2.1. Central GMC™ Server (Database and Web Server)

The main computer for monitoring ("GMC™" Server) is a Personal Computer (PC) which software is used to collect data from the field monitoring systems, such as "GMS", "PLC" equipment, mobile equipment, any meteorological equipment, or other field instruments.

Central "GMC™" Server is built from standard Personal Computer (PC) components. Its software runs "Microsoft Windows 2000" operating system and has three basic functions:

- Data collection and control system
- Database
- "WEB" presentation.

2.1.1. Data collection and control system

This function of Central Server "GMC™" relates to the data collection from RWIS field stations and at the same time controls the system. Several processes are performed in parallel under the "Microsoft Windows NT/2000"¹ operating system to provide both data collection and management of RWIS field equipment. These processes are monitored continuously and automatically restart due to errors.

¹ Windows NT/2000 is an operating system for use on both client and server computers.

2.1.2. Database

The database uses the “Microsoft SQL Server 2000²” software. The Central “GMCTM” Server uses standard communication method for a database that allows the use of other databases if requested.

2.1.3. Web presentation

The software for “WEB” presentation was developed in the “Java³” and “ASP” programming language. This solution allows for easy distribution of data to clients whereby customers do not need application software since they use “Java” compatible “Web Browser”. The system can contain Geographic Information System (“GIS”).

2.2. **RWIS field monitoring stations GMSTM**

The main monitoring station (RWIS field station “GMSTM”) contains industrial computer that uses “real-time” operating system (“Boot ROM”, “RTXC io model - RTXC file”, “application (process)”) to collect data from sensors mounted on the truss. The station is made of high quality components and is tested to withstand temperatures of -40 to +50 °C and has no movable parts. The “GMSTM” field station can manage any type of sensors communicating with them using analog, digital and serial interface. The “GMSTM” field station has fifteen (15) analog “input” and fifteen (15) digital “input / output” devices, the six high performance counters and nine (9) serial ports. These “I/O” channels may be configured to collect meteorological data, traffic monitoring, and/or for other environmental monitoring purpose.

More technical details about existing 9 (nine) RWIS field stations “GMSTM” located in Mačva, Kolubara and Belgrade in Serbia are enclosed in Appendix 1.

2.3. **Communication system**

The current communication system is through GSM modems but, depending on the capabilities of mobile telephony providers, GPRS or 3G⁴ modems may also be used.

3. **The Main Goal and Subject of the Contract**

3.1. **The Main Goal**

The main goal of the system tendered under this Contract is to enable the competent national institution (Public Enterprise “Roads of Serbia”) in collecting, updating and processing road weather information data from the Road Weather Stations (RWSs) in real time. Its purpose is to provide various services for different end-users for the planning and management of winter road maintenance through secure access to a common database serving a network of existing and new RWSs located in different parts of the country.

Relating to this tender, this goal shall be fulfilled by the acquisition of Road Weather Stations (RWSs), telecommunication equipment and Central Server with installed, configured and tested software for collection, processing and presentation (numerical and graphical) of road weather information data.

Required RWIS equipment and software must provide full compatibility with the existing RWIS in PERS and enable using previous (historical) and current data from the existing as well as from the new Road Weather Stations (RWSs).

² Microsoft SQL Server is a relational data base management system developed by Microsoft.

³ Java is a programming language expressly designed for use in the distributed environment of the Internet.

⁴ 3G, short for third Generation, is the third generation of mobile telecommunications technology.

3.2. The Subject

The subject of the Contract is the supply, delivery, installation, putting into operation, testing, training and warranty services by the Contractor (Supplier) of the specified supplies and services for the End Recipient (PE "Roads of Serbia", Bulevar kralja Aleksandra 282, PO box 17, 11050 Beograd 22).

The required supplies, software and training consist of:

- Delivery of Road Weather Stations (RWSs) their on-site assembly and installation on the field (Project locations);
- Supply and installation of a Central Server for communication with the (existing and new) RWSs and presentation of data on road-weather conditions;
- Supply and configuration of communication equipment for transfer of data;
- Supply of software for collection, processing and presentation of data from RWS (operating system, data base, software for data collecting, software for data processing and presentation);
- Training for PERS's staff in operating with required supplies and software.

The Contractor should supply the following equipment, software and training in accordance to specified Technical Specifications (Annex II.B Technical Specifications + Technical Offer):

| No. | Item | Unit | Qty | Location* |
|-----|--|------|-----|----------------------------------|
| 1. | RWIS Field station kit | Pcs | 18 | Kruševac, Niš, Vranje |
| 2. | RWS Air temperature and humidity kit | Pcs | 18 | Kruševac, Niš, Vranje |
| 3. | RWS Road surface temperature kit | Pcs | 26 | Kruševac, Niš, Vranje |
| 4. | RWS Precipitation kit | Pcs | 18 | Kruševac, Niš, Vranje |
| 5. | RWS Wind sensor kit | Pcs | 18 | Kruševac, Niš, Vranje |
| 6. | RWIS Central monitoring system kit | Pcs | 1 | Belgrade/PERS |
| 7. | RWS Pole for field station kit (including mounting of sensors and equipment) | Pcs | 18 | Kruševac, Niš, Vranje |
| 8. | RWIS Cellular modem kit | Pcs | 18 | Kruševac, Niš, Vranje |
| 9. | RWIS Conversion kit for existing stations (GMS stations in Mačva, Kolubara and Belgrade) | Pcs | 9 | Mačva, Kolubara, Belgrade |
| 10. | Installation of RWIS equipment and related software | Sum | 1 | Belgrade / Kruševac, Niš, Vranje |
| 11. | Training | Sum | 1 | Belgrade / Kruševac, Niš, Vranje |

* See: Appendix No.2 for particular locations

The End Recipient and therefore the delivery address for all supplies and services required in this tender are:

- Delivery and installation of Server and related communication and application software:

Public Enterprise "Roads of Serbia"
Sector for Traffic Control Information Systems (ITS Department)
Brodarska bb
11000 Beograd,
Republic of Serbia

- Delivery and installation of RWSs and related communication and application software:

Project locations (18) on the national road network (for delivery and installation of new RWSs) and existing locations (6) (for delivery and upgrading of existing RWSs – Mačva and Kolubara) and existing locations (3) (for delivery and upgrading of existing RWSs –Belgrade) (See Appendix 2 – List of RWIS locations).

For the purpose of offer preparation Contractor can consider **the average project location for installation/upgrade of all RWSs (27) is approx. 250 km from Belgrade** (See Appendix 2 - List of RWIS locations).

End Recipient (PERS) will provide the following Works and prerequisites:

- **Civil Engineering Works** at the different locations for the installation of the RWIS field stations (foundation, installation of metal pole, fencing/security protection, depending on location) in accordance to the detailed instructions (design) of the Contractor (Supplier);
- **Infrastructure pre-conditions** at the different locations for the installation of the RWIS (power supply, pavement, existence of GSM/GPRS/2G/3G/etc. network or PTT line, depending on location) in accordance to the detailed instructions (design) of the Contractor (Supplier);
- **Communication pre-conditions** (functional communication line via GSM/GPRS/3G/etc., preferably though VPN, Internet or company LAN, Frame Relay⁵ between GPRS router and LAN Server or equivalent);
- **Permits required for the installation** in accordance with the Serbian legislation.

3.3. General Description of Contract Items

3.3.1. Item No. 1 - RWIS Field station kit

RWIS field station is built around a rugged custom designed field computer with a real time operating system with communication over serial line, modem, radio, cellular etc.

RWIS field station shall include sensors and equipment for recording of the following properties:

- air temperature and humidity
- road surface temperature
- precipitation (intensity, type and accumulated amount, visibility in precipitation)
- wind speed and direction
- additional properties (sensors) for future expansion, not less than 2 (two).

The data shall be collected via modem or other suitable data communication system, to one or more centres where the information is processed, stored and displayed.

The RWIS field station kit shall be enclosed in a rugged weatherproof box and sealed to protect the unit from wind, dust and airborne particles, and exposure to moisture.

RWIS field station is configured, but not limited to, with:

- Stainless steel weather-proof box with double wall
- Rack
- Power supply (AC 220 V / 50Hz) and appropriate Solar panel
- Connection board
- Carrier (Mother) board

⁵ Frame Relay is a standardized wide area network technology that specifies the physical and logical link layers of digital telecommunications channels using a packet switching methodology. Originally designed for transport across Integrated Services Digital Network (ISDN) infrastructure.

- Other future sensors (compatibility).

Standard: CE Certification⁶.

The system should facilitate modification and update of the software remotely.

The data transmitted by the sensors and equipment should be first stored locally in the field station and then should be collected or sent via the chosen communication link (wireless, through GSM/GPRS/2G/3G/etc. or equivalent) to the Central Server(s). The data collection interval shall be adjustable but the station should be able to store at least 1 week of data between uploads.

Each station is required to have a back-up power supply for autonomous operation in case of mains power failure over at least an 24 hour period.

The carrier (mother) board shall be a field sensor platform/logger for rough and remote outdoor environments. It has to include cabling and mounting equipment.

3.3.2. Item No. 2 - RWS Air temperature and humidity kit

RWS air temperature and humidity kit shall provide reliable humidity and temperature measurement. The kit shall have measurements stability and withstand a well harsh environment.

The probe structure shall be solid and the enable maximum protection against liquid water, dust and dirt.

Standard: CE Certification.

It has to include cabling and mounting equipment.

3.3.3. Item No. 3 - RWS Road surface temperature kit

RWS road surface sensors shall be made by high quality and resistant material suitable for the measurement of road surface temperature. It shall guarantee high thermal and mechanical resistance for durability.

Standard: CE Certification.

It has to include cabling and mounting equipment.

3.3.4. Item No. 4 - RWS Precipitation kit

The RWS Precipitation kit shall serve for transmitting measured values and shall be well suited for measurement and detection of different types of precipitation such as drizzle, rain, hail, snow and mixed precipitation.

The acquisition shall comprise the types of precipitation, intensity and the spectrum. All measuring values shall be available for the user via appropriate interface.

Standard: CE Certification.

It has to include cabling and mounting equipment.

⁶ CE Marking on a product is a manufacturer's declaration that the product complies with the essential requirements of the relevant European health, safety and environmental protection legislation.

3.3.5. Item No. 5 - RWS Wind sensor kit

The RWS wind sensor kit shall serve for precise and maintenance free measurement of wind velocity (anemometer) and wind direction (wind vane).

Standard: CE Certification.

It has to include cabling and mounting equipment.

3.3.6. Item No. 6 - RWIS Central monitoring system kit

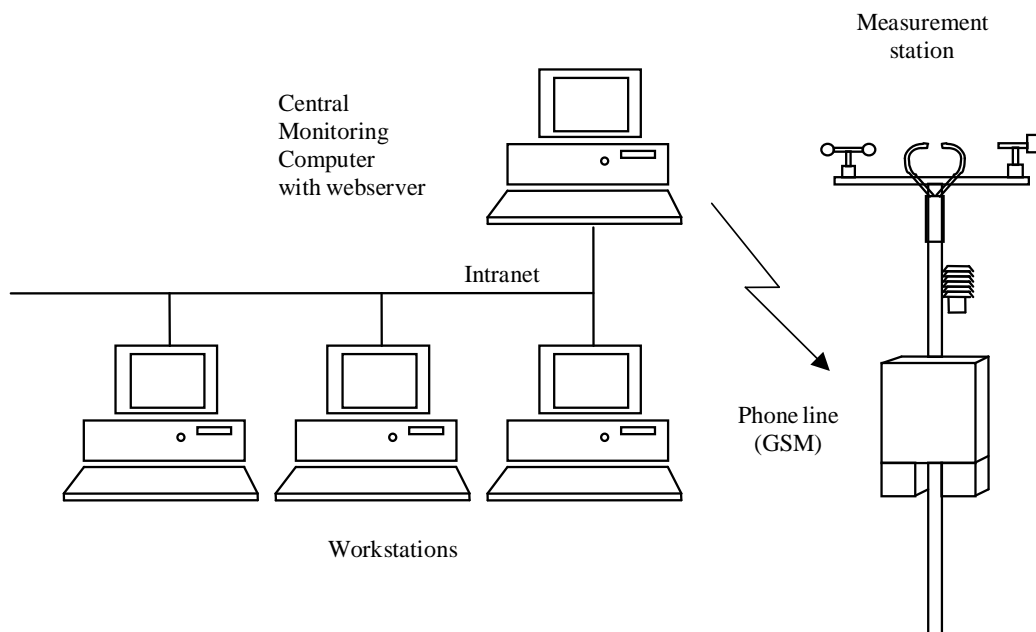
RWIS Central monitoring kit is a system for collection, storage and presentation of the data from the field monitoring stations (RWSs).

RWIS Central monitoring system kit shall collect, store, process and present (numerically and graphically) data from the new RWSs (18) and from the existing RWSs (9) in Mačva, Kolubara and Belgrade.

The new system may run Microsoft Windows Server 2012 R2 SA or equivalent and shall collect data at regular intervals from the field stations and shall store the data into a database.

The RWIS Central monitoring system kit shall consist of, but not be limited to:

- Central Monitoring Computer (Server) with Web Server
- Modem(s) for calling the RWSs
- Microsoft Windows Server 2012 R2 SA or equivalent software
- Microsoft SQL Server 2014 SA or equivalent software
- Central Server software for collection, storage and presentation of data from RWSs



RWIS Central monitoring system overview (Source: PERS ITS Dept.)

The new Central Monitoring Computer may run on a Microsoft Windows Server 2012 R2 SA system operating software or equivalent. The Server system software shall have a web server running to allow users to connect to the Central Monitoring Computer over a network, which can be either an Intranet or the Internet. The Central Monitoring Computer should be equipped with modem(s) or equivalent system for communication with field stations.

Data Collection and Transfer

The data should be transferred from the field stations with a modem or equivalent system. The existing Central Monitoring Computer calls each station in predetermined intervals and asks for current data. The new system shall collect data from the new eighteen (18) RWSs and from the existing nine (9) RWSs in Mačva, Kolubara and Belgrade.

Data Storage

The collected data should be stored in a Microsoft SQL Server 2014 SA , or equivalent software. The system shall store data from the new eighteen (18) RWSs and from the existing nine (9) RWSs in Mačva, Kolubara and Belgrade. The supplier must perform data migration from existing database system (Microsoft SQL Server 2000⁷) to new database.

Data Presentation

The data shall be presented to the user either in a standalone application or in a web application through secure public communication networks.

The supported browsers should be Microsoft Internet Explorer (version 5 or later), Mozilla Firefox (version 3 or later) or equivalent common browsers. The software shall present data (numerically and graphically) from the new eighteen (18) RWSs and from the existing nine (9) RWSs in Mačva, Kolubara and Belgrade.

The Central Server software for data collection, storage and presentation shall enable, but not be limited to:

- Collect, store and present (numerically and graphically) actual data from the new RWSs (18) and from the existing RWSs (9) in the real-time;
- Store data for at least a 3 year period with back-up functionality;
- Use historical data from the existing RWSs (9);
- Basic graphical presentation of RWSs geographical locations on the road network of the Republic of Serbia (new and existing RWSs) on background mapping showing topographic details, natural features, land use, towns and villages, bridges, road maintenance depots and critical locations;
- To show the latest data from a user-specified grouping of stations simultaneously;
- To view data from a specific station. The user can select the station either from the list or directly from the digital map;
- To see the latest data (values) from the latest call of the selected station. The values shall be updated automatically at regular adjustable intervals.
- Warning messages according to user-specified weather-event criteria.
- To view history data over a user specified time interval. The user shall be able to get all values either one value per hour or one value per day. The history data shall be presented both in text and graphical format.
- To monitor the values from the stations. When some values on a specific station reach a critical level, the system shall launch an alarm for that station.
- To see all latest data from all stations in a summarized form.
- To edit and print text and graphical reports.
- To export data in different formats.

RWIS Central monitoring system (hardware+ software) must be able to handle up to 100 field stations or more.

3.3.7. Item No. 7 - RWS Pole for field station kit (including only mounting of sensors and equipment)

Stabile RWS Pole (or truss) for field station kit shall be made from quality metal material (stainless steel) capable to hold required RWS field station kit and sensors. It has to include mounting of only sensors and equipment as described in the previous chapter 3.2, excluding the civil works, infrastructure and communications pre-conditions and permits that will be provided by the End Recipient (PERS).

It has to include cabling and mounting equipment (where applicable).

⁷ Microsoft SQL Server is a relational data base management system developed by Microsoft.

The obligation of tenderer is to submit offers with detailed view of the foundation metal Pole, its installation as well as its technical details.

3.3.8. Item No. 8 - RWS Cellular modem kit

RWS Cellular modem kit shall serve for establishing a connection between new RWSs (18) and Central Monitoring Computer (Server). Data transfer shall be enabled via GSM/GPRS/2G/3G/etc. network or modem kit (where GSM/GPRS/3G/etc. network is not accessible) or equivalent system.

Electromagnetic compatibility (EMC): Complies with the EMC standard EN61000-6-1:4, Immunity & Residual environments.

Safety: EN 60950, IT equipment.

Standard: CE Certification.

It has to include cabling and mounting equipment (where applicable).

3.3.9. Item No. 9 - RWS Conversion kit for the existing stations

RWS Conversion kit for the existing stations shall consist of a plug compatible CPU card or equivalent system for conversion of data from the format of existing RWSs (9) installed in Mačva, Kolubara and Belgrade to the format of new RWSs (18).

For the existing station, the tenderer should offer the interface - data logger, that can connect existing sensors within Central monitoring system that meet the requirements of EU directives (EN 15518 to 1.2 3: 2013). The tenderer is obliged to submit data format with a data logger, data model in which data is sent from the data logger to a central location and to allow full compatibility of data formats with MPS subject to the tender with the new database PMS. In the area of the platform on which is implemented databases and database applications, it is necessary to use the latest solutions for software management platform.

Standard: CE Certification.

It has to include cabling and mounting equipment (where applicable).

3.3.10. Item No. 10 - Installation of RWIS equipment and related software

All RWIS equipment, Central server and related software shall be installed, activated and tested as well as the operating system, the communication software and the application software. They shall be activated and registered to the End Recipient, in "ready to use" condition.

3.3.11. Item No. 11 - Training

The Contractor shall provide training to future PERS's trainers and nominated staff, before obtaining provisional acceptance. The training shall be conducted in the End Recipient's facilities, in Belgrade and at the field locations in Kruševac, Niš and Vranje.

The Contractor shall submit the training program for the End Recipient approval within 1 month after Contract signature.

The training plan should contain minimum the following information:

- CVs for the trainers (minimum 5 years' experience)
- Structure of the training sessions
- Training period
- Course duration

- Place of training
- Manual/Instructions list which will be used for training
- Training implementation plan.

The Manuals and Instructions used for training shall be audio-video tutorials, flipcharts and printed courses.

The Contractor must evaluate the transferred knowledge of all participating personnel after the completion of training courses.

The training materials must be in Serbian language (in case of English speaking lecturer simultaneous translation must be provided by Contractor / Supplier).

Factory Acceptance Test (FAT) may be performed for some items by the End Recipient (PERS).

4. Technical requirements

4.1. General

All equipment shall be provided complete with the necessary accessories and/or parts in order to ensure that the unit/system is capable of operating according to the required technical and quality specifications.

All specifications listed for each specified item are the minimum requirements. Any improvements on the specifications or additional features offered should be clearly identified in the Contractor's offer.

4.2. Technical Standards

Road Weather Information System and related components should be in compliance with the following technical standards regarding the specific properties listed under section 4.6 and Annex II.B Technical Specifications + Technical Offer:

- SRPS EN 15518-1:2013 (identical with EN 15518-1:2011 CEN/TC 337), Winter maintenance equipment - Road weather information systems - Part 1: Global definitions and components.
- SRPS EN 15518-2:2013 (identical with EN 15518-2:2011 CEN/TC 337), Winter maintenance equipment - Road weather information systems - Part 2: Road weather - Recommended observation and forecast.
- SRPS EN 15518-3:2013 (identical with EN 15518-3:2011 CEN/TC 337), Winter maintenance equipment - Road weather information systems - Part 3: Requirements on measured values of stationary equipment.

Notwithstanding the above, components should also comply with the EU Electromagnetic Compatibility Directive (EMC 2014/30/EU) and the Low Voltage Directive (2006/95/EC, to be replaced by forthcoming LVD Directive 2014/35/EU).

4.3. Power

Supply PMS implemented through public low-voltage distribution network 220V (single-phase) and 380 V AC (three-phase) with neutral, 50 Hz nominal and with renewable power sources (eg., solar panels). In the event of termination of constant power supply, it is necessary to plan an uninterruptible power supply (UPS) or battery power (with solar panels) to allow the autonomy of at least 24 hours in case of power failure or lack of supplement supply by solar panels. Installing PMS should publish alarm, which is read at a central location - locations if an interruption occurs or the power supply voltage drop greater than 15% of the declared value with a nominal voltage of electricity, the power variant with solar panels.

4.4. Environmental

4.4.1. In-door units

In this tender all equipment shall be capable of operating under following temperature, humidity and protection level (as defined in EN 60529): operating temperature: between 10⁰ C and 40⁰ C; relative humidity (non-condensing): RH: 20% - 80%.

4.4.2. Out-door units

Operational temperature for out-door units shall be in accordance with EN 15518-3:2013 standard. Cabinets shall have double walls.

4.5. Safety

All equipment shall have necessary warnings and interlocks on the modules operating/generating more than 30 Volts AC or DC, in accordance with current IEC and EU standards. The Contractor is responsible for advising of any Health and Safety (H&S) risks associated with equipment provided and of suitable protective measures.

4.6. Equipment

4.6.1. General requirements

The items to be provided should not be hybrids, but designed as a unit and shall have a registered brand name. Due to the variety of equipment comprising the required system/s, interoperability/ compatibility requirements shall be strictly observed to ensure the delivery of a turn-key system.

Equipment allowing capacity upgrading must be provided in a way that upgrades can be performed by installing additional capacity, without discarding the already installed capacities.

The Contractor shall furnish, install and commission all equipment, fixings and fittings, including final installation and connection and all miscellaneous items of equipment, fixings and fittings in order that the supplies are left in place tested, fully operational and ready for use.

The Contractor must provide necessary measures to prevent any damage during delivery and installation stages. If damage occurs, it must be rectified in an appropriate way by the Contractor. The Contractor must keep the work site clean and safe against fire and/or other hazards during any/all delivery and installation stages until the provisional acceptance.

Equipment must conform and/or be compatible with standards, or with the commonly accepted best production practices currently in force, including any ISO, IEC or other relevant standards that may be applied to each specific category of equipment.

The Contractor must provide evidence of it, or the manufacturer's if the Contractor is not the manufacturer, current Quality Management System Certificate according to ISO 9001 or the equivalent national standards, for each equipment item or group of items.

The Contractor is required to demonstrate that offered specifications are responsive to the tender dossier requirements identifying model and manufacturer of each individual item in its technical offer and providing necessary documentation such as catalogues, brochures, manuals and/or booklets that provide detailed technical specifications of the offered equipment thus enabling the contracting authority to check the information provided in the offer.

If not specifically stated otherwise, or not stated at all, all equipment (where compatibility may be an issue) and application software must be compatible with Microsoft Windows 7 or equivalent and Microsoft Windows Server 2012 R2 SA server operating systems or equivalent.

All software that is delivered in this tender (such as operating system and application software) must be licensed to the End Recipient of this tender (**Public Enterprise “Roads of Serbia”, Belgrade, Republic of Serbia**) in order to allow the trained personnel of the End Recipient to perform software installation, update/upgrade and/or diagnosis/report activities without suppliers’ assistance in the future.

4.6.2. Thermal resistance

In accordance with EN 15518-3:2013 standard:

1. Sensors embedded in the pavement need to survive surface temperatures from – 40 °C to + 70 °C;
2. Equipment placed in the air need to survive air temperatures from – 40 °C to + 60 °C.

4.6.3. Chemical resistance

In accordance with EN 15518-3:2013 standard:

All components of the road and weather information system installed on the pavement shall be resistant to the thawing agents and fuels to which roads are normally exposed.

4.6.4. Mechanical resistance

In accordance with EN 15518-3:2013 standard:

Sensors and other components embedded in the pavement shall withstand regular mechanical loads exerted by traffic, including rollovers by snow-clearing machines.

4.6.5. Electro-magnetic resistance

In accordance with SRPS EN 15518-3:2013 standard and the Electromagnetic Compatibility Directive (EMC 2014/30/EU).

All components of the road and weather information system shall not be affected by conventional environing electro-magnetic conditions.

5. **Technical documents to be delivered during implementation period**

Each item set of equipment shall be provided with an original set of users’ manuals (printed and / or on a CD/DVD) for all parts of the equipment. These manuals shall be supplied in Serbian (where applicable) and English languages.

The following Manuals / Instructions have to be provided in Serbian language:

- Basic Operational and Maintenance Guide for new eighteen (18) Road Weather Stations;
- User Guide for Central Server software for collection, storage and presentation of data from RWSs.

The mandatory documents for the provisional acceptance:

- Original certificate of origin in compliance with Europe Aid rules;
- Warranty documents for each part (item) of delivered RWIS, signed and stamped by the manufacturer and/or the Contractor/Supplier;
- Warranty document for whole installed RWIS, signed and stamped by the Contractor/Supplier;
- Technical document (Certificate) for correct functionality of installed equipment and software;
- Declaration for fully functionality of Central Server application software for collection, storage and presentation data from RWIS field stations signed and stamped by the Software Developer.
- The Contractor/Supplier should prove that the equipment proposed is produced by a manufacturer who is accredited by ISO 9001 or an equivalent national standard.

No provisional acceptance can be pronounced without the presence of the complete set of documents.

6. Warranty

The Contractor/Supplier shall warrant that all delivered items as well as whole delivered RWIS shall be free of defects in materials and workmanship for a period of one (1) year after provisional acceptance.

The Contractor/Supplier shall ensure the availability on the market of the spare parts for a minimum period of seven (7) years from the contract signature date.

During the warranty period, the Contractor/Supplier shall provide customer service, with following maximum response times:

| | |
|--|--|
| Response time for request for intervention | up to 48 hrs |
| Response time for replacement of electronical elements (hardware, sensors, etc.) | up to 7 days from moment of reception of justified request for element replacement |
| Response time for intervention (upload or download) data or FW or MW or part of SW from RWS or Central Monitoring Computer | up to 24 hrs via remote control |

7. Visibility

The Contractor/Supplier should familiarize himself and comply with the objectives and priorities and guarantee the visibility of the EU financing (see the Communication and Visibility Manual for EU external actions specified and published by the European Commission at http://ec.europa.eu/europeaid/work/visibility/index_en.htm).

All equipment must have a durable self-adhesive label with EU Visibility Logo.

The Contractor/Supplier shall produce a draft of the layout and submit it for approval by the Contracting Authority prior to production/delivery. The Contracting Authority shall advise the successful bidder on the exact dimension, layout, colour regime and wording/symbols of these self-adhesive stickers upon Contract signature.

Annex II.B Technical Specifications + Technical Offer**Contract title: Supply of Road Weather Information Systems (RWIS) equipment, software and training****Publication reference: EuropeAid/137118/IH/SUP/RS**

| 1. Item Number | 2. Specifications | 3. Specifications Offered | 4. Notes, remarks, ref to documentation | 5. Evaluation Committee's notes |
|----------------------|--|---------------------------------|---|--|
| 1. | Item name: RWIS Field station kit | | | |
| | a) <u>General</u> <ul style="list-style-type: none">• RWIS field station is configured, but not limited with:<ul style="list-style-type: none">- Stainless steel weather-proof (double wall) box- Rack- Power supply (AC 220 V / 50Hz)- appropriate Solar panel- Back-up power supply (24hrs)- Connection board- Carrier (Mother) board- Other future sensors (compatibility)• Operating temperature range (EN 15518-3:2011): -40 ... +60 °C.• Enables data collection via modem or other suitable data communication to centre(s)• Minimum 1 week data storage capacity• Adjustable interval for data collection• Enables future integration of sensors (not less than two) and communication solutions• Software can be modified and updated remotely• Standard: CE Certification | | | |
| | b) <u>Additional</u> <ul style="list-style-type: none">• Cabling and mounting kit | | | |

| 1. Item Number | 2. Specifications | 3. Specifications Offered | 4. Notes, remarks, ref to documentation | 5. Evaluation Committee's notes |
|----------------------|--|------------------------------|---|--|
| 2. | Item name: RWS Air temperature and humidity kit | | | |
| | a) <u>General</u> <ul style="list-style-type: none"> • Operating temperature range (EN 15518-3:2011): -40 ... +60 °C • Electromagnetic compatibility (EMC): Complies with the EMC standard EN61326-1: "Electrical equipment for measurement control and laboratory use" • USB connection for service use • Standard: CE Certification • Cabling and mounting kit | | | |
| | b) <u>Relative humidity</u> <ul style="list-style-type: none"> • In accordance with EN 15518-3:2011 that requires: <ul style="list-style-type: none"> - Measuring range: at least between 30 % and 100 % RH - Resolution: 1% - Accuracy at: <ul style="list-style-type: none"> ±3 %, (85 ... 100 % RH) ±5 %, otherwise | | | |
| | c) <u>Air temperature</u> <ul style="list-style-type: none"> • In accordance with EN 15518-3:2011 that requires: <ul style="list-style-type: none"> - Measurement range: -40 ... +60 °C - Resolution: 0.1 °C - Accuracy: ± 0.1°C between – 10°C and + 10°C ± 0.5 °C otherwise | | | |

| 1. Item Number | 2. Specifications | 3. Specifications Offered | 4. Notes, remarks, ref to documentation | 5. Evaluation Committee's notes |
|----------------------|---|------------------------------|---|--|
| | <p>d) <u>Dew-point temperature (calculated)</u></p> <ul style="list-style-type: none"> • In accordance with EN 15518-3:2011 that requires: <ul style="list-style-type: none"> - Measuring range: between – 10 °C and + 10 °C and relative humidity > 85% - Resolution: 0.1 °C - Accuracy: ± 1.5 °C <hr/> <p>e) <u>Additional</u></p> <ul style="list-style-type: none"> • Cabling and mounting kit | | | |
| 3. | <p>Item name: Road surface temperature kit</p> <hr/> <p>a) <u>General</u></p> <ul style="list-style-type: none"> • In accordance with EN 15518-3:2011 that requires: <ul style="list-style-type: none"> - To survive at surface temperatures from – 40 °C to + 70 °C - Measuring range: – 30 °C to + 60 °C - Resolution: 0.1 °C - Accuracy: – 15 °C to +10 °C, (± 0.2 °C) – 30 °C to –15 °C, (± 0.8 °C) and + 10 °C to +60 °C, (± 0.8 °C) • Standard: CE Certification <hr/> <p>b) <u>Additional</u></p> <ul style="list-style-type: none"> • Cabling and mounting kit | | | |

| 1. Item Number | 2. Specifications | 3. Specifications Offered | 4. Notes, remarks, ref to documentation | 5. Evaluation Committee's notes |
|----------------------|--|------------------------------|---|--|
| 4. | Item name: RWS Precipitation kit | | | |
| | a) <u>General</u> <ul style="list-style-type: none"> Operating temperature range (EN 15518-3:2011): -40 ... +60 °C Altitude: operational range from 0 to 1,500 m asl as minimum Standard: CE Certification | | | |
| | b) <u>Precipitation detection time and type</u> <ul style="list-style-type: none"> In accordance with EN 15518-3:2011 that requires: <ul style="list-style-type: none"> The following precipitation have to be detected in the following time: <ul style="list-style-type: none"> 2 min: $\geq 1,2$ mm/h 6 min: $\geq 0,4$ mm/h 10 min: $\geq 0,1$ mm/h Precipitation type: Distinction between solid and liquid precipitation with 80 % confidence within the above precipitation detection time. | | | |
| | c) <u>Precipitation intensity</u> <ul style="list-style-type: none"> In accordance with EN 15518-3:2011 that requires: <ul style="list-style-type: none"> Measuring range: between 0.1 mm/h and 200 mm/h Resolution: 0.1 mm/h Accuracy: <ul style="list-style-type: none"> ± 30 % of measured value between 0.1 mm/h and 0.5 mm/h ± 20 % of measured value between 0.5 mm/h and 5 mm/h ± 40 % of measured value above 5 mm/h | | | |

| 1. Item Number | 2. Specifications | 3. Specifications Offered | 4. Notes, remarks, ref to documentation | 5. Evaluation Committee's notes |
|----------------------|--|------------------------------|---|--|
| | <p>d) <u>Visibility at precipitation</u></p> <ul style="list-style-type: none"> • In accordance with EN 15518-3:2011 that requires: <ul style="list-style-type: none"> - Measuring range: 10 m to 500 m - Resolution: 10 m - Accuracy: ± 10 m or ± 20 % of measured value, whichever is greater. | | | |
| | <p>e) <u>Additional</u></p> <ul style="list-style-type: none"> • Cabling and mounting kit | | | |

| 1. Item Number | 2. Specifications | 3. Specifications Offered | 4. Notes, remarks, ref to documentation | 5. Evaluation Committee's notes |
|----------------------|---|------------------------------|---|--|
| 5. | Item name: RWS Wind sensor kit (direction and speed) | | | |
| | a) <u>General</u> <ul style="list-style-type: none"> • Operating temperature range (EN 15518-3:2011): -40 ... +60 °C • SI Units (m/s; km/h) • Standard: CE Certification | | | |
| | b) <u>Wind direction</u> <ul style="list-style-type: none"> • In accordance with EN 15518-3:2011 that requires: <ul style="list-style-type: none"> - Measuring range: 0...359° - Resolution : 0.1° - Accuracy: ±10° - Starting value: < 1 m/s at an initial deflection of 90° - The wind direction shall be specified as an average vector over a sliding time interval of 10 min. | | | |
| | c) <u>Wind speed</u> <ul style="list-style-type: none"> • In accordance with EN 15518-3:2011 that requires: <ul style="list-style-type: none"> - Measuring range: at least between 0 m/s and 35 m/s - Resolution : 0.1m/s - Accuracy: ± 1 m/s between 1 m/s and 10 m/s ± 10 % of measured value otherwise - Starting value: < 1 m/s | | | |
| | d) <u>Additional</u> <ul style="list-style-type: none"> • Cabling and mounting kit | | | |

| 1. Item Number | 2. Specifications | 3. Specifications Offered | 4. Notes, remarks, ref to documentation | 5. Evaluation Committee's notes |
|----------------------|---|------------------------------|---|--|
| 6. | <p>Item name: RWIS Central monitoring system kit</p> <p>a) General</p> <ul style="list-style-type: none"> • RWIS Central monitoring system (hardware+ software) must be able to handle up to 100 field stations or more. <p>b) Central Monitoring Computer (Server)</p> <ul style="list-style-type: none"> • Processor : minimum 2.40GHz/8-core/20MB or equivalent • Memory : minimum 16GB (1x16GB Registered DIMMs, 2133 MHz) • Connectivity : minimum Embedded 1Gb Ethernet 4-port 331i Adapter • minimum 2,5'' HDD or SSD 1 TB - 4 psc • minimum 1 U • Power consumption minimum 500 W • SW & LICENCES • Microsoft Windows Server 2012 R2 SA or equivalent • Microsoft SQL Server 2014 SA , or equivalent <ul style="list-style-type: none"> ✓ NOTE licences for 8 core e.g. for recherche processor: ✓ 6 CAL for both app; ✓ consider 'Umbrella Agreement ' between Microsoft and Government of Republic of Serbia. ✓ Producer Microsoft declares technical support for recherche products till 2023. | | | |

| 1. Item Number | 2. Specifications | 3. Specifications Offered | 4. Notes, remarks, ref to documentation | 5. Evaluation Committee's notes |
|----------------------|---|------------------------------|---|--|
| | <p><u>c) Central Server Software for RWS data collection, storage and presentation</u></p> <p><u>The software shall enable, but not limited to:</u></p> <ul style="list-style-type: none"> • Collect, store and present (numerically and graphically) actual data from the new RWSs (18) and from the existing RWSs (9) in the real-time; • Store data for at least a 3 year period with back-up functionality; • Use historical data from the existing RWSs (9). (Refer to subsection 3.3.6 for general description); • Basic graphical presentation of RWSs geographical locations on the road network of the Republic of Serbia (new and existing RWSs) on background mapping showing topographic details, natural features, land use, towns and villages, bridges, road maintenance depots and critical locations; • To show the latest data from all stations at the same time; • To view data from a specific station. The user can select the station either from the list or directly from the digital map; • To see the latest data (values) from the latest call of the selected station. The values shall be updated automatically at regular adjustable intervals; • Warning messages according to user-specified 'event' criteria; • To view history data between user-specified time intervals. The user shall be able to get all values either one value per hour or one value per day. The | | | |

| 1. Item Number | 2. Specifications | 3. Specifications Offered | 4. Notes, remarks, ref to documentation | 5. Evaluation Committee's notes |
|----------------------|--|------------------------------|---|--|
| | <p>history data shall be presented either in text or graphical format;</p> <ul style="list-style-type: none"> • To monitor the values from the stations. When some values on a specific station reach critical level, the system shall launch an alarm for that station; • To see all latest data from all stations in a summarized form; • To edit and print text and graphical reports; • To export data in different formats. | | | |
| 7. | <p>Item name: RWS Pole for field station kit (including only mounting of sensors and equipment)</p> <p>a) <u>General</u></p> <ul style="list-style-type: none"> • Construction: stainless steel post or truss • Capable to hold required field station kit (Item No.1) and required sensors (Items No. 2-5) <p>b) <u>Additional</u></p> <ul style="list-style-type: none"> • Cabling and mounting kit (where applicable) | | | |

| 1. Item Number | 2. Specifications | 3. Specifications Offered | 4. Notes, remarks, ref to documentation | 5. Evaluation Committee's notes |
|----------------------|--|------------------------------|---|--|
| 8. | Item name: RWS Cellular modem kit | | | |
| | a) <u>General</u> <ul style="list-style-type: none"> • Operating, storage and transport range: -40...+60°C • Mobile/Cellular Technology: GSM/GPRS/2G/3G or equivalent. • Electromagnetic compatibility (EMC): Complies with the EMC standard EN61000-6-1:4, Immunity & Residual environments • Safety: EN 60950, IT equipment. • Standard: CE Certification. | | | |
| | b) <u>Additional</u> <ul style="list-style-type: none"> • Include cabling and mounting kit (where applicable) | | | |
| 9. | Item name: RWS Conversion kit for the existing field stations | | | |
| | a) <u>General</u> <ul style="list-style-type: none"> • Plug compatible CPU card or equivalent; • Operating, storage and transport range: -40...+60°C; • Enables conversion of data from the format of existing RWSs (9) installed in Mačva, Kolubara and Belgrade to the format of new RWSs (18): • Standard: CE Certification. | | | |

| 1. Item Number | 2. Specifications | 3. Specifications Offered | 4. Notes, remarks, ref to documentation | 5. Evaluation Committee's notes |
|----------------------|---|------------------------------|---|--|
| | b) <u>Additional</u> <ul style="list-style-type: none"> • Include cabling and mounting equipment (where applicable) | | | |

| 1. Item Number | 2. Specifications | 3. Specifications Offered | 4. Notes, remarks, ref to documentation | 5. Evaluation Committee's notes |
|----------------------|--|------------------------------|---|--|
| 10. | Item name: Installation of RWIS equipment and related software | | | |
| | a) <u>General</u> <ul style="list-style-type: none"> • All RWIS equipment, server and software installed and activated as well as the operating system, the communication software and the application software. They shall be activated and registered to the End Recipient, in “<i>ready to use</i>” condition. The installation shall include (for Items No. 1-9 above): • Installation, activation and testing of new eighteen (18) RWSs; • Installation, activation and testing of conversion kits at the existing nine (9) RWSs; • Installation, activation and testing of Central monitoring system. | | | |
| | b) <u>Additional</u> <ul style="list-style-type: none"> • Include cabling and mounting equipment (where applicable). | | | |

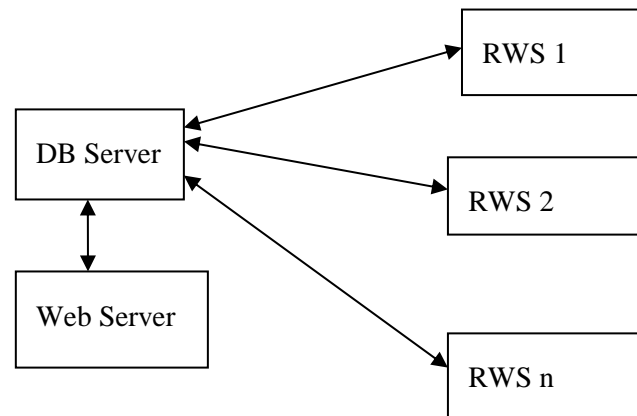
| 1. Item Number | 2. Specifications | 3. Specifications Offered | 4. Notes, remarks, ref to documentation | 5. Evaluation Committee's notes |
|----------------------|---|------------------------------|---|--|
| 11. | Item name: Training | | | |
| | a) <u>Training for RWIS operation :</u> <ul style="list-style-type: none"> On-site (on minimum three field locations), on-job training, during the installation phase for minimum three (3) days in total of training for four (4) persons per location. (Refer to subsection: 3.3.11 for general description). | | | |
| | b) <u>Training for RWIS / Central Server communication software and presentation of road weather data:</u> <ul style="list-style-type: none"> On-site training (Belgrade/PERS), minimum three (3) days training for twenty (20) persons. (Refer to subsection: 3.3.11 for general description) | | | |

APPENDIX No. 1: DESCRIPTION OF EXISTING RWIS SYSTEM IN SERBIA MANAGED BY PERS

The existing RWIS system in Serbia has been in use since 2005, and up to date, its primary role has been to support winter road maintenance.

This system in its present configuration consists of six road weather stations equipped with sensor unit (measuring air temperature and pavement, wind, humidity and precipitation) and 3 server units:

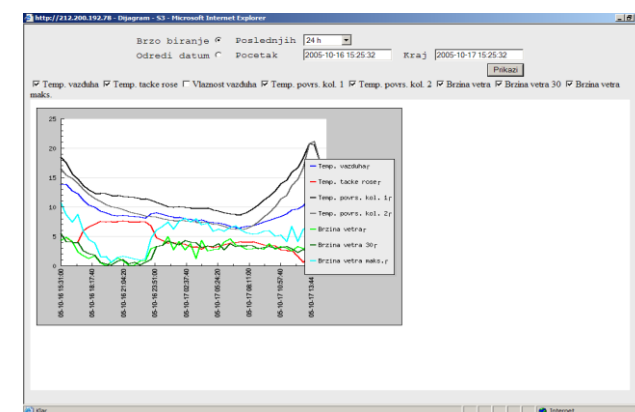
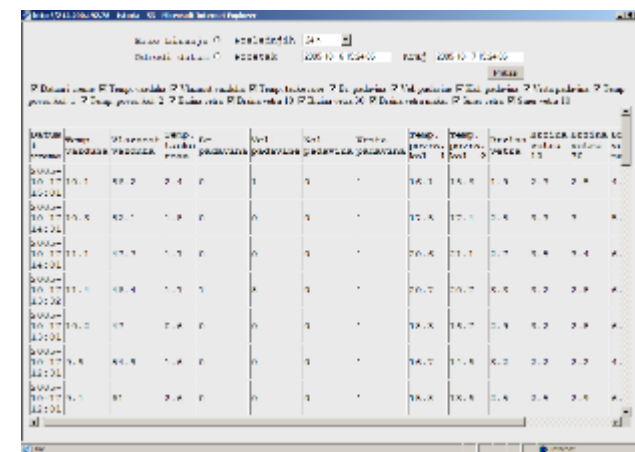
- Server for the collection and storage of data from weather stations ("Server database")
- Server for presentation of these data ("Web" server) and
- Server for processing of data for winter road maintenance ("Server for winter maintenance").



Simplified presentation of RWIS managed by PERS

Source: PERS ITS Department

Installed RWIS at Cerovac



Web presentation of road weather data

The system has no commercial purpose. Only PERS, road maintenance organizations within the territory and representatives of the Ministries of Interior, Emergency and Public Transport have access to the system.

GMS™

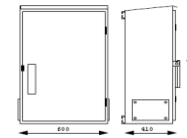
State of the art Monitoring Station

Advanced communications platform for

- Weather stations
- Camera systems
- Traffic monitoring
- Road / Runway status monitoring
- Variable message signs control
- End user embedded systems



Cabinets



GMS™ computer cabinet FFV GSH-6216

| Parameter | Specification | Parameter | Specification |
|-------------|-------------------------|--------------|--|
| Material | Stainless steel SS 2333 | Certificates | EN 50081, EN 50082 |
| Weight | 20 kg (approx) | Filters | Incoming power and signals |
| Power input | 230V AC | Protection | Fault current protection 30 mA on 230V user power output |

μ-GMS™ computer card cabinet FFV GSH-6820

| Parameter | Specification |
|-------------------|--|
| Material | Aluminum |
| Size | 250(height) x 170(width) x 110(depth) mm |
| Weight | |
| Power input | 24V AC or 24 V DC |
| Cable connection | 18 pin |
| Sensor connection | 4 holes |
| Misc | Room for up to 4 signal converters |

μ-GMS™ connection box FFV GSH-6830

| Parameter | Specification |
|--------------|--|
| Material | Aluminum |
| Size | 250(height) x 170(width) x 110(depth) mm |
| Weight | |
| Power input | 230V AC 6A (other source upon request) |
| Power output | 24V AC, 24V DC and 12V DC |
| Filters | 230V Voltage peak and interference, Telephone signal, incoming cables EN 50081, EN 50082 |
| Connections | 10 holes for sensor cables and power inlet |
| Misc | Room for modem, Signal converters etc |

Computer cards specification

Computer card hardware (GMS™ and μ-GMS™)

| Type | Amount/Size/Type | Specification |
|-------|-----------------------------|--|
| MCU | 1 | Motorola 68332, 16 MHz (up to 25 MHz on request) |
| ROM | 8.5 MB (μ-GMS) 4.5 MB (GMS) | Flash-ROM 4-8 MB ROM 0.5 MB |
| RAM | 4 MB (μ-GMS) 2 MB (GMS) | |
| RTC | 1 | Real Time Clock |
| Power | 1 | 12V 200 mA (μ-GMS) 5V 500 mA (GMS) |

Computer card software (GMS™ and μ-GMS™)

| Type | Specification |
|--|--|
| Real time, multiprocess operating system | RTOS |
| Watchdog | Supervises all processes functionality. Automatically reboots system if error detected |
| Remote update | Software can be remote updated |
| Object oriented design | Enables a structured construction of the system |
| File transfer | ASCII, Xmodem and Ymodem transfers |
| Optional logging | Stores information in Flash-ROM at specified intervals |

IO connections (GMS™ and μ-GMS™)

| Type | Number of channels | Specification |
|---------------------------------|------------------------|--|
| RS232 | 4 (μ-GMS) 8 (GMS) | Max 460 800 bps |
| Analogue input | 8 (μ-GMS) 16 (GMS) | 4-20 mA |
| Digital input | 16 (μ-GMS) 15 (GMS) | 12V |
| Digital output | 8 | 12V |
| High performance counters (TFU) | 6 | Frequency up to 2 ¹⁹ Hz, Pulse width, period time etc |

IO configuration (GMS™ and μ-GMS™)

| Type | Channel number | Configuration |
|---------------|----------------|---|
| RS232 | 1 | System communication channel. Software support for modem communication, ordinary or GSM (Siemens M20, TC35, Ericsson) |
| RS232 | 2 | System communication channel. Direct RS232 connection |
| Analogue | 1 | Air temperature sensor |
| Analogue | 2 | Air humidity sensor |
| Analogue | 3 | Pressure |
| Digital input | 1-6 | Wind direction sensor |
| Digital input | 7-9 | OpticEye precipitation sensor status (internally connected) |
| Counter | 1 | Wind speed sensor (WAA151) |
| Counter | 2 | OpticEye precipitation sensor (internally connected) |

Standard weather station sensors

Performance and accuracy specified in output data from GMS™



OpticEye™ standalone precipitation sensor FFV GSH-5031

| Parameter | Specification | Parameter | Specification |
|-------------------|--|-------------|--|
| Material | Aluminum | Input data | Air temp, humidity, wind speed (internally retrieved from computer card) |
| Size | 530 x 330 x 330 mm (μ-GMS) | Output data | Classification in rain, snow, sleet, snow drift |
| Weight | Approximately 3 kg | | Intensity for rain in mm/h <± 10% |
| Power need | 24V AC/DC (from connector box) | | Intensity for snow in mm/h snow depth <± 30% |
| Power consumption | 10-25 W (depends on environment temperature) | | Intensity for other types are in mm/h <±50% |
| Heating | Yes | Resolution | 0.1 mm/h |

Also available in version integrated with GMS: FFV GSH-5013



Wind sensors

| Parameter | FFVGS-6710 | FFVGS-5004 | FFVGS-5005 |
|-----------------------------|--|--------------|----------------------|
| | Anemometer | Wind vane | Anemometer |
| Measurement range | 0.5 ... 60 m/s | 0 ... 360 ° | 0 ... 360 ° |
| Performance (accuracy) | ± 0.3 m/s (< 10 m/s) < 2 % (> 10 m/s) | < ± 3° | ± 0.17 m/s < ± 3° |
| Threshold | < 1.0 m/s | < 1.0 m/s | < 0.5 m/s |
| Distance constant | 2 m | 2 m | < 0.4 m/s |
| Delay distance | | 0.6 | 0.4 m |
| Operating temperature range | 0 ... +55 °C | 0 ... +55 °C | -40 ... +55 °C |
| Dimensions (height x width) | 265 x 360 mm | 240 x 90 mm | 300 x 360 mm |
| Weight | 360 g | 570 g | 660 g |
| Heating | No | Yes | Yes |



Air Temperature and Humidity sensor FFVGS-6256

| Parameter | Temperature | Relative Humidity |
|------------------------|----------------|--|
| Range | -50 ... +50 °C | 0 ... 100 % |
| Performance (accuracy) | < ± 0.3 °C | ± 2 %, 0 ... 90 % ± 3 %, 90 ... 100 % |



Surface temperature sensor FFVGS-5003

| Parameter | Specification |
|------------------------|--|
| Type | RT100-43760 class A, with 20m cable |
| Range | -50 ... +50 °C (Other ranges upon request) |
| Performance (accuracy) | < ± 0.3 °C |



Air pressure sensor FFVGS-6700

| Parameter | Specification |
|------------------------|---|
| Range | 0.07 ... 4000 bar (Other ranges upon request) |
| Performance (accuracy) | ± 0.1% r |

Additional sensors and equipment



Color and NIR camera FFVGS-6400 and FFVGS-6410

| Parameter | Color FFVGS-6400 | IR FFVGS-6410 |
|-----------------|------------------|---------------|
| Resolution | 640x480 | 640x480 |
| Picture format | JPEG | JPEG |
| Compression | 10%-90% | 10%-90% |
| Daylight filter | No | Yes |

Available in version integrated with GMS



Frod™ Ground frost sensor FFVGS-6600

| Parameter | Specification |
|-------------------------|---|
| Type | Electronic, microprocessor controlled |
| Sensor depth difference | 50 mm (other differences upon request) |
| Sensor depth coverage | 0 ... up to 3 m (ranges set upon request) |
| Performance (accuracy) | < ± 0.3 °C |



Frensor Mk110 Freezing point sensor FFVGS-7650

| Parameter | Specification |
|--------------------------------|--|
| Type | Active, uses peltier element to detect phase shift from liquid to solid state of deicing fluid |
| | Independent of deicing chemical used |
| Freezing point detection range | -20 ... 0 °C (Accuracy ± 0.2 °C) |
| Operating temperature | -50 ... +50 °C (Freezing point data in the interval -40 ... +20 °C) |
| Miscellaneous | A system consists of one controller card and up to four sensor heads. Factory calibrated. |



Visibility sensor FFVGS-6067

| Parameter | Specification |
|-----------------------|---|
| Type | Forward scattering, 2 W at 880 nm for 100-µs per sample |
| Power | 12 V DC, 10mA |
| Size and weight | Approximately 250 x 110 x 150 mm, approximately 2 kg |
| Operating temperature | -40 ... +40 °C |
| Measurement range | 0 ... 640 m |
| Miscellaneous | RS232 interface to computer card |



Net Radiometer (requires GMS™ stainless steel cabinet) FFVGS-6720

The CNR 1 Net Radiometer is intended for research level total global net radiation measurement, the energy balance between the incoming spectral short-wave and long-wave IR radiation, from 0.3 to 50 µm, relative to the surface reflected short-wave and outgoing long-wave IR radiation.

The integrated four-way sensor design of the CNR 1 incorporates an upward-facing, ISO-class thermopile pyranometer and pyrgeometer, and a complimentary pair downward-facing pyranometer and pyrgeometer. The body of the CNR 1 houses a PT-100 RTD temperature sensor (YSI 10K thermistor optional), for accurate instrument body temperature measurements. Upon manufacture, the sensitivity of all four sensors are trimmed and calibrated to a single identical sensitivity coefficient.



HEAT FLUX PLATE FFVGS-6730

CN3 Heat Flux Plate

The Middleton CN3 Heat Flux Plate senses the conductive heat transmission in the medium in which it is buried. It is suitable for soil energy balance studies, and for determining heat transfer in walls, roads and bridges.



Traffic Monitoring System (TMS) FFVGS-6900

Real time traffic counter. Specification can be obtained upon request.

Integrated in GMS



Variable speed limits/Variable Message Signs (VMS)

Handling of variable message signs is prepared in GMS and μ -GMS systems. Integration of specific end user VMS are performed upon request. Common VMS types are text and fully graphical ones.

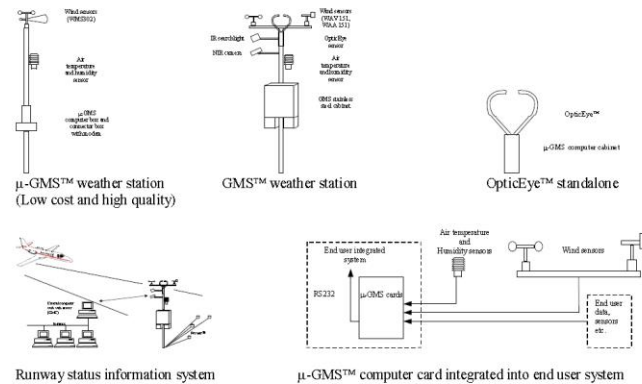


Ice buildup sensor FFVGS-7670

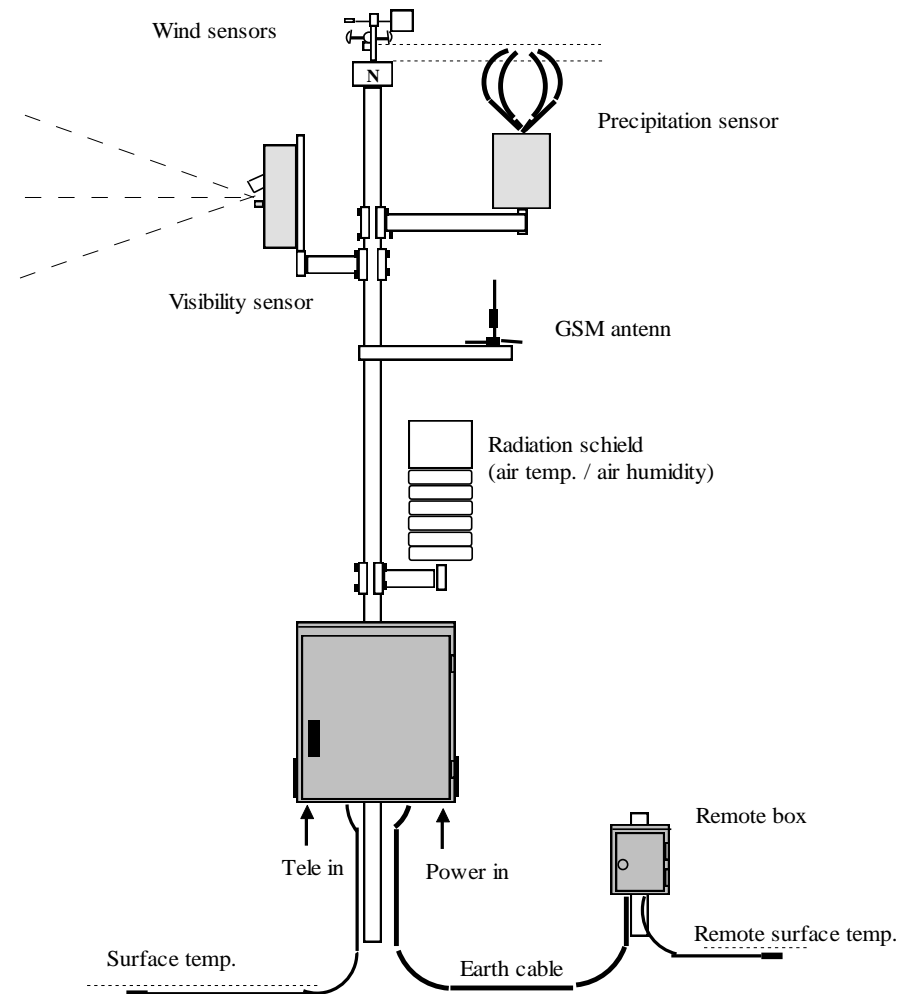
Monitors ice buildup according to the ISO 12494 std. The sensor is heated and rotates in order to get correct readings in adverse weather conditions. Specification can be obtained upon request.
Integration on GMS



Integration examples



Layout GMS



GMS-layout E.sdr 2002-04-12



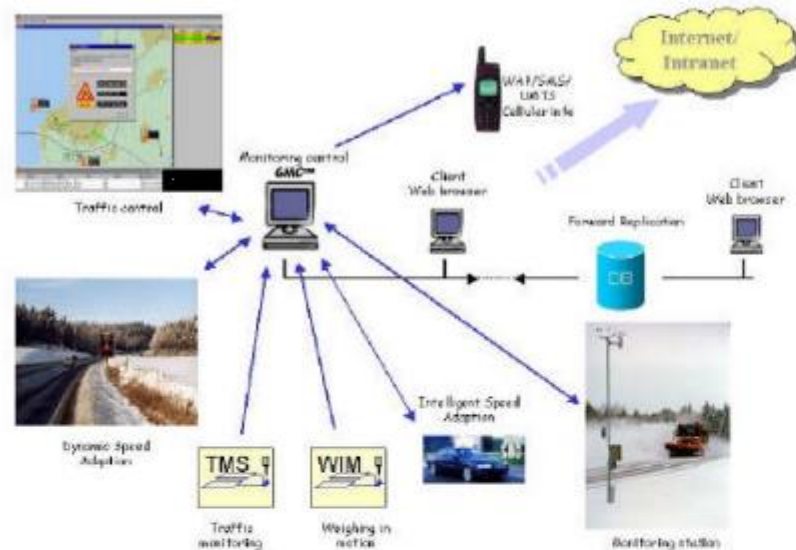
Central system

- ☐ Data from sensors is first collected and stored locally in the GMS™ field stations.
- ☐ The GMS™ (General Monitoring Computer) central system contacts the field stations regularly and collects data. This data is processed and stored in a central SQL database.
- ☐ The information can be made available to end users as web applications on Internet/Intranet or as subscribed SMS messages.
- ☐ Information can also be made available to the general public on the Internet.
- ☐ Selected information can also be sent to other organisations, eg. transport operators.
- ☐ Other types of information can be integrated into the system (e.g. weather satellite images).
- ☐ Mobile solutions can be integrated into the system.



Road Weather Information System

Road, Weather, Traffic and Safety

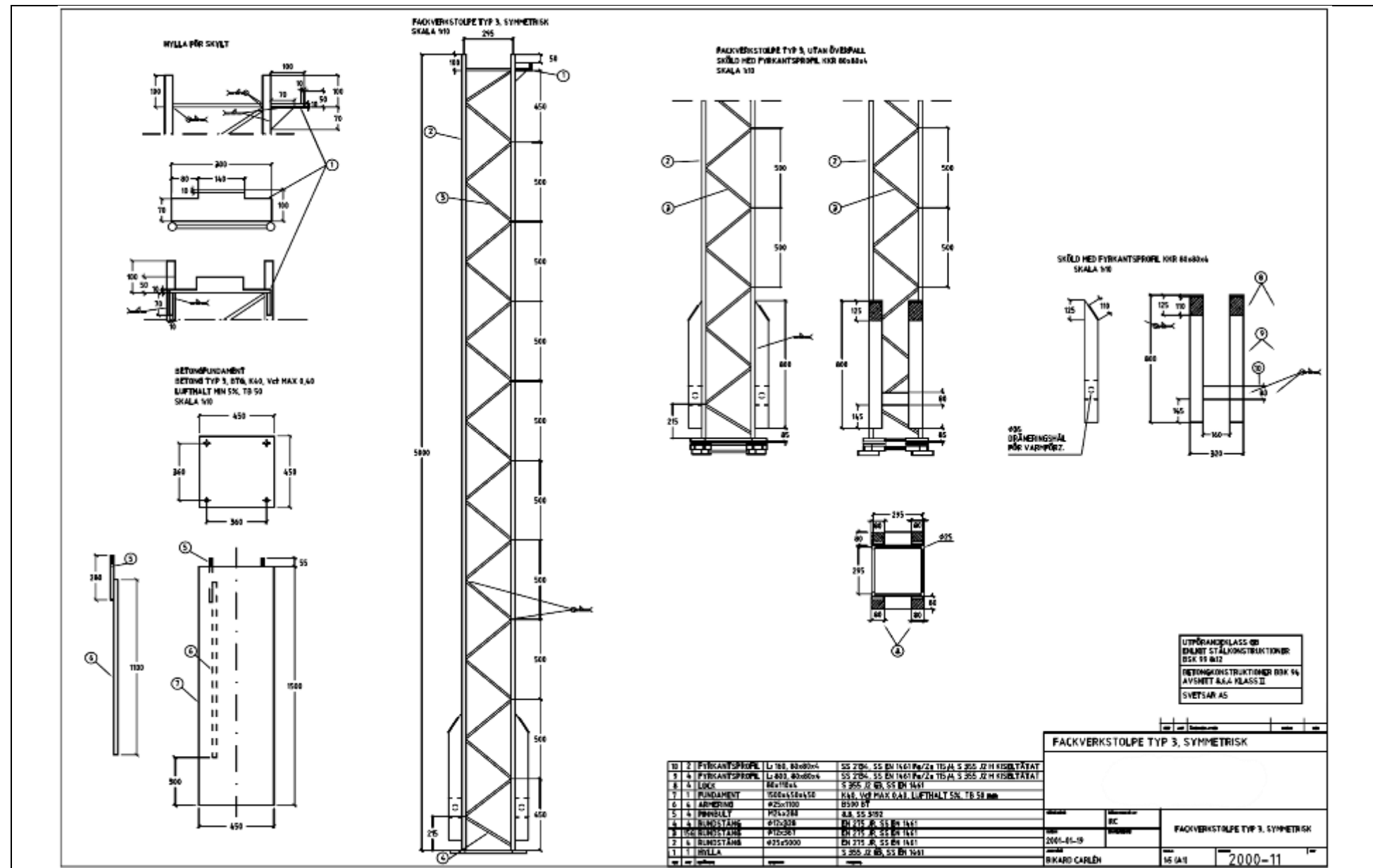


Field equipment

□ The General Monitoring Station (GMSSM) is used to handle sensors and equipment as described below. GMSSM is a very rugged custom designed field computer with a real time operating system. Communication over serial line, modem, radio, cellular etc.

- Wind speed and direction
- Road surface temperature
- Air temperature
- Air pressure
- Humidity
- Dew point temperature
- Precipitation (intensity, type and accumulated amount)
- Visibility
- Ground frost
- Road condition (surface freezing point)
- Solar radiation
- Flux metering
- Digital images (color and IR).
- Traffic monitoring (integrated traffic monitoring equipment).
- Mobile road condition (surface freezing point)





APPENDIX No. 2: LIST OF RWIS LOCATIONS

| No. | ID_RWIS | Location Name | Road Name | Section Name | Chainage | Position (Left/Right) | Distance from Belgrade (km) (approx.) | Description |
|-----|---------|--|-----------|--|------------|-----------------------|---------------------------------------|-------------|
| 1 | NEW_01 | Settlement Poljna Trstenik, Kruševac | IIA 189 | Oparić - Velika Drenova | 40+391.00 | TBD | 190 | / |
| 2 | NEW_02 | Ražanj OMV petrol station, Niš | IA 1 | Ražanj junction - Aleksinački rudnici junction | 390+267.00 | TBD | 190 | / |
| 3 | NEW_03 | Bridge Južna Morava- Trupale, Niš | IA 1 | Niš South junction – Merošina junction | 438+647.00 | TBD | 250 | / |
| 4 | NEW_04 | Settlement Radmanovo Brzeće, Kruševac | II A 212 | Brus (Brzeće)-Brzeće | 45+789.00 | TBD | 260 | / |
| 5 | NEW_05 | Bridge Kuršumlija-Niš, Niš | IB 35 | Kuršumlija - Rudare | 253+331.00 | TBD | 300 | / |
| 6 | NEW_06 | Bridge Lake Čelije, Kruševac | IB 38 | Kruševac (Jastrebac) - Razbojna | 35+588.00 | TBD | 230 | / |
| 7 | NEW_07 | Minićevo (Knjaževac-Zaječar), Niš | IB 35 | Minićevo (Vitkovac) - Minićevo (Debelica) | 143+063.00 | TBD | 280 | / |
| 8 | NEW_08 | Settlement Negosavlje bridge Medveđa, Kruševac | IB 39 | Lebane (Krivača) - Negosavlje | 116+682.00 | TBD | 310 | / |
| 9 | NEW_09 | Boljevac little bridge, Niš | IIA 219 | Boljevac (Boljevac selo) - Bučje | 1+980.00 | TBD | 210 | / |
| 10 | NEW_10 | Bela Palanka bridge, Niš | IIA 259 | Crvena Reka - Bela Palanka | 32+210.00 | TBD | 280 | / |
| 11 | NEW_11 | Vrelo bridge (Svrljig-Niška Banja), Niš | IB 35 | Svrljig (Popšica) - Malča | 193+046.00 | TBD | 260 | / |
| 12 | NEW_12 | Babušnica-Vlasotince | IB 39 | Babušnica - Bonjince | 37+128.00 | TBD | 320 | / |

| | | | | | | | | |
|----|--------|--|------------|---|------------|-------|-----|--|
| | | small Bridge, Vranje | | | | | | |
| 13 | NEW_13 | Dimitrovgrad, Niš | IIA 259 | Sukovo - Dimitrovgrad | 83+322.00 | TBD | 330 | / |
| 14 | NEW_14 | Bridge Juž.Morava Grdelica, Vranje | IA 1 | Grdelica junction - Predejane junction | 493+470.00 | TBD | 300 | / |
| 15 | NEW_15 | Vlasinsko lake, Vranje | IB 40 | Vlasina Okruglica - Vlasinsko lake | 30+588.00 | TBD | 350 | / |
| 16 | NEW_16 | Highway Korridor X, Vranje junction, Vranje | IIA 258 | Ranutovac - Vranje | 74+457.00 | TBD | 340 | / |
| 17 | NEW_17 | Preševo junction, Vranje | IA 1 | Levosojе - Preševo junction | 577+302.00 | TBD | 380 | / |
| 18 | NEW_18 | Pečenjevce junction, Vranje | IA 1 | Leskovac center junction - Leskovac South junction | 464+596.00 | TBD | 270 | / |
| 19 | EXI_01 | Mačva 01 | IB 21 | Ruma - Šabac | 69+753 | Right | 86 | On bridge over river Sava near Šabac |
| 20 | EXI_02 | Mačva 02 | IB 21 | Šabac – Koceljeva | 82+050 | Right | 95 | Near Cerovac |
| 21 | EXI_03 | Mačva 03 | IB 26 | Loznica – Mali Zvornik | 125+548 | Left | 144 | On bypass Loznica |
| 22 | EXI_04 | Kolubara 01 | IB 27 | Valjevo – Osečina | 53+509 | Right | 116 | Near Osladić |
| 23 | EXI_05 | Kolubara 02 | IB 21 | Koceljeva – Valjevo | 122+575 | Right | 102 | Near Brankovina (Blizanski Vis) |
| 24 | EXI_06 | Kolubara 03 | IB 27 | Loznica - Zavlaka | 27+913 | Left | 129 | On bridge over river Jadar near Zavlaka |
| 25 | EXI_07 | Belgrade 01 | IA 1 | Šimanovci – Dobanovci | 92+800 | Right | 22 | Near Dobanovci |
| 26 | EXI_08 | Belgrade 02 | IA 1 | Beograd – Bujanj Potok | 17+200 | Left | 1 | Near interchange Mostar |
| 27 | EXI_09 | Belgrade 03 | Near IB 29 | Near IB 29 (local road) | - | - | 11 | Near Železnik |

TBD = to be determined

Note: The data given for new RWIS locations (rows: NEW_01 - NEW_18) are macro location data. Micro location data will be defined by the works design for the installation of the new RWIS field stations (preparation on going by PERS) in accordance to the detailed instructions (design) of Contractor (Supplier).