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SECTION 17100 SCADA SYSTEM REQUIREMENTS

SECTION 17100
SCADA SYSTEM REQUIREMENTS

1. GENERAL

The clauses in this section define the general requirements and standards of workmanship for the manufacture, supply, installation and commissioning of all SCADA equipment, and shall be applicable to these works.

1.1. OBJECT

1.1.1. GENERAL

The system of drinking water distribution of Yerevan consists of numerous sites of production and a complex network of pipes. This set is equipped with numerous sensors allowing to know flows and so to better know the functioning of the network. The system of remote processing in place, allows only the gone back up of the information of these flows.

With the aim of mastering and optimizing the functioning of the distribution network, it is necessary to complete the park of instrumentation (flow meters, pressure sensor) and of equipments (motorized valves) which will allow to complete the collected data and to act directly on the network.

The existing system of remote processing, allowing only the data acquisition and having no capacity to realize operations of command will be replaced by a real system of remote processing.

1.1.2. DESCRIPTION OF THE WORKS

Three origins of data must be remotely managed :

- The pressure sensor on the network.
- The flowmeters on the network.
- The stations (plants, springs, tanks).

It is all in all about 130 sites of measure that must be connected(bound) with a system of supervision which will centralize the collected data.

The system of collection and exploitation of the data installed will have to allow:

- The display in quasi-real time of the state of the drinkable water distribution system.
- To alert the developer in case of failure of one of the organs of the system.
- The automation of the production of statistical data.

It is intended to install the central post of the system of supervision in the building office of Yerevan Djur.

The above-mentioned system of remote processing will have to allow:

- To control in quasi-real time the smooth running of the main production sites.
- To warn quickly the operators in case of failure on the system to limit the times of intervention.
- To optimize the progress of the information connected to the system to improve the reliability and the accessibility to the information.
- To produce regular dashboards (daily, monthly and annual) to direct the research for the failures (leaks, etc.).
- To optimize the performance indicator of the contract of lease.

The system of remote processing will also have to allow:

- To command the opening or the closure of motorized regulation valves.

To command the starting or the stop of the pumps of drillings distributed on big area in both fields of harnessing and the access of which is very difficult in particular in winter.

1.1.3. DRINKABLE WATER DISTRIBUTION SYSTEM ARCHITECTURE

The system of drinking water distribution is constituted by eleven production sites feeding a network organized in 9 under systems of distribution.

1.1.4. PRODUCTION SITES

Production sites are constituted in the following way :

1) Fields of drillings :
   - APARAN (13 drillings)
   - KATNAGHBYUR (13 drillings)
2) Pumping stations :
   - ARARATYAN 3 & 4
   - ARZAQAN - GYUMUSH
   - ARZNI
   - GARNI
   - SHOR SHOR
3) Springs :
   - DZORAGHBYUR-YERGES
   - TSARAVAGHBYUR

1.1.5. DISTRIBUTION NETWORK

Each of the distribution sub-systems takes for origin a production site and feed one or several sectors through one or several tank sites.

The distribution sub-systems are constituted in the following way :

1) APARAN Network :
   - 1 field of drillings (13 drillings).
   - 3 tank sites.
   - 14 sectors of distribution.
2) ARARATYAN Network :
   - 2 pumping stations. (ARARATYAN 3 & 4)
   - 1 tank site.
   - 3 sectors of distribution.
3) ARZAQAN - GYUMUSH Network :
   - 2 pumping stations. (ARZAKAN & GYUMUSH)
   - 1 lifting station on the network (KHARBERG)
   - 4 tank sites.
   - 12 sectors of distribution.
4) ARZNI Network :
   - 1 pumping station.
   - 2 tank sites.
   - 1 sector of distribution.
5) DZORAGHBYUR-YERGES Network :
   - 1 spring.
6) GARNI Network :
   - 1 pumping station.
   - 1 chlorination station.
   - 4 tank sites.
   - 11 sectors of distribution.
7) KATNAGHBYUR Network :
   - 1 pumping station.
   - 8 tank sites.
   - 24 sectors of distribution.
8) SHOR-SHOR Network :
   - 1 pumping station.
   - 1 tank site.

9) TSARAVAGHBYUR Network :

- 1 spring.
- 1 tank site.
- 4 sectors of distribution.

1.1.6. EXISTING INSTRUMENTATION EQUIPMENTS

Certain number of instrumentation equipments is already installed on the drinking water distribution system.

This equipments are mainly, flowmeters, level sensors and pressure sensors, who are installed on differents components of the distribution sub-system, such as pumping station, spring, tank and sector of network.

1.1.7. EXISTING RECORDING EQUIPMENTS

Certain number of data recorders is already installed on the drinking water distribution system.

This equipments are data loggers, who are installed on differents components of the distribution sub-system, such as pumping station, spring, tank and sector of network.

1.1.8. EXISTING COMMUNICATION EQUIPMENTS

Certain number of communication equipments is already installed on the drinking water distribution system.

This equipments are GSM transmitters, who are installed on differents components of the distribution sub-system, such as pumping station, spring, tank and sector of network, and who are connected at the supervision system.

1.2. WORK INCLUDED

1.2.1. SCADA SYSTEM

This contract includes for the provision of a SCADA (Supervisory Control And Data Acquisition) system for the monitoring and control of the Drinkable Water Distribution System of Yerevan.

The SCADA system shall be implemented as an operational management tool, i.e. shall provide with facilities to undertake the day to day monitoring and control of the Drinkable Water Distribution System and the production of general management information.

A Supervision and Control system will be installed to manage this installation.

The SCADA system database will be configured to include at minima:

- 2000 database points.
- 80 mimic displays.
- 30 trend displays.
- 15 reports.

The SCADA will consist of the following:

- One supervision operator Control station installed in the offices of Yerevan Djur administration building.
- A remote station in each of the concerned sites.

All these remote stations shall communicate between them with GSM system. (See Control System Block Diagram)

1.2.2. CONTROL STATIONS

1.2.2.1. SUPERVISION OPERATOR CONTROL STATION

The supervision operator Control Station installed in the offices of Yerevan Djur administration building will consist of the following:

- One Remote Terminal Unit (RTU).
- Two workstation.
- One Wall Screen Full HD 42 inches.
- One Uninterruptible Power Supply (UPS) Unit.

1.2.2.2. LOCAL CONTROL INTERFACE

Each local control Interface installed in the instrumentation panels will consist of the following:

- One Remote Terminal Unit (RTU) with modules of I/O. (Analogic and Digital).
- One Uninterruptible Power Supply (UPS) Unit.
- The instrumentation converters.

1.2.3. SCADA SYSTEM FEATURES

1.2.3.1. SCADA MIMICS

The following mimics are anticipated for Aeratsia control screens:

1. **List of SCADA Mimics**

MIMICS	Quantity
SCADA Network Status Schematic	1
Drinkable Water Distribution System Geographical Overview	1
Drinkable Water Distribution System Overview	1
Drinkable Water Distribution Network Overview	9
Pumping Station	8
Spring	2
Global Field of Drillings	1
Drillings	13
Tank Site	25
Chlorination Station	1
A contingency for the following number of additional mimics shall be included	20%

1.2.3.2. ALARM FACILITIES

The facility shall be fitted to enunciate user definable alarms that have been accepted within a user definable period via the klaxon and lights associated with each control panel. The klaxon and light at each panel shall be reset on acceptance of the alarm.

1.2.3.3. HISTORIC INFORMATION

The SCADA system will automatically save the current day's historic data and delete any data greater than 365 days old at midnight. The facilities shall be provided to recover data greater than 365 days old from the archive device.

1.2.3.4. REPORT GENERATION

The SCADA will allow for simple reports generation summarizing statistical information relating to the operation and performance of the WWTP station.

1.2.3.5. SCADA SYSTEM DATABASE CONFIGURATION

The SCADA database will be configured to include all input/output requirements. This shall include, but not be limited to:

- Descriptions.
- High, High-High, Low-Low and Low alarm levels.
- Alarm text.
- Alarm priorities.
- Dead-bands.
- Persistency (How long the signal must be in alarm condition before alarm is raised).
- Historic data for trending of inputs etc.
- Scanning intervals.

1.3. PROJECTION ON THE EQUIPMENTS OF THE CONTROL COMMANDS SYSTEM

The system of control commands require within the framework of its development the forecast to equip the various components of the drinking water distribution system.

These various components are the following ones:

- A central post of control commands (Supervision work station).
- The pumping stations.
- The springs.
- The fields of drillings.
- The Tanks.
- The points of data recording on the main line of the distribution network.
- The points of data recording on the sectors of the distribution network.

The various equipments to be connected with the system of control command are the following ones:

- Ultra sonic flowmeter. (Via transmitters)
- Pressure sensor.
- Level sensor.
- Motorized regulation valve.
- Motor of pump in the pumping station.

2. PROJECT DESCRIPTION

2.1. OBJECT

The present chapter in for object to define needs for the study, the supply, the transport, the installation, the development, the essays and the training necessary for the realization of a system of remote processing for the whole network of the drinkable water supply of Yérevan.

The network to be overseen is constituted by the following elements:

- 6 production pumping stations.
- 2 Springs including each 13 pumps of harnessing.
- 1 lifting pumping station on the network.
- 1 chlorination station.
- 24 tank sites.
- 19 control points on the main line.
- 64 control points on the sector on the distribution network.

The various equipments to be connected with the system of control command are the following ones

- Ultra sonic flowmeter. (Via transmitters)
- Pressure sensor.
- Level sensor.
- Motorized regulation valves.
- Motor of pump.
- Electric Characteristics of sites (Voltage, Intensity,….)

2.2. DEFINITION

2.2.1. OBJECTIVE

The installed of remote processing system has to bring to the developer as to the Client the following profits:

- The optimization of the functioning of the network thanks to the concentration of the data and the possibility of commanding at a distance the critical organs of the network (pumps, valves of regulations).
- The continuity of service by the immediate consideration of a major technical incident before the defect is perceptible by the users.
- The optimization of the interventions and the operating costs by avoiding the useless travels thanks to the transmission of precise and reliable information.
- The control of the consumptions (electricity, etc.) by controlling perfectly the parameters of functioning of the installations..
- The traceability of the incidents and the operations of repair associated.
- The possibility of realizing an effective preventive maintenance.

2.2.2. MEANS

To facilitate the handling of the installations of remote processing by the developer, the tenderers will have to hand a proposing offer:

- Of the material answering the characteristics and the wanted features.
- Of the material(equipment) of suppliers having robust references in various remote processing networks.
- The clearly defined services concerning the development of the application of remote processing and the necessary training, so allowing the autonomy of the staff.

2.2.3. LEXICON

One numbers of technical equipments will be quoted in this document under the shape of abbreviations defined below:

- RTU : Remote Terminal Unit.
- GSM : Cellular Telephony Transmission System.
- DI : Digital Input.
- DO : Digital Output.
- AI : Analog Input.
- AO : Analog Output.

2.3. NETWORK PRESENTATION

2.3.1. FUNCTIONNING GENERAL OF THE REMOTE PROCESSING NETWORK

All the sites concerned by the remote processing will be equipped by RTU (Simplified RTU or Evolutionary RTU).

The RTU's will allow the remote monitoring of the various sites by the sending of the alarms, the archived data and the balance sheet of functioning towards the Central Post of Remote processing (SCADA).

In case of failure of the communications between the RTU's and the SCADA, RTU's will have to be able to transmit alarms towards the agents of the developer by the sending of message by vocal or SMS.

The SCADA will archive all the information received of RTU's in a sauvegardable base, and will make the provision of the information and the archivings in the form of curves overview diagram and reports of exploitation.

The data transmission will be made by the support GSM dated or RTC and according to a secured protocol avoiding the loss of information.

The information available on the SCADA will be also available for consultation by one or several computers situated in the concerned Management (remote access).

The RTU's will have to allow the command of various equipments such as pumps or motorized valves, as well as the modification of instructions of the injectors of chlorine in local or remote functioning.

2.3.2. OVERVIEW DIAGRAM OF THE REMOTE PROCESSING NETWORK

A general overview diagram of the network is represented in Appendix (Plan joins).

2.3.3. REMOTE PROCESSING EQUIPMENT FOR GARNI NETWORK (NETWORK N°1)

The Garni network is constituted by a pumping station equipped with 5 pumps feeding 4 tanks, and a chlorination station.

The project includes the control and the command of the pumping station, the chlorination station, the 4 tanks, the 5 points on the main line as well as of 11 points (sectors) on the distribution network.

2.3.3.1. EQUIPMENTS TO BE MANAGED

Equipments to be managed on the Garni network are listed in the board following according to their feature.

Installation Type	Identification	Pump	Flowmeter	Pressure sensor	Level sensor	Motoriezd valves	Chlorination dosimeter	Chlorination injector	Voltage and intensuty measurement	On-site power supply	GSM signal coverage
Pumping Station	**Garni (1.1)**	**5**	**1**	**(3)**		**(6)**			**5 U&I**	**Yes**	**Yes**
Chlorination Station	**Garni (1.A)**			**2**			**(1)**	**1**		**Yes**	**Yes**
Main Line	**Nubar Main Fl (1.2)**		**1**							**Yes**	**Yes**
	Noubarashen Petrol (1.2.A)		**(1)**	**(1)**		**(1)**				**Yes**	**Yes**
	Arinberd Fl (1.4)		**1**							**Yes**	**Yes**
	Sari tax (1.7)		**2**	**(1)**						**Yes**	**Yes**
	Nardos Khoren (1.8)		**1**							**Yes**	**Yes**
Tanks	**Noubarashen (1.3)**									**Yes**	**Yes**
	Arin-Berd (1.5)		**4**	**(1)**	**1**	**(6)**	**1**			**Yes**	**Yes**
	Araratyan (1.6)		**1**	**(1)**	**1**	**(2)**	**1**			**Yes**	**Yes**
	Abovian Purak (1.9)		**7 + (2)**		**2**	**(12)**	**1**			**Yes**	**Yes**

Network	Sector Kentron 1 (1.9)		1 (*)							Yes	Yes
	Sector Kentron 2 (mosc-abov) (1.10)		1	(1)						Yes	Yes
	Sector Kentron 3 (Ter-isahak)(1.11)		1							Yes	Yes
	Sector Kentron 4 (1.9)		1 (*)							Yes	Yes
	Sector Kentron 5 (Ter-Mosc) (1.12)		1							Yes	Yes
	Sector Kentron 5 (boiler) (1.13)									Yes	Yes
	Sector Kentron 7 (1.9)		1 (*)							Yes	Yes
	Sector Kentron 8 (Charentc) (1.14)		1	(1)						Yes	Yes
	Sector Kentron 8/1 (Charentc) (1.14)		1	(1)						Yes	Yes
	Erebuni hraprak (erebuni) (1.5.1)		1	(1)						Yes	Yes
	Erebuni hraprak (Ayvazovski) (1.5.1)		1	(1)						Yes	Yes

Noted: on indication in board of the type(x), (The number enters bracket) specifies the number of the type of envisaged equipment but who does not exist at present.

2.3.3.2. REMOTE PROCESING EQUIPMENTS

Equipments allowing the remote processing of the Garni network are defined in the following board.

Installation Location	Type of Instrumentation and Equipment	Quantity	Digital Input (DI)	Analog Input (AI)	Digital Output (DO)	Analog Output (AO)
Pumping Station Garni (1.1)	Pump	5	20		5	
	Flowmeter	1	1	1		
	Pressure Sensor	3		3		
	Flow Regulation Valve	6	18	6	6	6
	Power Meter	5		10		

	Evolutionary RTU	**1**	**39**	**20**	**11**	**6**
Chlorination Station Garni (1.A)	**Pressure Sensor**	**2**		**2**		
	Chlorine Dosimeter	**1**		**1**		
	Chlorine Injector	**1**				**1**
	Evolutionary RTU	**1**		**3**		**1**
Main Line Nubar Main Fl (1.2)	**Flowmeter**	**1**	**1**	**1**		
	Simplified RTU	**1**	**1**	**1**		
Main Line Noubarashen Petrol (1.2.A)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Flow Regulation Valve	**1**	**3**	**1**	**1**	**1**
	Evolutionary RTU	**1**	**4**	**3**	**1**	**1**
Main Line Arinberd Fl (1.4)	**Flowmeter**	**1**	**1**	**1**		
	Simplified RTU	**1**	**1**	**1**		
Main Line Sari tax (1.7)	**Flowmeter**	**2**	**2**	**2**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**2**	**3**		
Main Line Nardos Khoren (1.8)	**Flowmeter**	**1**	**1**	**1**		
	Simplified RTU	**1**	**1**	**1**		
						5
Tank Arin-Berd (1.5)	**Flowmeter**	**4**	**4**	**4**		
	Pressure Sensor	**1**		**1**		
	Level Meter	**1**		**1**		

	Flow Regulation Valve	**6**	**18**	**6**	**6**	**6**
	Chlorine Dosimeter	**1**		**1**		
	Evolutionary RTU 1	**1**	**7**	**3**	**2**	**2**
	Evolutionary RTU 2	**1**	**15**	**10**	**4**	**4**
Tank Araratyan (1.6)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Level Meter	**1**		**1**		
	Flow Regulation Valve	**2**	**6**	**2**	**2**	**2**
	Chlorine Dosimeter	**1**		**1**		
	Evolutionary RTU	**1**	**7**	**6**	**2**	**2**
Tank Abovian Purak (1.9)	**Flowmeter**	**9**	**9**	**9**		
	Level Meter	**2**		**2**		
	Flow Regulation Valve	**12**	**36**	**12**	**12**	**12**
	Chlorine Dosimeter	**1**		**1**		
	Evolutionary RTU 1	**1**	**35**	**15**	**11**	**11**
	Evolutionary RTU 2	**1**	**5**	**5**		
	Evolutionary RTU 3	**1**	**5**	**4**	**1**	**1**
Network Sector Kentron 1 (1.9)	**Included in 1.9 RTU**					
Network Sector Kentron 2 (mosc-abov) (1.10)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
Network Sector Kentron 3 (Ter-isahak)(1.11)	**Flowmeter**	**1**	**1**	**1**		

	Simplified RTU	**1**	**1**	**1**		
Network Sector Kentron 4 (1.9)	**Included in 1.9 RTU**					
Network Sector Kentron 5 (Ter-Mosc) (1.12)	**Flowmeter**	**1**	**1**	**1**		
	Simplified RTU	**1**	**1**	**1**		
Network Sector Kentron 7 (1.9)	**Included in 1.9 RTU**					
Network Sector Kentron 8 (Charentc) (1.14)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
Network Sector Kentron 8/1 (Charentc) (1.14)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
Network Erebuni hraprak (erebuni) (1.5.1)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
Network Erebuni hraprak (Ayvazovski) (1.5.1)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		

2.3.4. REMOTE PROCESSING EQUIPMENT FOR KATNAGHBYUR NETWORK (NETWORK N°2)

The Garni Katnaghbyur is constituted by a field of drillings equipped with 13 pumps feeding 8 tanks.

The project includes the control and the command of the field of drillings, the 8 tanks, the 4 points on the main line as well as of 24 points (sectors) on the distribution network.

2.3.4.1. EQUIPMENTS TO BE MANAGED

Equipments to be managed on the Katnaghbyur network are listed in the board following according to their feature.

Installation Type	Identification	Pump	Flowmeter	Pressure sensor	Level sensor	Motoriezd valves	Chlorination dosimeter	Chlorination injector	Voltage and intensuty measurement	On-site power supply	GSM signal coverage
Pumping Station	**Katnaghbyur (2.0)**	**13**	**3 + (14*)**			**(2)**	**(3)**	**(3)**	**14 U&I**	**Yes**	**Yes**
Main Line	**Abelyan shit (2.1.1)**					**(2)**				**No**	**Yes**
	Borman (2.1.2)		**3**	**(3)**						**Yes**	**Yes**
	Marash Araz (2.1.3)		**2**							**Yes**	**Yes**
	Katn-Arzak (2.4.2)		**1**	**(1)**		**(1)**				**Yes**	**Yes**
	Katn Kentron (2.1.2.A)					**(1)**				**Yes**	**Yes**
Tanks	**Dzoraghbyur (2.2.1)**		**3**		**1**	**(3)**	**1**			**Yes**	**Yes**
	Jrvejh (2.1.4)		**2 + (3)**		**2**	**(6)**	**2**			**Yes**	**Yes**
	Marash (2.1.5)		**3**	**(1)**	**1**	**(3)**	**1**			**Yes**	**Yes**
	Sari Tagh (2.1.6)		**2 + (2)**	**(1)**	**1**	**(5)**	**1**			**Yes**	**Yes**
	Zeytun Jramb (2.3.1)		**2 + (1)**	**(1)**	**1**	**3**	**1**			**Yes**	**Yes**
	Qanaqer Nerqin (2.3.2)		**2**		**1**	**2**	**1**			**Yes**	**Yes**
	Mhub (2.4.1)		**1 + (3)**		**(2)**	**(4)**	**1**			**Yes**	**Yes**

	Qanaqer Verin (2.4.3)		**2 + (2)**		**1**	**5**	**1**			**Yes**	**Yes**
Network	**Narekaci (Ekexeci) (2.1.7)**		**1**	**(1)**						**Yes**	**Yes**
	Babajanyan77/7 (2.1.8)									**Yes**	**Yes**
	Avan-Arinj (2.1.9)		**1**							**Yes**	**Yes**
	Hovhannisyan24/2 (2.1.10)		**1**							**Yes**	**Yes**
	Duryan (Safaryan st) (2.1.11)		**1**	**(1)**						**Yes**	**Yes**
	1 Masiv (Mersedes)(2.1.12)		**1**	**(1)**						**Yes**	**Yes**
	1 Masiv (Gayi ardzan) (2.1.13)		**1**							**Yes**	**Yes**
	1 Masiv (Lvovyan) (2.1.14)		**1**							**Yes**	**Yes**
	2 Masiv (Gayi-Moldovakan) (2.1.15)		**1**	**(1)**						**Yes**	**Yes**
	2 Masiv (Harkajini dimac) (2.1.16)		**2**	**(1)**						**Yes**	**Yes**
	2 Masiv (Bagrevandi skzbnamas) (2.1.17)		**1**							**Yes**	**Yes**
	3 Masiv (Ojaxi dzor) (2.1.18)		**1**	**(1)**						**Yes**	**Yes**
	4 Masiv (Sigaroni mot) (2.2.2)		**1**	**(1)**						**Yes**	**Yes**
	5 Masiv (27 shenqi mot)(2.2.3)		**1**	**(1)**						**Yes**	**Yes**
	6 Masiv (Ancumi mot)(2.1.18)		**1**	**(1)**						**Yes**	**Yes**
	7 Masiv (Pioner palat)(2.1.20)		**1**	**(1)**						**Yes**	**Yes**

	7 Masiv (D.Bek Avetisyan)(2.1.21)		**1**							**Yes**	**Yes**
	8 Masiv (Tevosyan PRV)(2.2.4)		**1**	**(1)**						**Yes**	**Yes**
	9 Masiv (34 Shenqi mot)(2.1.22)		**1**	**(1)**						**Yes**	**Yes**
	Marash- 1 sektor (Ortopetiki hetevum)(2.1.23)		**1**	**(1)**						**Yes**	**Yes**
	Marash- 2 sektor (El-canci dimac)(2.1.24)		**1**							**Yes**	**Yes**
	Marash- 3 sektor (AHK-i mot)(2.1.25)		**1**	**(1)**						**Yes**	**Yes**
	Marash- 4 sektor (Ortopetiki araj)(2.1.26)		**1**							**Yes**	**Yes**
	Mushakan (D.Bek chor xuc)(2.1.27)									**Yes**	**Yes**

Noted: on indication in board of the type(x), (The number enters bracket) specifies the number of the type of envisaged equipment but who does not exist at present.

(14*) corresponds to mechanical flowmeters.

2.3.4.2. REMOTE PROCESING EQUIPMENTS

Equipments allowing the remote processing of the Katnaghbyur network are defined in the following board.

Installation Location	**Type of Instrumentation and Equipment**	**Quantity**	**Digital Input (DI)**	**Analog Input (AI)**	**Digital Output (DO)**	**Analog Output (AO)**
Pumping Station Katnaghbyur (2.0)	**Pump**	**13**	**52**		**13**	
	Flowmeter	**17**	**17**	**17**		
	Flow Regulation Valve	**2**	**6**	**2**	**2**	**2**

	Chlorine Dosimeter	**3**		**3**		
	Chlorine Injector	**3**				**3**
	Power Meter	**14**		**28**		
	Evolutionary RTU 1	**1**	**30**	**18**	**6**	
	Evolutionary RTU 2	**1**	**25**	**15**	**5**	
	Evolutionary RTU 3	**1**	**10**	**6**	**4**	
	Evolutionary RTU 4	**1**	**10**	**11**		**5**
Main Line Abelyan shit (2.1.1)	**Flow Regulation Valve**	**2**	**6**	**2**	**2**	**2**
	Evolutionary RTU	**1**	**6**	**2**	**2**	**2**
Main Line Borman (2.1.2)	**Flowmeter**	**3**	**3**	**3**		
	Pressure Sensor	**3**		**3**		
	Evolutionary RTU	**1**	**3**	**6**		
Main Line Marash Araz (2.1.3)	**Flowmeter**	**2**	**2**	**2**		
	Simplified RTU	**1**	**2**	**2**		
Main Line Katn-Arzak (2.4.2)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Flow Regulation Valve	**1**	**3**	**1**	**1**	**1**
	Evolutionary RTU	**1**	**4**	**3**	**1**	**1**
Main Line Katn-Kentron (2.1.2A)	**Flow Regulation Valve**	**1**	**3**	**1**	**1**	**1**
	Evolutionary RTU	**1**	**3**	**1**	**1**	**1**
Tank Dzoraghbyur (2.2.1)	**Flowmeter**	**3**	**3**	**3**		

	Level Meter	**1**		**1**		
	Flow Regulation Valve	**3**	**9**	**3**	**3**	**3**
	Chlorine Dosimeter	**1**		**1**		
	Evolutionary RTU	**1**	**12**	**8**	**3**	**3**
Tank Jrvejh (2.1.4)	**Flowmeter**	**5**	**5**	**5**		
	Level Meter	**2**		**2**		
	Flow Regulation Valve	**6**	**18**	**6**	**6**	**6**
	Chlorine Dosimeter	**2**		**2**		
	Evolutionary RTU	**1**	**23**	**15**	**6**	**6**
Tank Marash (2.1.5)	**Flowmeter**	**3**	**3**	**3**		
	Pressure Sensor	**1**		**1**		
	Level Meter	**1**		**1**		
	Flow Regulation Valve	**3**	**9**	**3**	**3**	**3**
	Chlorine Dosimeter	**1**		**1**		
	Evolutionary RTU	**1**	**12**	**9**	**3**	**3**
Tank Sari Tagh (2.1.6)	**Flowmeter**	**4**	**4**	**4**		
	Pressure Sensor	**1**		**1**		
	Level Meter	**1**		**1**		
	Flow Regulation Valve	**5**	**15**	**5**	**5**	**5**
	Chlorine Dosimeter	**1**		**1**		
	Evolutionary RTU	**1**	**19**	**12**	**5**	**5**
Tank Zeytun Jramb (2.3.1)	**Flowmeter**	**3**	**3**	**3**		

	Pressure Sensor	**1**		**1**		
	Level Meter	**1**		**1**		
	Flow Regulation Valve	**3**	**9**	**3**	**3**	**3**
	Chlorine Dosimeter	**1**		**1**		
	Evolutionary RTU	**1**	**12**	**9**	**3**	**3**
Tank Qanaqer Nerqin (2.3.2)	**Flowmeter**	**2**	**2**	**2**		
	Level Meter	**1**		**1**		
	Flow Regulation Valve	**2**	**6**	**2**	**2**	**2**
	Chlorine Dosimeter	**1**		**1**		
	Evolutionary RTU	**1**	**8**	**6**	**2**	**2**
Tank Mhub (2.4.1)	**Flowmeter**	**4**	**4**	**4**		
	Level Meter	**2**		**2**		
	Flow Regulation Valve	**4**	**12**	**4**	**4**	**4**
	Chlorine Dosimeter	**1**		**1**		
	Evolutionary RTU	**1**	**16**	**11**	**4**	**4**
Tank Qanaqer Verin (2.4.3)	**Flowmeter**	**4**	**4**	**4**		
	Level Meter	**1**		**1**		
	Flow Regulation Valve	**5**	**15**	**5**	**5**	**5**
	Chlorine Dosimeter	**1**		**1**		
	Evolutionary RTU	**1**	**19**	**11**	**5**	**5**
Network Narekaci (Ekexeci) (2.1.7)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		

	Simplified RTU	**1**	**1**	**2**		
Network Avan-Arinj (2.1.9)	**Flowmeter**	**1**	**1**	**1**		
	Simplified RTU	**1**	**1**	**1**		
Network Hovhannisyan24/2 (2.1.10)	**Flowmeter**	**1**	**1**	**1**		
	Simplified RTU	**1**	**1**	**1**		
Network Duryan (Safaryan st) (2.1.11)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
Network 1 Masiv (Mersedes)(2.1.12)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
Network 1 Masiv(Gayi ardzan) (2.1.13)	**Flowmeter**	**1**	**1**	**1**		
	Simplified RTU	**1**	**1**	**1**		
Network 1 Masiv (Lvovyan) (2.1.14)	**Flowmeter**	**1**	**1**	**1**		
	Simplified RTU	**1**	**1**	**1**		
Network 2 Masiv (Gayi-Moldovakan) (2.1.15)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
Network 2 Masiv (Harkajini dimac) (2.1.16)	**Flowmeter**	**2**	**2**	**2**		
	Pressure Sensor	**1**		**1**		

	Simplified RTU	**1**	**2**	**3**		
Network 2 Masiv (Bagrevandi skzbnamas) (2.1.17)	**Flowmeter**	**1**	**1**	**1**		
	Simplified RTU	**1**	**1**	**1**		
Network 3 Masiv (Ojaxi dzor) (2.1.18)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
Network 4 Masiv (Sigaroni mot) (2.2.2)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
Network 5 Masiv (27 shenqi mot)(2.2.3)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
Network 6 Masiv (Ancumi mot)(2.1.18)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
Network 7 Masiv (Pioner palat)(2.1.20)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
Network 7 Masiv (D.Bek Avetisyan)(2.1.21)	**Flowmeter**	**1**	**1**	**1**		
	Simplified RTU	**1**	**1**	**1**		

Network 8 Masiv (Tevosyan PRV)(2.2.4)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
Network 9 Masiv (34 Shenqi mot)(2.1.22)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
Network Marash- 1 sektor (Ortopetiki hetevum)(2.1.23)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
Network Marash- 2 sektor (El-canci dimac)(2.1.24)	**Flowmeter**	**1**	**1**	**1**		
	Simplified RTU	**1**	**1**	**1**		
Network Marash- 3 sektor (AHK-i mot)(2.1.25)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
Network Marash- 4 sektor (Ortopetiki araj)(2.1.26)	**Flowmeter**	**1**	**1**	**1**		
	Simplified RTU	**1**	**1**	**1**		

2.3.5. REMOTE PROCESSING EQUIPMENT FOR ARARATYAN NETWORK (NETWORK N°3)

The Araratyan network is constituted by a pumping station equipped with 10 pumps feeding 1 tank.

The project includes the control and the command of the pumping station, the 1 tank, the 1 point on the main line as well as of 3 points (sectors) on the distribution network.

2.3.5.1. EQUIPMENTS TO BE MANAGED

Equipments to be managed on the Araratyan network are listed in the board following according to their feature.

Installation Type	Identification	Pump	Flowmeter	Pressure sensor	Level sensor	Motoriezd valves	Chlorination dosimeter	Chlorination injector	Voltage and intensuty measurement	On-site power supply	GSM signal coverage
Pumping Station	**Araratyan (3)**	**2 x 5**	**3**	**(3)**					10	**Yes**	**Yes**
Main Line	**Noragavit (3.1)**									**Yes**	**Yes**
Tanks	**Kharberd (3.2)**		**5**	**(1)**	**1**	**(7)**	**1**			**Yes**	**Yes**
Network	**JEK (3.2.1)**		**2**	**(1)**						**Yes**	**Yes**
	Maqur erkat (3.2.2)		**1**							**Yes**	**Yes**
	Artcakh (3.1.1)		**1**							**Yes**	**Yes**

Noted: on indication in board of the type(x), (The number enters bracket) specifies the number of the type of envisaged equipment but who does not exist at present.

2.3.5.2. REMOTE PROCESING EQUIPMENTS

Equipments allowing the remote processing of the Araratyan network are defined in the following board.

Installation Location	Type of Instrumentation and Equipment	Quantity	Digital Input (DI)	Analog Input (AI)	Digital Output (DO)	Analog Output (AO)
Pumping Station Araratyan (3)	Pumps	10	40		10	
	Flowmeter	3	3	3		
	Pressure Sensor	3		3		
	Power Meter	10		20		
	Evolutionary RTU	1	43	26	10	
Tank Kharberd (3.2)	Flowmeter	5	5	5		
	Pressure Sensor	1		1		
	Level Meter	1		1		
	Flow Regulation Valve	7	21	7	7	7
	Chlorine Dosimeter	1		1		
	Evolutionary RTU	1	26	15	7	7
Network JEK (3.2.1)	Flowmeter	2	2	2		
	Pressure Sensor	1		1		
	Simplified RTU	1	2	3		
Network Maqur erkat (3.2.2)	Flowmeter	1	1	1		

	Simplified RTU	**1**	**1**	**1**		
Network Artcakh (3.1.1)	**Flowmeter**	**1**	**1**	**1**		
	Simplified RTU	**1**	**1**	**1**		

2.3.6. REMOTE PROCESSING EQUIPMENT FOR DZORAGHBYUR-YERGES NETWORK (NETWORK N°4)

The Dzoraghbyur-Yerges network is constituted by a spring.

The project includes the control and the command of the spring.

2.3.6.1. EQUIPMENTS TO BE MANAGED

Equipments to be managed on the Dzoraghbyur-Yerges network are listed in the board following according to their feature.

Installation Type	Identification	Pump	Flowmeter	Pressure sensor	Level sensor	Motoriezd valves	Chlorination dosimeter	Chlorination injector	Voltage and intensuty measurement	On-site power supply	GSM signal coverage
Spring	**DZORAGHBYUR-YERGES (4)**		**3**			**(1)**	**(1)**			**Yes**	**Yes**

Noted: on indication in board of the type(x), (The number enters bracket) specifies the number of the type of envisaged equipment but who does not exist at present.

2.3.6.2. REMOTE PROCESING EQUIPMENTS

Equipments allowing the remote processing of the Dzoraghbyur-Yerges network are defined in the following board.

Installation Location	Type of Instrumentation and Equipment	Quantity	Digital Input (DI)	Analog Input (AI)	Digital Output (DO)	Analog Output (AO)
Spring DZORAGHBYUR-YERGES (4)	Flowmeter	3	3	3		
	Flow Regulation Valve	1	3	1	1	1
	Chlorine Dosimeter	1		1		
	Evolutionary RTU	1	6	5	1	1

2.3.7. REMOTE PROCESSING EQUIPMENT FOR TSARAVAGHBYUR NETWORK (NETWORK N°5)

The Tsaravaghbyur network is constituted by a spring feeding 1 tank.

The project includes the control and the command of the spring, the tank as well as of 4 points (sectors) on the distribution network.

2.3.7.1. EQUIPMENTS TO BE MANAGED

Equipments to be managed on the Tsaravaghbyur network are listed in the board following according to their feature.

Installation Type	Identification	Pump	Flowmeter	Pressure sensor	Level sensor	Motoriezd valves	Chlorination dosimeter	Chlorination injector	Voltage and intensuty measurement	On-site power supply	GSM signal coverage
Spring	**Tsaravaghbyur (5)**		**3**			**(1)**	**(1)**	**1**		**Yes**	**Yes**
Tanks	**Tsitshernakaberd (5.1)**		**(2)**		**1**	**(1)**	**1**			**Yes**	**Yes**
Network	**Sector 12 Kilikia (5.2)**									**Yes**	**Yes**
	Kilikia (5.3)									**Yes**	**Yes**
	Haghtanaki Kamurj (5.4)		**1**							**Yes**	**Yes**
	Boiler (1.13)		**(3)**	**(1)**						**Yes**	**Yes**

Noted: on indication in board of the type(x), (The number enters bracket) specifies the number of the type of envisaged equipment but who does not exist at present.

2.3.7.2. REMOTE PROCESING EQUIPMENTS

Equipments allowing the remote processing of the Tsaravaghbyur network are defined in the following board.

Installation Location	Type of Instrumentation and Equipment	Quantity	Digital Input (DI)	Analog Input (AI)	Digital Output (DO)	Analog Output (AO)
Spring Tsaravaghbyur (5)	Flowmeter	3	3	3		
	Flow Regulation Valve	1	3	1	1	1
	Chlorine Dosimeter	1		1		
	Chlorine Injector	1				
	Evolutionary RTU	1	6	5	1	1
Tank Tsitshernakaberd (5.1)	Flowmeter	2	2	2		
	Level Meter	1		1		
	Flow Regulation Valve	1	3	1	1	1
	Chlorine Dosimeter	1		1		
	Evolutionary RTU	1	5	5	1	1
Network Haghtanaki Kamurj (5.4)	Flowmeter	1	1	1		
	Simplified RTU	1	1	1		
Network Boiler (1.13)	Flowmeter	3	3	3		
	Pressure Sensor	1		1		
	Simplified RTU	1	3	4		

2.3.8. REMOTE PROCESSING EQUIPMENT FOR SHOR-SHOR NETWORK (NETWORK N°6)

The Shor-Shor network is constituted by a pumping station equipped with 6 pumps feeding 1 tank.

The project includes the control and the command of the pumping station, the tank and the 2 points on the main line.

2.3.8.1. EQUIPMENTS TO BE MANAGED

Equipments to be managed on the Shor-Shor network are listed in the board following according to their feature.

Installation Type	Identification	Pump	Flowmeter	Pressure sensor	Level sensor	Motoriezd valves	Chlorination dosimeter	Chlorination injector	Voltage and intensuty measurement	On-site power supply	GSM signal coverage
Pumping Station	**Shor-Shor (6)**	**6**	**2**	**(2)**			**(1)**	**(1)**	**6U&I**	**Yes**	**Yes**
Main Line	**Cloratun (6.1)**		**(1)**			**(2)**				**Yes**	**Yes**
	Karmir khachShor-Shor (6.2)									**No**	**Yes**
Tanks	**Kati Kombinat (6.3)**		**(2)**		**1**	**(2)**	**1**			**Yes**	**Yes**

Noted: on indication in board of the type(x), (The number enters bracket) specifies the number of the type of envisaged equipment but who does not exist at present.

2.3.8.2. REMOTE PROCESING EQUIPMENTS

Equipments allowing the remote processing of the Shor-Shor network are defined in the following board.

Installation Location	Type of Instrumentation and Equipment	Quantity	Digital Input (DI)	Analog Input (AI)	Digital Output (DO)	Analog Output (AO)
Pumping Station Shor-Shor (6)	Pumps	6	24		6	
	Flowmeter	2	2	2		
	Pressure Sensor	2		2		
	Chlorine Dosimeter	1		1		
	Chlorine Injector	1				
	Power Meter	6		12		
	Evolutionary RTU	1	26	17	6	
Main Line Cloratun (6.1)	Flowmeter	1	1	1		
	Flow Regulation Valve	2	6	2	2	2
	Evolutionary RTU	1	7	3	2	2
Tank Kati Kombinat (6.3)	Flowmeter	2	2	2		
	Level Meter	1		1		
	Flow Regulation Valve	2	6	2	2	2
	Chlorine Dosimeter	1		1		
	Evolutionary RTU	1	8	6	2	2

2.3.9. REMOTE PROCESSING EQUIPMENT FOR APARAN NETWORK (NETWORK N°7)

The Aparan network is constituted by a field of drillings equipped with 13 pumps feeding 3 tanks.

The project includes the control and the command of the field of drillings, the 3 tanks, the 1 point on the main line as well as of 13 points (sectors) on the distribution network.

2.3.9.1. EQUIPMENTS TO BE MANAGED

Equipments to be managed on the Aparan network are listed in the board following according to their feature.

Installation Type	Identification	Pump	Flowmeter	Pressure sensor	Level sensor	Motoriezd valves	Chlorination dosimeter	Chlorination injector	Voltage and intensuty measurement	On-site power supply	GSM signal coverage
Pumping Station	**Aparan (7)**	**13**	**1 + (14*)**				**(1)**	**1**	**14**	**Yes**	**Yes**
Main Line	**Karmir Khach Aparan (6.2)**					**(3)**				**Yes**	**Yes**
Tanks	**Qasakh (7.1)**		**2 + (2)**		**2**	**(3)**	**2**			**Yes**	**Yes**
	Davtashen verin (7.2)		**(1)**	**(2)**	**1**	**(4)**	**1**			**Yes**	**Yes**
	Fizaka (7.3)		**1 + (1)**	**(1)**	**1**	**(2)**	**1**			**Yes**	**Yes**
Network	**Sector - Mashtoc 5 (Shiraz) (7.1.1)**		**1**	**(1)**						**Yes**	**Yes**
	Sector - Mashtoc 7 bloc (Shiraz) (7.1.1)		**1**	**(1)**						**Yes**	**Yes**
	Sector - Mashtoc 15 (Fuchik-Margaryan)(7.2.1)		**1**	**(1)**						**Yes**	**Yes**
	Sector - Mashtoc 1 Davt-I (near the cemetery)(7.1.2)		**1**	**(1)**						**Yes**	**Yes**
	Sector - Mashtoc 1 (near the Davt-I 21 building)(7.1.3)		**1**							**Yes**	**Yes**

	Sector - Mashtoc 1 (near the Davt-I 33 building) (7.1.4)		**1**							**Yes**	**Yes**
	Sector - Mashtoc 3 (near the Davt-I 33 building)(7.1.4)		**1**							**Yes**	**Yes**
	Sector - Mashtoc 2 (near theDavtII 9 building)(7.1.5)		**1**	**(1)**						**Yes**	**Yes**
	Sector - Mashtoc 2 (near the DavtII 22 building) (7.1.6)		**1**							**Yes**	**Yes**
	Sector - Mashtoc 2 (near the Davt III 6 building) (7.1.7)		**1**							**Yes**	**Yes**
	Sector - Mashtoc 2 (for Mashtoc Davt 4) (7.1.8)		**1**							**Yes**	**Yes**
	Sector - Mashtoc 4 (near Davt IV Arazen building)(7.1.9)		**1**	**(1)**						**Yes**	**Yes**
	Sector - Mashtoc 4 (near the Davt IV 45 building)(7.1.10)		**1**	**(1)**						**Yes**	**Yes**
	Fizaka Cross (7.1.11)		**1**	**(1)**		**(1)**				**Yes**	**Yes**

Noted: on indication in board of the type(x), (The number enters bracket) specifies the number of the type of envisaged equipment but who does not exist at present.

2.3.9.2. REMOTE PROCESING EQUIPMENTS

Equipments allowing the remote processing of the Aparan network are defined in the following board.

Installation Location	Type of Instrumentation and Equipment	Quantity	Digital Input (DI)	Analog Input (AI)	Digital Output (DO)	Analog Output (AO)
Pumping Station Aparan (7)	Pumps	13	52		13	
	Flowmeter	15	15	15		
	Chlorine Dosimeter	1		1		
	Chlorine Injector	1				1
	Power Meter	14		28		
	Evolutionary RTU 1	13	5	3	1	
	Evolutionary RTU 2	1	2	5		1
		1				
Main Line Karmir Khach Aparan (6.2)	Flow Regulation Valve	3	9	3	3	3
	Evolutionary RTU	1	9	3	3	3
Tank Qasakh (7.1)	Flowmeter	4	4	4		
	Level Meter	2		2		
	Flow Regulation Valve	3	9	3	3	3
	Chlorine Dosimeter	2		2		
	Evolutionary RTU	1	13	11	3	3
Tank Davtashen verin (7.2)	Flowmeter	1	1	1		
	Pressure Sensor	2		2		

	Level Meter	**1**		**1**		
	Flow Regulation Valve	**4**	**12**	**4**	**4**	**4**
	Chlorine Dosimeter	**1**		**1**		
	Evolutionary RTU	**1**	**13**	**9**	**4**	**4**
Tank Fizaka (7.3)	**Flowmeter**	**2**	**2**	**2**		
	Pressure Sensor	**1**		**1**		
	Level Meter	**1**		**1**		
	Flow Regulation Valve	**2**	**6**	**2**	**2**	**2**
	Chlorine Dosimeter	**1**		**1**		
	Evolutionary RTU	**1**	**8**	**7**	**2**	**2**
Network Sector - Mashtoc 5 (Shiraz) (7.1.1)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
Network Sector - Mashtoc 7 bloc (Shiraz) (7.1.1)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
Network Sector - Mashtoc 15 (Fuchik-Margaryan)(7.2.1)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
Network Sector - Mashtoc 1 Davt-I (near the cemetery)(7.1.2)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		

Network Sector - Mashtoc 1 (near the Davt-I 21 building)(7.1.3)	**Flowmeter**	**1**	**1**	**1**		
	Simplified RTU	**1**	**1**	**1**		
Network Sector - Mashtoc 1 (near the Davt-I 33 building) (7.1.4)	**Flowmeter**	**1**	**1**	**1**		
	Simplified RTU	**1**	**1**	**1**		
Network Sector - Mashtoc 3 (near the Davt-I 33 building)(7.1.4)	**Flowmeter**	**1**	**1**	**1**		
	Simplified RTU	**1**	**1**	**1**		
Network Sector - Mashtoc 2 (near theDavtII 9 building)(7.1.5)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
Network Sector - Mashtoc 2 (near the DavtII 22 building) (7.1.6)	**Flowmeter**	**1**	**1**	**1**		
	Simplified RTU	**1**	**1**	**1**		
Network Sector - Mashtoc 2 (near the Davt III 6 building) (7.1.7)	**Flowmeter**	**1**	**1**	**1**		
	Simplified RTU	**1**	**1**	**1**		
Network Sector - Mashtoc 2 (for Mashtoc Davt 4) (7.1.8)	**Flowmeter**	**1**	**1**	**1**		
	Simplified RTU	**1**	**1**	**1**		
Network Sector - Mashtoc 4 (near Davt IV Arazen building)(7.1.9)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
Network Sector - Mashtoc 4 (near the Davt IV 45 building)(7.1.10)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		

	Simplified RTU	**1**	**1**	**2**		
Network Fizika Cross (7.1.11)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Pressure Regulation Valve	**1**		**1**		
	Simplified RTU	**1**	**1**	**3**		

2.3.10. REMOTE PROCESSING EQUIPMENT FOR ARZAQAN-GYUMUSH NETWORK (NETWORK N°8)

The Arzaqan-Gyumush network is constituted by two pumping stations equipped each with 1 pump feeding a lifting pumping station on the network (Kharberg) and 4 tanks.

The project includes the control and the command of the 2 pumping stations, the lifting pumping station, the 4 tanks, the 7 points on the main line as well as of 13 points (sectors) on the distribution network.

2.3.10.1. EQUIPMENTS TO BE MANAGED

Equipments to be managed on the Arzaqan-Gyumush network are listed in the board following according to their feature.

Installation Type	Identification	Pump	Flowmeter	Pressure sensor	Level sensor	Motoriezd valves	Chlorination dosimeter	Chlorination injector	Voltage and intensuty measurement	On-site power supply	GSM signal coverage
Pumping Station	**Arzaqan (8)**	**1**	**1**				**(1)**	**1**		**Yes**	**Yes**
	Gyumush (8.1)	**1**	**3**	**2 + (3)**		**(1)**	**(1)**		**2**	**Yes**	**Yes**
Main Line	**Nor hachn (8.2)**			**(1)**		**(2)**				**Yes**	**Yes**
	Zovuni Arz (8.3)		**1**							**Yes**	**Yes**
	Davtasheni Kamurj (8.3.1)			**(1)**		**(1)**				**Yes**	**Yes**
	Malakan (8.3.2)									**Yes**	**Yes**
	Leningradyan (8.3.3) 16str (8.3.3A)		**1**							**Yes**	**Yes**

	Qanaqer Arz (8.4)		**1**							**Yes**	**Yes**
	Lamperi Lich (8.4.1)		**1**	**(1)**						**Yes**	**Yes**
Tanks	**Kilikia (8.3.4)**									**Yes**	**Yes**
	Lamper (8.4.2)		**6**		**1**	**(4)**	**1**			**Yes**	**Yes**
	Jambul (8.3.5)		**1 + (2)**		**1**	**(2)**	**1**			**Yes**	**Yes**
	Lukashin (8.3.6)		**2**		**3**	**(4)**	**1**			**Yes**	**Yes**
Network	**Sector Shahumyan 8 (Tichina) (8.3.7)**		**1**	**(1)**						**Yes**	**Yes**
	Sector Shahumyan 8 (Sheram) (8.3.8)		**1**	**(1)**						**Yes**	**Yes**
	Sector Shahumyan 8 (Z.Andranik) (8.3.9)		**1**	**(1)**						**Yes**	**Yes**
	Sector Shahumyan 2 (Raffi)(8.3.10)		**1**	**(1)**						**Yes**	**Yes**
	Sector Shahumyan 1 (Babajanyan)(8.3.11)		**1**	**(1)**						**Yes**	**Yes**
	Sector Shahumyan 11 (for Isakov)(8.3.12)		**1**							**Yes**	**Yes**
	Sector Shahumyan 11 (for Tairov)(8.3.12)		**1**							**Yes**	**Yes**
	Sector Shahumyan (for v. Haxtanak most)(8.3.13)		**1**							**Yes**	**Yes**
	Sector Shahumyan (for v. Haxtanak tser) (8.3.14)		**1**	**(1)**						**Yes**	**Yes**
	Sector Shahumyan (near rob. Factory for Tairov)(8.3.15)		**1**	**(1)**						**Yes**	**Yes**
	Sector Shahumyan 5 (Shrjanajin)(8.3.16)		**1**	**(1)**						**Yes**	**Yes**
	Sector Shahumyan 6 (Kurxinyan)(8.3.17)		**1**	**(2)**						**Yes**	**Yes**

Noted: on indication in board of the type(x), (The number enters bracket) specifies the number of the type of envisaged equipment but who does not exist at present.

2.3.10.2. REMOTE PROCESING EQUIPMENTS

Equipments allowing the remote processing of the Arzaqan-Gyumush network are defined in the following board.

Installation Location	Type of Instrumentation and Equipment	Quantity	Digital Input (DI)	Analog Input (AI)	Digital Output (DO)	Analog Output (AO)
Pumping Station Arzaqan (8)	Pumps	1	4		1	
	Flowmeter	1	1	1		
	Chlorine Dosimeter	1		1		
	Chlorine Injector	1				1
	Evolutionary RTU	1	5	2	1	1
		1				
Pumping Station Gyumush (8.1)	Pumps	1	4		1	
	Flowmeter	3	3	3		
	Pressure Sensor	5		5		
	Flow Regulation Valve	1	3	1	1	1
	Chlorine Dosimeter	1		1		
	Power Meter	2		4		
	Evolutionary RTU	1	10	14	2	1
		1				
Main Line Nor hachn (8.2)	Pressure Sensor	1		1		
	Flow Regulation Valve	2	6	2	2	2
	Evolutionary RTU	1	6	3	2	2
		1				

Main Line Zovuni Arz (8.3)	**Flowmeter**	**1**	**1**	**1**		
	Simplified RTU	**1**	**1**	**1**		
		1				
Main Line Davtasheni Kamurj (8.3.1)	**Pressure Sensor**	**1**		**1**		
	Flow Regulation Valve	**1**	**3**	**1**	**1**	**1**
	Evolutionary RTU	**1**	**3**	**2**	**1**	**1**
		1				
Main Line Leningradyan (8.3.3)	**Flowmeter**	**1**	**1**	**1**		
	Simplified RTU	**1**	**1**	**1**		
		1				
Main Line Qanaqer Arz (8.4)	**Flowmeter**	**1**	**1**	**1**		
	Simplified RTU	**1**	**1**	**1**		
		1				
Main Line Lamperi Lich (8.4.1)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
Tank Lamper (8.4.2)	**Flowmeter**	**6**	**6**	**6**		
	Level Meter	**1**		**1**		
	Flow Regulation Valve	**4**	**12**	**4**	**4**	**4**
	Chlorine Dosimeter	**1**		**1**		
	Evolutionary RTU	**1**	**18**	**12**	**4**	**4**
		1				
Tank Jambul (8.3.5)	**Flowmeter**	**3**	**3**	**3**		
	Level Meter	**1**		**1**		
	Flow Regulation Valve	**2**	**6**	**2**	**2**	**2**
	Chlorine Dosimeter	**1**		**1**		

	Evolutionary RTU	**1**	**9**	**7**	**2**	**2**
		1				
Tank Lukashin (8.3.6)	**Flowmeter**	**2**	**2**	**2**		
	Level Meter	**3**		**3**		
	Flow Regulation Valve	**4**	**12**	**4**	**4**	**4**
	Chlorine Dosimeter	**1**		**1**		
	Evolutionary RTU	**1**	**14**	**10**	**4**	**4**
Network Sector Shahumyan 8 (Tichina) (8.3.7)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
		1				
Network Sector Shahumyan 8 (Sheram) (8.3.8)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
		1				
Network Sector Shahumyan 8 (Z.Andranik) (8.3.9)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
		1				
Network Sector Shahumyan 2 (Raffi)(8.3.10)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
		1				
Network Sector Shahumyan 1 (Babajanyan)(8.3.11)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
		1				

Network Sector Shahumyan 11 (for Isakov)(8.3.12)	**Flowmeter**	**1**	**1**	**1**		
	Simplified RTU	**1**	**1**	**1**		
		1				
Network Sector Shahumyan 11 (for Tairov)(8.3.12)	**Flowmeter**	**1**	**1**	**1**		
	Simplified RTU	**1**	**1**	**1**		
		1				
Network Sector Shahumyan (for v. Haxtanak most)(8.3.13)	**Flowmeter**	**1**	**1**	**1**		
	Simplified RTU	**1**	**1**	**1**		
		1				
Network Sector Shahumyan (for v. Haxtanak tser) (8.3.14)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
		1				
Network Sector Shahumyan (near rob. Factory for Tairov)(8.3.15)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
		1				
Network Sector Shahumyan 5 (Shrjanajin)(8.3.16)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		
		1				
Network Sector Shahumyan 6 (Kurxinyan)(8.3.17)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**2**		**2**		
	Simplified RTU	**1**	**1**	**3**		

2.3.11. REMOTE PROCESSING EQUIPMENT FOR ARZNI NETWORK (NETWORK N°9)

The Arzni network is constituted by a pumping station equipped with 2 pumps feeding 2 tanks.

The project includes the control and the command of the pumping station, the 2 tanks, the 2 points on the main line as well as of 1 point (sector) on the distribution network.

2.3.11.1. EQUIPMENTS TO BE MANAGED

Equipments to be managed on the Arzni network are listed in the board following according to their feature.

Installation Type	Identification	Pump	Flowmeter	Pressure sensor	Level sensor	Motoriezd valves	Chlorination dosimeter	Chlorination injector	Voltage and intensuty measurement	On-site power supply	GSM signal coverage
Pumping Station	**Arzni (9)**	**2**	**2 + (1)**	**1 + (2)**		**(6)**	**(1)**	**2**	**2**	**Yes**	**Yes**
Main Line	**Moris (9.1)**		**1**							**Yes**	**Yes**
	Andoy domik (9.1.1)					**(2)**				**Yes**	**Yes**
Tanks	**Dinamo (9.1.2)**		**1**	**(1)**		**(1)**	**1**			**Yes**	**Yes**
	Kovkasyan (9.2)		**2 + (1)**		**1**	**(2)**	**1**			**Yes**	**Yes**
Network	**Sector 1 Qochar Kulpenk(9.2.1)**		**1**	**(1)**						**Yes**	**Yes**

Noted: on indication in board of the type(x), (The number enters bracket) specifies the number of the type of envisaged equipment but who does not exist at present.

2.3.11.2. REMOTE PROCESING EQUIPMENTS

Equipments allowing the remote processing of the Arzni network are defined in the following board.

Installation Location	Type of Instrumentation and Equipment	Quantity	Digital Input (DI)	Analog Input (AI)	Digital Output (DO)	Analog Output (AO)
Pumping Station Arzni (9)	Pumps	2	8		2	
	Flowmeter	3	3	3		
	Pressure Sensor	3		3		
	Flow Regulation Valve	6	18	6	6	6
	Chlorine Dosimeter	1		1		
	Chlorine Injector	2				2
	Power Meter	2		4		
	Evolutionary RTU	1	29	17	8	8
Main Line Moris (9.1)	Flowmeter	1	1	1		
	Simplified RTU	1	1	1		
		1				
Main Line Andoy domik (9.1.1)	Flow Regulation Valve	2	3	1	1	1
	Evolutionary RTU	1	6	2	2	2
Tank Dinamo (9.1.2)	Flowmeter	1	1	1		
	Pressure Sensor	1		1		
	Flow Regulation Valve	1	3	1	1	1
	Chlorine Dosimeter	1		1		

	Evolutionary RTU	**1**	**4**	**4**	**1**	**1**
		1				
Tank Kovkasyan (9.2)	**Flowmeter**	**3**	**3**	**3**		
	Level Meter	**1**		**1**		
	Flow Regulation Valve	**2**	**6**	**2**	**2**	**2**
	Chlorine Meter	**1**		**1**		
	Evolutionary RTU	**1**	**9**	**7**	**2**	**2**
Network Sector 1 Qochar Kulpenk(9.2.1)	**Flowmeter**	**1**	**1**	**1**		
	Pressure Sensor	**1**		**1**		
	Simplified RTU	**1**	**1**	**2**		

2.3.12. SUMMARY OF THE REMOTE PROCESSING EQUIPMENTS

Equipments allowing the remote processing of all the drinking water networks feeding the city of Yerevan are synthesized in the board below.

Drinking Water System	Identification or Location	Simplified RTU With GSM + 8 DI + 4 AI	Evolutionary RTU	SCADA Work Station
n°1	**GARNI**	**11**	**9**	
n°2	**KATNAGHBYUR**	**23**	**16**	
n°3	**ARARATYAN**	**3**	**2**	
n°4	**DZORAGHBYUR-YERGES**		**1**	
n°5	**TSARAVAGHBYUR**	**2**	**2**	
n°6	**SHOR-SHOR**		**3**	
n°7	**APARAN**	**14**	**18**	

n°8	**ARZAQAN-GYUMUSH**	**16**	**7**	
n°9	**ARZNI**	**2**	**4**	
Yerevan Djur Technical Office	**YEREVAN**			**1**
Total		**71**	**62**	**1**

2.4. SCOPE OF WORKS

2.4.1. REMOTE PROCESSING EQUIPMENTS

The contractor will owe the supply, the transport, the installation, the connectings and the putting into service of the following equipments of remote processing:

- 1 Central Post of Supervision (SCADA), constituted by 2 workstations.
- 71 Simplified Remote Terminal Unit (RTU).
- 62 Evolutionary Remote Terminal Unit (RTU).

The contractor also have to plan in his service all the necessary equipments for the installation and for the supply of the remote processing equipments, for the minima:

- The control/command cupboards allowing the interfacing of all the concerned equipments. (IP68 for the outside)
- The addition of protections (circuit breakers) in the electric cupboards for the supply of equipments including cablings.
- The supply of the protections against the surges and the lightning of the remote processing equipments .
- The supply of uninterrupted power systems or batteries for the preservation in permanent functioning of remote processing the equipments.
- As well as all the necessary accessories to assure a smooth running of the remote processing system.

The entrepreneur will also have to plan in his offer the staff training.

2.4.1.1. CENTRAL POST OF REMOTE PROCESSING SYSTEM (SCADA)

The Central Post of Remote processing will be installed in the offices of Yérévan Djur, it will be constituted by two workstations, as well as of a wall big screen.

Both workstations will have to be able to be centralized in the same place either be used in master / slave mode with a deported post.

2.4.1.2. REMOTE TERMINAL UNIT (RTU)

The Remote Terminal Units described previously for each of the sites will be installed locally on every corresponding site.

3. SCADA SYSTEM SPECIFICATION

3.1. FUNCTIONAL DESIGN SPECIFICATION

The Contractor shall submit a Functional Design Specification (FDS) to be approved by The Engineer prior to manufacture and purchasing of equipment.

The FDS shall be submitted in English and the national language of the Purchaser on A4 size sheets numbered within each section and page within section, to include, but not limited to, the following for each Treatment Area and item of packaged plant:

- Content List.
- Reference to supporting standards, manuals and specifications.
- Description of the design and design criteria.
- Relevant details of associated mechanical, electrical and instrumentation equipements.
- Control philosophy (functional description).
- Complete set of supporting drawings.
- Design documentation, including:
  - A description of each major element of the control scheme.
  - A flow-chart or pseudo-code description of each sequential element of the controle scheme.
  - Analysis of failure modes and shutdown procedures.
- Calculations.
- Quality control procedures and approvals.
- Outline of test procedures.
- Manufacturer's literature for each item of equipement supplied.

All drawing shall be on A4 or A3 sized paper as appropriate to ensure legibility include a title block detailing:

- Purchaser's Name.
- Contract Title.
- Contractors Name.
- Drawing Title.
- Drawing Number.
- Date.
- Author.
- Verification and approval by the Contractor prior submission.

3.2. SYSTEM OVERVIEW

A control centre should be established in a location to be agreed with the Engineer to accommodate the Dispatcher equipment and operator workstations.

The system implemented should be able to operate within the control strategy described but shall be flexible enough to be easily changed should the control philosophy change.

The proposed system shall provide:

- A centralised Dispatcher processing function, complete with standby facilities and local workstations.
- Distributed intelligence using microprocessor based Programmable Logic Controllers (RTU's) for monitoring and data logging. Under normal operating conditions, the RTUs shall monitor and control plant to given schedules and record the installation's operational/performance data e.g. pump start/stop, inlet flow, storm tank level etc.
- The RTUs shall have programmable alarm limits for discrete and rate of change settings. This shall apply to both real and derived values. There shall be a facility for high and low priority alarms, e.g. low, very low, high and very high.

In order to cater for communications failures, the RTU shall be capable of holding 8 days worth of data as follows:

- Analogue, totalised and derived signals - on significant change/15 minute intervals.
- Digital signals on change of state.
- The data gathered from the RTUs shall be incorporated into the Dispatcher database and shall also be made available to applications programs written by the client.
- Where RTUs are programmed to perform local control of plant it shall be possible for the programmes, schedules, set-points etc. to be downloaded from the Dispatcher. Subject to being assigned suitable privileges, system users shall have the facility to make short term alterations to RTU control schedules via the control centre, e.g. to implement remedial action when an alarm occurs.

SCADA Control shall be effected at two levels, these being:

- RTU local control via programs stored locally at the RTU, e.g. pump start, fallback control.
- Supervisory control from the control centre. An authorised user, at the control centre shall be able to modify the control routines at any RTU by downloading new control (start/stop) schedules, new performance criteria e.g. increase/decrease flow/pressure or operating individual items of plant e.g. open/close valve, start/stop pump.
- There shall be a requirement to download control programs and schedules to the RTUs from the dispatcher via the communications network.
- The preferred method of communication with site based RTU's is cable with low power UHF radio for remote sites. As future developments may require different forms of communication at specific sites, the equipment shall be capable of operating in all modes with minimal software changes.
- The system shall operate using 'management by exception' techniques. The RTU shall monitor and control the site and record operational data. When an alarm condition is detected the RTU will dial into the master station immediately to announce the alarm and forward any data collected. Where alarm conditions arise, individual alarm presentation with alarm lists, mimic and tabular diagrams, and help pages shall be available to assist the operator.

3.3. DISPATCHER SYSTEM HARDWARE

3.3.1. GENERAL

A centralised SCADA Dispatcher shall be provided for the SCADA system unless otherwise specified within the particular specification.

All equipment required to fulfil the requirements shall be industry standard proven computing equipment with a demonstrable long-term life cycle and support.

To permit other manufacturer's equipment, e.g. RTUs, to be added to the SCADA system, all equipment shall, wherever possible, interface using open-system communications protocols.

3.3.2. SYSTEM AVAILABILITY

3.3.2.1. GENERAL

The strategic importance of the SCADA system requires a high level of system availability, i.e. not less than 99.9% availability for each calendar year. The SCADA system shall therefore be provided with the following.

3.3.2.2. HOT STANDBY

The system shall be provided with a master and standby Dispatchers where the standby Dispatcher shall be continually updated and automatically assume responsibility within 30 seconds following failure of the master Dispatcher.

Synchronisation of the databases following system recovery shall be automatic i.e. shall not require manual intervention.

3.3.2.3. UNINTERRUPTIBLE POWER SUPPLY (UPS)

The system shall be provided with a UPS capable of supporting all the main computer equipment (central processing units, discs, communications processors etc.), operating consoles and the alarm/event printer for a period of not less than 4 hours. The UPS shall be provided to cater for a 50% increase in load without the need for additional hardware.

Note: Essential services, e.g. UPS, generator and security etc. shall be monitored by the SCADA system.

3.3.2.4. MAINTENANCE

The Dispatcher equipment shall be subject to a maintenance contract where a competent engineer shall attend site within 8 hours from the time the failure was reported, twenty four hours a day, 365 days a year.

3.3.2.5. COMMUNICATIONS EQUIPEMENT

The Dispatcher equipment shall be provided with all necessary communications equipment to support:

- All operator workstations.
- All printing devices.
- The communications network comprising:
  - Communications to all on-site RTUs.
  - All remote equipment.
  - Equipment as detailed in the particular specification.

3.3.2.6. DATA STORAGE

Each master station shall be provided with the following storage media:

- Random Access Memory – to store the "real–time"/instantaneous database.
- Hard discs – to store the system configuration, mimics and local short–term (70 days) historical database etc.:
  - Digital points on change of state.
  - Analogue points at 15 minute intervals.
  - Derived points.
- Optical disc - to store off-line (greater than 70 days old) historical database, system backups, data transfer etc.
- DVD burner- to transfer data to off-line PC equipment.

3.3.2.7. OPERATOR WORKSTATION

The operator workstations shall be the main Man-Machine Interface (MMI) and shall consist of 23 inch (minimum) Visual Display Units (VDUs) capable of displaying graphical and alphanumeric characters in at least sixty-four colours in all foreground/background combinations.

The VDU shall have an associated keyboard consisting of a standard typewriter QWERTY alphanumeric set, with additional numeric and special function keys, augmented by a mouse or tracker-ball.

3.3.2.8. PRINTING DEVICES

The system shall be provided with two types of printing device:

1) Alarm/Event Printer:
   - To provide a hard copy log of all alarms and significant events, e.g. operator sign-on or control override issued a medium speed dot matrix printer shall be provided. The printer shall be capable of 300 characters per second, 132 characters per line, multiple colours (to differentiate alarms and level of alarms from events) and operating on continuous fan fold stationery.
2) Colour Printer:
   - To provide high quality printed output for report summaries, programme development, copies of mimic displays, historical trends etc., issued a high speed colour ink-jet printer shall be provided.

3.3.3. REMOTE DATA TRANSFER

The SCADA system shall be capable of processing the data received from operational sites e.g. into daily minimum, maximum and means, and forwarding the raw and processed data to off-line packages e.g. Microsoft Excel.

3.4. SYSTEM FEATURES

3.4.1. GENERAL

The Purchaser requires a low risk system supplied with proven software.

3.4.2. SYSTEM ACCES

Users of the system shall be allocated individual passwords allowing each user an appropriate level of access commensurate with their requirements, responsibilities and areas of knowledge and interest.

Three general categories of access have been identified:

- Data only.
- Data and Control.
- Data and System Management.

Data only shall be generally available to all system users. Data and control shall be limited to those personnel with the knowledge and responsibility to take control actions.

3.4.3. COLOUR GRAPHICS DISPLAYS

The following display types shall be available on all colour graphics terminals:

- Mimic diagrams.
- Help pages.
- Graphs.
- Bar charts.
- Alarm and event log listings.
- System configuration and maintenance displays.

3.4.3.1. MIMICS DIAGRAMS

Mimic diagrams are required to present a pictorial representation of the plant and its present status. Features required are as follows:

- Display of fixed (background) diagrammatic plant information and text.
- Display of variable information i.e. symbols or text displaying plant status.
- Easy picture creation, possibly using a CAD style package.

3.4.3.2. DISPLAY OF VARIABLES

Variables can be considered as digital on/off parameters, analogue or totalisors.

Digitals may be either status (e.g., running/stopped) or alarm points, and shall be displayed by:

- Text changing.
- Symbol colour changing.
- Symbol shape changing.
- Text or symbol flashing.

It must be possible to associate more than one digital point with a symbol, so that more than two colours/shapes can have operational meaning. For example, a pump may be shown in four colours indicating running/stopped/failed/non-operational.

In addition, it shall be possible to associate any number of symbols within different mimics with a particular digital point.

Analogues and totalisors shall be displayed by:

- Numeric value.
- Bar chart.
- Graph.

It shall be possible to display all these three types of indication in mimic diagrams. Colour changes shall be used to indicate further information about a point, e.g. if an alarm limit has been exceeded.

3.4.3.3. DISPLAY ATTRIBUTES

Using the display facilities described above, the mimic diagrams shall indicate the following attributes for analogue, digital and totaliser points:

Attribute	Point Type
Status On/Off	Digital Status
Alarm/Normal	Digital Alarms
1st Stage Alarm (High, Low)	Analogues
2nd Stage Alarm (High-High, Low-Low)	Analogues
Communications Failure	All
Alarm Manually Suppressed (out of service)	All
Alarm Automatically Suppressed	All
Out of Range	Analogues

3.4.3.4. PICTURES CREATION

It is essential that picture creation is a straightforward procedure, a CAD type package would be suitable. It must be possible to create symbols which may then be used in any orientation, size and colour and to create a symbol library, i.e. a part of a diagram which may then be used many times. It must be possible to display, on any single mimic diagram, information from anywhere within the system.

3.4.4. HELP PAGES

Help pages shall be available within the system, to assist the operators in dealing with received alarm conditions. These pages will be compiled by the plant managers and will provide advice as to which staff shall be notified of which alarms.

Help pages may be presented as individual pages accessed from a mimic, or as a window superimposed on a mimic.

3.4.5. GRAPHS

Graphical representation of historical data is required, with a selectable time base and the ability to put up to four graphs on display at once on the same axes, using different colours.

The system must be easy to use, with automatic default facilities so that only a minimum of instructions need be given to the system to obtain each plot.

Features that will be required are:

- Pre-configured and ad-hoc trend displays.
- Ability to compare graphs over different time spans, e.g. today's flow compared against yesterday's flow.
- Read-out of the actual value of a graph at a given time point.
- Ability to roll a graph forward and backwards in time.
- Ability to set the scale for each graph.
- Trend graphs giving a plot of the selected variable up to the last scan, updating when a new value is received.
- Ability to incorporate a trend graph as a feature on a mimic diagram.
- Graphical output of both analogue and digital signals (real and derived). Digital signals will produce a square wave type plot indicating for instance when a pump started and stopped.
- Auto ranging scale unless manually overridden.
- Ability to display data from different sites within the same trend display.

3.4.6. BAR CHARTS

A bar chart type representation of analogue variables is required. This is required on mimic diagrams, and must be capable of horizontal or vertical orientation, with selectable scaling. Width of bars must be selectable so that the feature can also be used for such items as tank level pictorial representations.

3.4.7. ALARM AND EVENT LOG LISTINGS

All alarms and changes of status (i.e. digital events) in the system shall be logged to disc. It shall be possible to recall this information to the screen via a select and sort programme. This programme shall sort and display information on at least the following bases:

- Process Area.
- Site type.
- Site name.
- Time period.
- Signal identification numbers.
- Signal state (on/off).
- Alarm status i.e. cleared, accepted and unaccepted.
- Alarms or status occurrences required.

Any sort parameters not entered shall default to "all".

3.4.8. SYSTEM SET-UP AND MAINTENANCE DISPLAYS

Suitable displays of information shall be provided to display all set-up features of the system. These displays will be closely associated with the SCADA system set-up facilities.

3.5. LOGGING ON/OFF

Every user of the SCADA system shall be required to log on (i.e. activate) his terminal when he wishes to operate on it. The system will be aware of which terminals are logged on and the access rights of the user and will therefore be aware of where to send certain information.

3.5.1. ALARM FACILITIES

3.5.1.1. GENERAL

Digital points within the system shall be capable of operating as either status (e.g. running/stopped) or alarm points (e.g. normal/failed). A digital alarm point shall enter the Alarm State when it is either a logical ‘1’ or logical ‘0’ as designated in the system set-up for each point, the opposite state being the normal condition.

Analogue points shall be provided with two high alarm limits (high and high–high), and two low alarm limits (low and low–low). Should an analogue value either rise or fall from a value considered to be normal, a first stage high or low alarm limit will be encountered resulting in a new alarm condition. Should the value continue to rise (or fall) it will then encounter the second stage high–high or low–low alarm limit again resulting in a new alarm condition.

3.5.1.2. ALARM PRIORITIES

Every alarm generated within the system shall be allocated an alarm priority to indicate the importance of the alarm. Whereas a digital point will have only one alarm priority, an analogue point will have three. This will allow the relative importance of the first and second stage high and high–high (low and low–low) alarms to be set. The alarm priority is used in conjunction with the 'area of interest' of the users logged onto the system to determine where and when a new alarm is enunciated. The priority of an alarm shall change if required depending on the time and date.

3.5.1.3. ALARM ANNUNCIATION

Alarms are to be enunciated on the operator workstation both visually and audibly, and have clear and unambiguous acceptance procedures. High priority alarms shall be presented for acceptance before low priority ones.

3.5.1.4. ALARMS FILTERING

The SCADA system shall have a "tool–kit" of facilities that may be applied to individual points in the system in order to prevent unnecessary annunciation of alarms. These shall typically include:

1) Analogues:
   - Dead Band.
   - Delay before initial alarm.
   - Minimum alarm repeat interval.
   - Logical suppression of new alarm if other conditions are presents.
   - Averaging values in RTU.
2) Digitals:
   - Delay before initial alarm.
   - Minimum alarm repeat interval.
   - Logical suppression of new alarm if other conditions are presents.

Users, subject to authorisation (i.e. correct level of access), shall be able to manually suppress an alarm, e.g., if a transducer is faulty and is being particularly troublesome. The suppression of alarms shall be logged to the event list.

3.5.1.5. DERIVED ALARMS

A combinational and sequential logic package is required within the SCADA system, allowing signals to be combined to form derived alarms. These may be combinations of analogue and digital information obtained from different sites (e.g., a pump may be running at a pumping station but no flow entering the associated inlet works resulting in a derived alarm indicating a potential burst).

3.5.2. HISTORIC INFORMATIONS

3.5.2.1. RTUS

RTUs will sample and store values of analogue parameters at predetermined intervals to cater for loss of communications. These will normally be 15 minutes but shall be user configurable between 1 minute and 24 hour intervals.

3.5.2.2. MASTER STATION

In addition to the raw operational data, a long-term archive of analogue max/min/mean values, pump hours run etc. will be maintained. Values stored will be as detailed within the Particular Specification.

3.5.3. CONTROLS

3.5.3.1. MANUAL CONTROL

It shall be possible to perform control operations (e.g. remote start/stop of pump) from any of the operator consoles. Access to controls will be limited by the access rights assigned to the individual passwords for various operatives (see System Access).

The issuing of control instructions shall take precedence over the scanning for alarms.

A well organised select check and execute system is required.

3.5.3.2. AUTOMATIC CONTROLS

Automatic control features shall be available within the SCADA system, and fall into two categories:

1) Profile type controls where a working pattern (e.g. of reservoir level) is downloaded to a RTU for use by a local control system. New profiles may be sent for each day or week etc., as required.

2) Combinational and sequential control:

There are circumstances where the only practicable way of closing a control loop is via the SCADA system, although this should be avoided whenever possible. The package used for alarm derivation will also fulfil the automatic control requirements. The following facilities shall be provided as a minimum:

- Logical AND/OR/NOT/EXOR/EQUALS.
- IF-THEN-ELSE Constructions.
- Arithmetic operations including >, $, >, #, =, +, -, H,), /.
- Logical constructions including time and data.
- Look-up tables, with interpolating facilities.
- Input to functions from any system point including digital, analogues, totalisors, controls from a keyboard, set-point input from a keyboard.
- Output from functions to be available as digital, analogue or totaliser points, or transmitted to any RTU as a control or set point.
- Access to point attributes in addition to present value, including:

  Suppressed, telemetry failed, in alarm (and for analogues, which alarm level).

3.5.4. TERMINAL TIME OUT

When a terminal is used for control purposes, it shall have to be logged on specifically for that function. If it is not used for a user configurable period of time (e.g. 5 minutes) in this mode, it shall automatically revert to a display only mode. A warning should be provided one minute prior to the auto log off.

3.5.5. SYSTEM RECORD

A record shall be kept on disc within the system of all operator actions, such as alarm acceptance or control actions performed on the system. The record shall include:

- Time and date.
- Action.
- Operator.

This record shall be retrievable from the system using a similar select and sort routine to that specified for status and alarm logs.

3.5.6. REPORT GENERATION

The system shall be capable of generating both regular and individual reports. Reports must be easily configured and altered in order to maintain their relevance.

An example of a regular report which may be produced from the system is the following, designed to be made available to the works manager each morning:

- Treatment works: previous day's output.
- Alarms that have occurred during the night.

3.5.7. SYSTEM TIME

The system shall support:

- Greenwich Mean Time (GMT/UCT).
- Daylight Saving Time (DST).
- Leap Years.

All data shall be logged at GMT/UCT + 2 hours, but automatically displayed in the appropriate local time adjusted for daylight saving.

3.5.8. SYSTEM DATA CONFIGURATION

The system shall be provided with privileged and secure on-line database building utilities i.e. it shall not be necessary to stop the scanning and alarm presentation facilities. Any configuration shall not be installed into the active database until completed, verified and authorised by the user. A reliable verification procedure shall be required to prevent the creation on invalid files and the deletion of in-use files.

It shall be possible to define process point files, calculated/derived point files, remote RTU files, to include:

- Meaningful point identification and description.
- Allocation of points to groups/locations.
- Range of analogue values in Engineering Units.
- Alarm limits/categories.
- Scan control/frequency.
- Report control (whether change of state is to be logged to the alarm/event printer).
- Save control (whether values are to be archived).
- MIS control (whether values may be transferred to other systems).

3.5.9. SYSTEM RESPONSE TIMES

The Dispatcher provided under this contract shall meet the following performance criteria:

Item	Description	Response (seconds)
1	From change of state of plant being detected by RTU	0.5
2	From change of state being detected by the Dispatcher to updating the SCADA database	0.5
3	From change of state in the SCADA database to updating the alarm list	0.5
4	From change of state in the SCADA database to updating the active mimic	0.5
5	All requests for mimic displays, alarm lists and help pages from the completion of the operator request.	3
6	All requests for trend displays and event lists shall from the completion of the operator request.	10
7	Time to perform screen dump from completion of the operator request	30

4. EQUIPMENT

4.1. REMOTE TERMINAL UNIT (RTU)

4.1.1. QUALITY CRITERIA

Equipments installed within the framework of this project of remote processing will have to answer particularly the following criteria:

- A very big reliability to guarantee a maximal availability of the remote processing, even on very exposed sites.
- An important sustainability of the solutions proposed for allow to realize easily a future extensions with the best cost.

A big simplicity of implementation and use to minimize the times of putting into service and assure the control of this tool by the staff concerned without specific training.

4.1.2. ASSEMBLY IN CUPBOARD

The RTU can have risen in face before of an electric cupboard to reach the data of the RTU on the graphic screen without having to open the cupboard.

4.1.3. MATÉRIAL

4.1.3.1. RELIABILITY AND MODULARITY

To guarantee the reliability of equipments, the proposed RTU must be conceived with components allowing a high pretection EMC (Electromagnetic Compatibility); that is the level 4 for the following standards:

- **IEC EN 61000-4-4**: Testing and measurement techniques - Electrical fast transient/burst immunity test.
- **IEC EN 61000-4-5**: Testing and measurement techniques - Surge immunity test.

Every RTU will have to have modular architecture:

- On one hand, to fit at best the configuration of the post to the need for the installation.
- On the other hand, to allow extensions a lesser cost.

Finally the modularity will allow to facilitate the maintenance: the cards being independents, the one compared with the others, the diagnosis will be faster and the replacement of a defective card will be made very easily.

4.1.3.2. ELECTRONIC CARDS

The not exhaustive list of cards below can constitute a RTU following the needs for the site to be equipped:

1) Inputs/Outputs Cards.
   - Digital Input Card.
   - Analogic Input Card.
   - Digital Output Card + Guard dog.
   - Analogic Output Card (If later need).
2) Cards of Communication.
   - GSM Modem.
   - RTC Modem.
   - Card for connections LS / LP.
   - Card for connections Ethernet.
   - Card for connections Radio.
   - Serial Interfaces RS232 / RS485.
   - Card for badge reader (Access control).

To facilitate the cabling, all the cards must be equipped with disconnectable terminal blocks.

Cards for the acquisition of the Analogic Inputs will have to be capable of feeding directly the sensors 4-20 mA, without requiring the appeal to an external power supply. This power supply must be protected from the short circuits.

Cards for the acquisition of the Digital Inputs will have to be of the type " in dry contact ": they will have to supply an opto-insulation and the power supply of the contacts via an isolated power supply besides with the equipment.

4.1.3.3. POWER SUPPLY OF THE RTU

The power supply of the RTU is a sensitive part. The group constituted by the power supply card and the safety power supply (battery / UPS) will have to answer the following characteristics:

- A battery charger (plan a battery offering a minimal autonomy of 12 hours).
- A device against the deep discharges to protect the life expectancy of the battery during prolonged power break.
- A protection against the inversions of polarity.
- A presence detection battery.
- A periodic test of capacity of the battery.

This last function guarantees the efficiency of the battery while optimizing maintenance costs (the battery will be only replaced on detection of insufficient capacity).

4.1.3.4. GSM MODEM

The modem GSM of the PLT is also an essential element because he assures the link with the control centre and the distant users. He will thus have to be of a big reliability and have a guarantee of sustainability.

The modem GSM will thus have to be integrated into the RTU. He cannot involve an office automation modem or an external modem of the business the characteristics of which are not adapted at the applications of remote processing.

4.1.4. FEATURES

The RTU proposed will have to assure the following functions:

1) Acquisition of inputs - outputs.
   - Digital status (on/off, defaults, …).
   - Measures (level, pressure, …).
   - Countings (Flow, time of functioning, …).
   - Command (opening/closing, …).
   - Regulations (Instruction of Flow, …).

The acquisition of inputs-output will be made or by means of cards of integrated or external inputs-output in the RTU.

2) Treatment of the acquired information
   - Measures (level, pressure, …).
   - Warning levels.
   - Temporizations of the alarms.
   - Calculation of balance sheets.
   - Complete module for the archiving of the information and the events:
     - For the measures : periodic archiving of the value and on variation if the measure evolves in a significant way between 2 archivings.
     - For the Digital inputs - output: archiving in every change of state.
     - For the countings : periodic archiving or in the form of balance sheets.

All these treatments will have to be configurable by the user, via an interface operator. This interface operator, schedules no requiring IT programming.

3) Transfert of alarms

The alarms will have to be able to be transmitted by GSM in the form of vocal messages, of SMS or of Emails towards on-call agents, or towards control centre.

The authorized people will have to be able to at any time consult at a distance the information of the installation via the voice server or by SMS, so authorizing a big freedom of movement.

4) Communication with other equipments

For the future evolutions, the RTU will have to be capable of communicating with other equipments by using a standard protocol as the MODBUS or MODBUS-TCP.

5) Interface Operator of exploitation

For the local exploitation, the RTU will have to integrate a graphic screen allowing the consultation of states, alarms, values archived in the form of curve, and the positioning of the instructions (according to the seizure of a password).

For the remote exploitation, the RTU or GSM will have to have a voice server allowing the management of the alarms, the consultation of states and the activation of commands.

Finally the RTU will have to be totally accessible, in local and remote, via a simple Internet browser, on PC.

6) Interface Operator of configuration

To assure its control by the concerned users, the tool of configuration will have to be particularly intuitive and call on to simple notions of "questions-answers" using the usual terms of the job (no specific language of programming). This tool of configuration will have to work on a standard PC and call on to graphical interfaces easy to treat.

7) Automatism

The RTU will have to have a function allowing to realize simply combinations between digital inputs, or to make an elementary automatism. On the other hand, to answer needs for more elaborate automatisms (regulation, permutation / management of pumps, the RTU will have to have a language of standard automatism (according to the standard IEC1131-1) and libraries of functions ready for the use.

4.2. COMPUTER HARDWARE

The computer hardware will be constituted according to necessary caratéristiques for the smooth running of the SCADA, but for the minima for a workstation of:

1) 1 Central unit.

Type : Intel Core 2 Duo 3,0 GHz.

2 Go de RAM.

2 DD SATA de 160 Go unitary.

XP Pro SP3 + Office PME 2007.

Engraver DVD + RW DL SATA.

Integrated sound card + microcomputing and Loudspeaker..

1 Ethernet port.

3 RS232 ports.

2 LPT ports.

10 USB ports.

Integrated remote maintenance modem.

2) 1 Armenian QWERTY keyboard.

3) 1 LCD 24" Full HD screen.

4) 1 A4 color printer.

5) 1 Current Black & White printer.

6) 1 optical mouse with programmable buttons and thumb wheel of navigation.

As a supplement to the material for every workstation, he will have to be supplies:

7) 1 Wall screen LCD 42'' Full HD.

5. COMMUNICATIONS

5.1. GENERAL

The Contractor shall supply install and commission all necessary communications equipment and software to provide a complete integrated communications network for the SCADA system.

5.2. EMPLOYER LIAISON

The Employer will be responsible for the processing the licences required from the national licensing agencies.

The Contractor shall, however, provide all detail design calculations, equipment characteristics, equipment approval certificates and completed application forms for the Employer to enable the Employer to process all applications for communications circuits, frequencies etc. as an administrative task.

The Tenderer shall, within his bid, allow for all necessary tests to prove compatibility of the offered equipment with the national licensing agencies and communications standards.

5.3. DATA RATES

The Contractor shall ensure that the data rates are not less than the following:

- Public Switched Telephone Network (PSTN) Direct Exchange Lines (DEL) connection: 2400 Baud.

5.4. TRANSMISSION AND PROTOCOL

The Contractor shall wherever possible use an industry standard transmission protocol. The Contractor shall provide details of the proposed protocol to be used at the time of Tender.

5.5. ELECTRONIC EQUIPMENT

All communications equipment used in the communications system shall be of high reliability and shall comply with the most recent edition of appropriate National and International Standards Specifications and recommendations at the time of Tender.

5.6. LIGHTNING PROTECTION

5.6.1. LIGHTNING PROTECTION DEVICES

The Contractor shall provide lightening and surge protection devices at each RTU on each communications circuit, base station and at all other parts of the radio network to ensure isolation and automatic resetting of the system being subject to high surge currents. Devices shall be unfused.

Lightning protection shall conform to the appropriate sections of BS6651, code of practice for protection of structures against lightning.

Lightning protection shall be selected to provide the highest degree of protection possible for the circuit being protected i.e. the clamp voltage shall be the lowest possible commensurate with normal operation of the circuit.

The type and manufacturer of the Lightning Protection Unit (LPU) shall be subject to the approval of the Engineer.

LPUs shall be earthed to the nearest earth reference bar, as direct as possible without inductive loops by a single unjointed cable.

Individual LPUs shall bolt directly onto a lightning earth bus bar. Cables and cores containing the circuits to be protected shall not be loomed or grouped together until the circuits subject to induced lightning energy have passed through the protection units.

Where two or more LPUs are mounted on the same Din rail mounted earth bar, the cable shall be sized as follows:

1) Cables less than 6 metres: 10 sq. mm.

2) Cables greater than 6 metres: 16 sq. mm.

The whole assembly shall be mounted inside an insulated box, if not already mounted separately from other equipment, close to the chosen earth termination in order to achieve a short, straight connection.

LPUs that are mounted in an enclosure supplied with an a.c. electrical power supply that utilise Din rail mounted earth bars shall have either:

3) The earth bars insulated by means of proprietary stand-offs or.

4) The Din rail insulated in an approved manner from the electrical power earth or any earthed conducting surface.

The route for the earth conductor shall be as far away as possible from the vicinity of the signal cables.

The earth conductor shall be copper, no greater than 16 sq. mm in section, it’s route shall be as short and direct as possible and, in any case, no longer than 10 metres.

Ideally the cable route should be straight, but any necessary bends shall have a long radius.

The earth termination and the method of connection shall be subject to the approval of the Engineer.

5.6.2. EARTH ELECTRODES

The Contractor shall provide an earth electrode system in cases where the contract provides for the facility of lightning surge diversion equipment. The system shall be cabled to the main protective conductor system at the common point of connection of the distribution system that it serves.

Earth electrode systems shall be provided where specified in the particular Specification.

Where the provision of lightning protection is specified, the Contractor shall provide an earth electrode system in accordance with the relevant code of practice.

5.6.3. EARTH ELECTRODE INSTALLATION

Earth electrode installation shall connect earthing conductors to the general mass of the earth. The installation shall comprise one or more earth rods, mesh or combination thereof to obtain the required earth electrode resistance.

Earth rods shall be of proprietary manufacture, 16 mm outer diameter, made up of sections of 1.2 metres long with internal screw and socket joints and fitted with hardened steel tip and driving cap. They shall be driven into the ground to a minimum of 2.4 metres.

A minimum of two earth rods or other electrode shall be provided for each main earthing system and the conductor brought back to the main earth bus bar for each.

Connections to the electrodes are to be readily accessible for periodic inspection and shall be protected against mechanical damage and corrosion. The actual connection to the rod shall be by means of a purpose made non ferrous clamp and shall be made below ground level in a concrete inspection pit having a removable cover.

When the installation is complete, soil resistivity or other tests shall be performed and witnessed by the Engineer, to ensure that the required earth loop impedance figure of less than 5 ohms is attained.

5.7. TESTING

The Contractor shall allow for the following tests with regard to communications equipment:

1) Factory testing of sub-assemblies.

2) Factory testing of complete units.

3) Factory simulated system tests to prove the performance of all elements of the integrated communications network.

4) Commissioning tests of all installed radio equipment to record the characteristics for future maintenance of the network.

Test certificates shall be provided at each stage and for each complete unit and sub-system. The Contractor shall supply all test equipment and shall provide seven days notice prior to testing to the Engineer.

5.8. PSTN COMMUNICATIONS

5.8.1. GENERAL

All equipment for connection to the PSTN lines shall be offered:

1) To comply in all respects to the National and Local regulations and approvals.

2) To comply with the most recent editions of appropriate CCITT Recommendations, National and International Standards Specifications and Recommendations.

3) Such that any line sending and receiving sensitivity controls shall be capable of alteration by removal of the unit by authorised maintenance personnel.

4) With evidence of prior use by major national telecommunications networks, together with type approval numbers and full details of CCITT Recommendations, National and International Standards Specifications and Recommendations met.

5.8.2. MODEMS

The Contractor shall supply and install all modems and interconnecting wiring to the SCADA system and telephone equipment as appropriate.

RTU equipment modems shall form part of the RTU unit and shall be compatible with the associated 'line connection' modules.

All modems shall be approved by the national and local service provider and shall comply with V21, V23, V26, and V29 (III-1) as appropriate.

6. TESTING

The Contractor shall provide for system testing as detailed. The tests shall conform to BS 5887 (code of practice for testing of computer based systems) and BS 6238 (code of practice for performance monitoring of computer based systems).

The Engineer shall approve all acceptance procedures for inclusion within the system specification.

6.1. FACTORY ACCEPTANCE TEST

6.1.1. GENERAL

The Tenderer shall provide for full Factory Acceptance Test of the fully configured system, to include:

1) The complete system network.
   - Support for all RTUs with all points over an integrated network, simulated to include all types of communications units and interfaces.
2) Mimic display pages on the system as defined within the particular specification.
3) Test 1 - Simultaneous occurrence of:
   - The control centre polling outstations in normal (i.e. daytime) operational mode receiving 50% of data from each RTU with 10% of points in alarm conditions.
   - Operator workstations performing:

     Simultaneous access.

     Access staggered by 2 seconds.
4) Test 2:
   - As test 1.
   - Performing daily system archive.
5) Test 3:
   - As test 1.
   - Performing archive data recovery.

     Full daily archive recovery.

     Four data points for one week (15 minute intervals).
6) Test 4:
   - As test 1.
   - Performing screen dump.
   - Printing daily report.

The simulation package shall use the SCADA system to demonstrate proper performance under full utilisation conditions.

The Contractor shall record the following:

- DISPLAY RESPONSE: This shall be no greater than as specified.
- PERCENTAGE CPU UTILISATION.
- SCAN TIME: This shall be no greater than 1 minute for full system scanning.
- TIME TO CLEAR BACKLOG: The Contractor shall also record any adverse conditions that become apparent.

The Contractor shall substantiate the validity of the simulation to the Engineer and shall confirm, at the time of Tender, by what means such simulation will be carried out.

1) The RTU to demonstrate:
   - All control and failure recovery sequences, simulating all digital and analogue inputs and outputs on each system.

2) The communications system to demonstrate:
   - Full simulation utilising all interface nodes, with RTUs connected, in order to prove the performance over the network. Communications failures shall be simulated in order to prove the automatic re-routing of communications to SCADA system.

6.1.2. FACTORY ACCEPTANCE TEST - WITNESSING

The Factory Acceptance Test shall be conducted in the presence of witnesses, who shall be nominated, in writing, by the Employer and the Contractor respectively. The witnesses shall be empowered to act during the Factory Acceptance Test, on behalf of the parties they represent, to judge the success or failure of a particular test. Either party as necessary, in writing may appoint nominated Deputies.

The Contractor shall provide evidence that the tests (FAT/SAT) have been successfully performed prior to the witnessing by the Engineer.

6.1.3. FACTORY ACCEPTANCE TEST - PROCEDURES

The testing procedures shall be designed such that each separate testable entity (e.g. hardware configuration, picture building) consists of a well-defined series of tests.

Each test shall be documented to include:

- The purpose of the test.
- Any pre-requisites required allowing the test to be completed successfully.
- Any hardware required allowing the test to be performed successfully.
- A detailed schedule of activities to be performed within the test.

6.1.4. FACTORY ACCEPTANCE TEST - RECORD

A log shall be maintained during the Factory Acceptance Test. This log shall record for each test performed:

- The test results.
- Any faults which occur.
- Any remedial action taken.
- Re-test results.
- Decisions taken by the witnesses which may affect the test results.

The witnesses of both parties shall initial all entries within the log.

Copies of the log shall be provided to the Employer on completion of the Factory Acceptance Test.

6.1.5. FAILURE AND RE-TEST

The success or failure shall be determined as follows:

- If the system performs as laid down in the Functional Design Specification the test shall be deemed successful.
- The tests shall not be failed due to external conditions, e.g. power fail, provided the system fulfils the resilience criteria detailed within this tender document and any subsequent project specification.
- The tests shall not be failed through incorrect operation provided the fault can be corrected by normal operating procedures and provided the test performed satisfactorily in all other aspects (e.g. printer ribbon failure).

Any test that is deemed unsuccessful may be retried following any remedial action that may be necessary.

If the system should fail any test and it is apparent that the fault may have affected the result of tests previously regarded as successful any or all of the tests affected may be re-tested.

To allow all participants to fully understand all aspects of the Factory Acceptance Test, the Factory Acceptance Test Specification as agreed between all parties shall be issued with the Contractor's Project Specification (CPS).

6.1.6. SYSTEM MANAGEMENT

The Factory Acceptance Test shall include, but not be limited to, the following as defined within Contractor's Project Specification.

1) Hardware
   - The hardware configuration being tested shall be fully detailed and cross-referenced against the Tender Return Document.
2) System Start-up and Shut-down Procedures
   - These tests shall exercise the system start-up and shut-down commands including:
     - System start-up commands.
     - Operator log-in and log-out commands.
     - Password verification.
     - Any special function command keys.
     - Orderly system shut-down.
3) System Back-up and Recovery
   - These tests shall exercise the system back-up and recovery procedures, including:
     - System back-up to archive media.
     - Orderly system shut-down.
     - Synchronisation of the Master Station and outstations.

6.1.7. SCADA DATA BASE CONFIGURATION

These tests shall exercise the database commands including:

- Password and level of access maintenance.
- The creation and amendment of RTUs.
- The maintenance of RTU communications parameters, e.g. telephone numbers, radio characteristics, change of media, scanning intervals, on/off telemetry scan.
- Regions of interest.
- Creation and amendment of SCADA points:
  - Name.
  - Type, e.g. status, analogue, derived.
  - Alarm limits.
  - Historic data recording and characteristics.
  - Re-transmission of value to associated points.
  - Scaling factors.
  - Calculation formulae maintenance.
  - Set output control parameters for digital, analogue and derived controls.

6.1.8. PICTURE CONFIGURATION

The tests shall exercise the picture configuration commands available to the privileged operators, including:

- The creation of picture pages, to include foreground/dynamic and background/static picture elements.
- The modification of picture pages, to include foreground/dynamic and background/static picture elements.
- The deletion, copying and renaming of pictures.
- Any function control key usage.
- Examples of all picture types, e.g.:
  - Static information pages (e.g. indices).
  - Mimic pictures for information display and control monitoring.
  - Alarm list pages.
  - Statistical pictures (e.g. trends, histograms).
  - Help/text pages.
- The display and printing of pictures.

6.1.9. DATA COLLECTION

These tests shall exercise the data collection commands available to the privileged operators, including:

- The collection of digital, analogue and derived parameters.
- The collection of all data from outstations at frequencies defined by the privileged operator.
- The manual entry of data.
- The inhibition of data collection from a RTU.
- The inhibition of data collection from an individual point.
- The editing of stored data (subject to correct level of access).

6.1.10. SUPERVISORY CONTROL

These tests shall exercise the supervisory control commands, including:

- The creation and downline loading of control sequences.
- Digital, e.g. open/close, and analogue, e.g. set point, controls of individual control points.
- Revertive checks to ensure the correct control point is addressed.

6.1.11. ALARM/EVENT HANDLING

These tests shall exercise the alarm and event reporting procedures, including:

- Digital and analogue alarms:
  - Reported on the alarm/event printer.
  - Logged to disc.
  - Reported to the appropriate operator consoles.
- Events, e.g. issue remedial control command:
  - Are only issued from appropriate operator consoles.
  - Logged to the alarm/event printer.
  - Logged to disc.
  - Are subject to correct level of access and regions of interest.
- Alarm acceptance/acknowledgement procedures.
- Alarm list interrogation procedures.
- Alarm list printing.
- Alarm inhibit for an individual point.

6.1.12. DATA LOGGING

These tests shall exercise the data logging and archiving procedures including:

- Tests to ensure all data/alarms collected are logged to the on-line archive storage.
- Tests to ensure data can be archived to and recalled from long term archive media.

6.1.13. RTU PROGRAMMING

These tests shall exercise the RTU sequence programming procedures, including:

- Sequence program editing, compilation and loading.
- The ability to load new sequences on demand by a privileged operator.

6.1.14. MANAGEMENT INFORMATION SYSTEM DEVELOPMENT

These tests shall demonstrate the use of the enquiry package and the applications programs development tool kit, including:

- The editing and compilation of programs.
- The abstracting of data from the SCADA database.
- The automatic scheduling of programs as a result of time of day queues and as a result of a SCADA event/alarm.

6.2. SITE ACCEPTANCE TESTS

The Contractor shall provide for full site acceptance tests for each item of plant to be provided under the Contract. This shall include the interface to the marshalling unit, the communication system, the earthing system and full functionality as demonstrated at the Factory Acceptance Test.

6.3. SYSTEMS ACCEPTANCE TESTS

The Contractor shall provide for full system test on completion to include tests as stated above.

All special test equipment relevant to the Contractor supplied equipment shall become the property of the Employer on completion.

7. TRAINING

The Contractor shall at time of tender state any minimum levels of training/experience required for participants, prior to attending the appropriate course.

The Contractor shall provide training for the Purchaser's staff as detailed. The Tenderer may offer training courses structured to meet his technical offering. These courses shall be subject to the approval of the Engineer and shall be detailed at the time of Tender.

In general training courses shall be provided at Purchaser’s offices as detailed within the particular specification. However some courses may be held at the manufacturer’s works as agreed by the Purchaser.

The Contractor shall provide all course materials and equipment needed.

The training shall be organised such that the Purchaser shall be able to operate and maintain the SCADA scheme following completion of all training courses.

7.1. SYSTEMS OPERATORS

The Contractor shall provide for the number of attendees as specified within the Particular Specification with 4 no. operators attending each course.

This purpose-designed course is to be held at the Works Control Centre. Training must be provided in advance of commissioning to enable the Purchaser's user staff to participate in the full process commissioning of the system and safely operate the plant and maintain the SCADA system.

System take-over shall not take place until satisfactory training has been provided.

This course shall be designed to familiarise the participants with the general running of the standard operating system and the SCADA package to include but not limited to:

- Loading and starting up the Operating System.
- System Operators interface.
- Operator control of program/task execution.
- Operator control of disc files.
- File transfer tasks - archiving, retrieval.
- Operator response to system failure, on-line/off-line diagnostics, transfer of control between the computers synchronisation of the system database.
- SCADA system interrogation facilities - alarm lists, log printouts select mimic and trend displays etc..
- Alarm acknowledge accept/delete.
- Control actions, e.g. start pump, close valve.
- All functions associated with each access level of the SCADA system.

7.2. SYSTEM SUPERVISOR PERSONNEL

The Contractor shall provide a five-day course for the number of attendees as specified within the Particular Specification.

To be held at the Works Control Centre prior to the systems hand-over and shall consist of all of the above tasks plus:

- Basic systems design overview.
- The use of computers to perform diagnostics and to tune other parts of the system.
- Changing passwords and access control.
- Sequence verification.
- Preventative maintenance.

7.3. SYSTEMS DEVELOPERS/PROGRAMMERS/ENGINEERS

The Contractor shall provide 1 no. five day course with the number of attendees as specified within the Particular Specification.

This course shall be designed to cover all configuration and advanced facilities of the SCADA package. To include, but not be limited to:

- The system database structure.
- System database building/configuration.
- Mimic building.
- Applications program interface to the system database.
- Management information system interface.
- Downtime loading of control programs/sequences to RTUs.
- Advanced operating features.

7.4. SITE TRAINING

The Contractor shall liase with the Engineer and the Purchaser on site as new areas of plant are to be changed over to the new system, to establish the following:

- What training is required for operating and maintenance staff?
- Who is to be trained?
- Who will provide the training and when?

The Contractor shall supply O & M documentation prior to training. A section of the plant shall not be handed to the Purchaser for operation until training on the control systems has been completed. Should defects occur prior to Take-over of the whole scheme the Contractor shall be responsible for rectifying the fault prior to any other phased hand-over of the scheme.

This training course/workshop shall be designed as a "reference" course rather than a formal educational course, i.e. the Contractor's personnel shall be present to assist the Purchaser's personnel, as necessary, with any technical difficulties.

8. OPERATIONS & MAINTENANCE DOCUMENTATION

8.1. GENERAL

This contract shall include full documentation for all equipment and software provided under this contract. The documentation shall be written in a clear and concise manner which is fully formatted and indexed to provide documentation that is easy to understand and friendly to use. It shall be capable of incorporating upgrades and amendments to information in an efficient and effective manner. Generally the documentation shall be compiled in A4 ring binders. Liaison will be required with the Engineer regarding the contents of the individual manuals.

All documentation shall also be provided on disk in the Employer standard format current at the letting of the contract. The Employer shall hold the copyright for these documents.

All drawings, unless within word-processing documents, shall also be provided in AutoCAD format on disk, or other media agreed with the Purchaser. All documentation shall conform to ISO 6592 Code of Practice for Documentation of Computer Based Systems. The Tenderer may offer manuals structured to meet his technical offering. These manuals shall be subject to the approval of the Engineer and shall be detailed at the time of Tender. The documentation shall be submitted to the Engineer for approval.

8.2. FULL SYSTEM OPERATING PROCEDURES (6 NO. COPIES)

The Contractor shall provide full operating procedures detailing how to use the SCADA system, to include but not limited to:

- Loading and starting up the Operating System.
- System Operators interface, including:
  - System mimic navigation.
  - SCADA system interrogation facilities - alarm lists, event log printouts and trend displays etc.
  - Alarm acknowledge accept/delete.
  - Control actions, e.g. start pump, close valve.
  - All functions associated with each access level of the SCADA system.
- Operator control of program/task execution.
- Operator control of disc files.
- File transfer tasks - archiving, retrieval.
- Operator response to system failure, on-line/off-line diagnostics, transfer of control between the computers synchronisation of the system database.

8.3. FULL SOFTWARE DOCUMENTATION (6 NO. COPIES)

The complete software specification shall be provided and shall include the system design specification, flowcharts, logic diagrams, system software definitions, program index, system build definition, and system data for each system and module. The information shall not be disclosed to any third party without the author's consent.

8.4. HARDWARE MANUALS (2 NO. COPIES)

The Contractor shall provide documentation for all equipment supplied within the Contract.

8.5. RTU PROGRAMMING DOCUMENTATION (1 NO. COPIE)

The Contractor shall provide a copy of all necessary RTU programming documentation as supplied by the RTU manufacturer.

9. QUALITY ASSURANCE

9.1. GENERAL

The SCADA Contractor shall be registered to ISO9001.

9.2. QUALITY PLAN

The Contractor shall provide a quality plan within 4 weeks of award of the contract.

9.3. SOFTWARE DEVELOPMENT

All software development shall be carried out under an EU-recognised quality system compatible with ISO 9001 that is defined in the quality plan.

9.4. PRODUCT AUDIT

The Engineer shall have the right to audit the product at any time during the contract period.

9.5. QUALITY RECORDS

The Contractor shall maintain quality records in line with the quality plan throughout the period of the contract. These will provide an audit trail for the design and implementation of the technical solutions adopted for the project.

9.6. ACCESS FOR THE ENGINEER'S REPRESENTATIVE

The Purchaser shall have the right to audit the project at any time during the contract period.

9.7. SUB-CONTRACTORS

The Contractor shall be responsible for the quality of any sub-contracted work and the quality plan shall incorporate all the work undertaken by sub-Contractors.

The Tenderer shall nominate his sub-Contractors in his tender return. The Contractor shall be required to obtain the Engineers approval (which will not be unreasonably withheld) to change any nominated sub-Contractor.

9.8. DELIVERY AND INSTALLATION

9.8.1. SCOPE

The Contractor shall be responsible for all costs involved with the delivery and installation of the equipment for the system.

9.8.2. DELIVERY

The Contractor shall provide all personnel and equipment necessary to unload the equipment and transport the equipment to its' final location.

9.8.3. INSTALLATION

The Contractor should be aware that there may be periods such as flood events or for operational reasons, that the Contractor will not be allowed to work on the system or some particular part of the system or RTU, for some specified period.

The Contractor shall make due allowances for this in his costing and programming of his installation and commissioning works.

9.9. SYSTEM RECOVERY

The Contractor shall supply a full backup set of the supplied software, on suitable archival media (e.g., CD-ROM, magnetic tape, optical disk, etc.). The Contractor shall also himself keep a full backup of the supplied software for the life cycle of the supplied equipment.

9.10. CONSUMABLES

The Contractor shall supply all consumables for the SCADA equipment for the duration of the contract, including, but not limited to:

- Printer paper.
- Printer ribbons/ink cartridges.
- Storage media.
- Cleaning materials.

9.11. SPARES AND TEST EQUIPMENT

The Contractor shall provide a list of recommended list of spares and test equipment required to the SCADA system.

To minimise the spares holding, the Contractor's design should consider the benefits of standardisation.oOo