

Requirements oneness Chart of two Lines of "Sport Uniform and

no.	Item descriptions	unit	quantity	remarks
1	Sport uniform (top and bottom) with liner, windbreaker, Tan Color and high quality, as standardized with different sizes, SR 10%, MS 10%, MR 15%, ML 15%, LS 15%, LR 15%, LL 10%, XLR 5%, and XLL 5%.	Pair	224.000	
2	Men Sport Sneaker running shoes with artificial leather high quality as standardized and with different sizes. 45 number size 5%, 41 number size 15%, 42 number size 30%, 43 number size 30%, and 44 number size 20%.	Pair	224.000	



Kabul Municipality شاروالی کابل



Bill of Quantity بل احجام

Project Name:

Construction, Installation, Testing & Commissioning of Actuated Traffic Signal for Kabul City

Item No.	Item Description	Unit	Qty	Unit Price (USD)	Total Price (USD)	Remarks
1	Provision of 12 m Mast Arm Pole (Including Installation, Foundation and all other related activities) As per Drawings and Technical Specifications.	No	40			
2	Provision of 9 m Mast Arm Pole (Including Installation, Foundation and all other related activities) As per Drawings and Technical Specifications.	No	60			
3	Provision of 6 m Mast Arm Pole (Including Installation, Foundation and all other related activities) As per Drawings and Technical Specifications.	No	40			
4	Provision and Installation of (Type 2 Signal Head with all related parts) As per Technical Specification and Drawings.	Set	280			
5	Provision and Installation of (Type 3L Signal Head with all related parts) As per Technical Specification and Drawings.	Set	140			
6	Provision and Installation of (Pedestrian Pushbutton with all related parts) As per Technical Specification and Drawings.	Set	280			
7	Provision and Installation of (Pedestrian Signal with all related parts) As per Technical Specification and Drawings.	Set	280			
8	Provision and Installation of (Terminal Cabinet including wiring and all related parts) As per Technical Specification and Drawings.	Set	140			
9	Provision and Installation of (Controller Cabinet Including Foundation, Wiring and all other related parts) As per Technical Specification and Drawings.	Set	35			



Kabul Municipality شاروالی کابل



Bill of Quantity بل احجام

Project Name:

Construction, Installation, Testing & Commissioning of Actuated Traffic Signal for Kabul City

Item No.	Item Description	Unit	Qty	Unit Price (USD)	Total Price (USD)	Remarks
10	Provision and Installation of (Service Cabinet Including Foundation, Wiring and all other related parts) As per Technical Specification and Drawings.	Set	35			
11	Provision and Installation of (Detector Camera Including Wiring and all othre related parts) As per Technical Specification and Drawings.	Set	70			
12	Provision and Installation of (Traffic Sign Type S1 Aluminum with all related parts) As per Technical Specification and Drawings.	No	140			
13	Provision and Installation of (Addressing Sign Type S2 Aluminum with all related parts) As per Technical Specification and Drawings.	No	140			
14	Provision of 10 mm, 3 core wire (Including Wiring to all Related parts)	m	1800			
15	Provision of 6 mm, 3 core wire (Including Wiring to all Related parts)	m	9800			
16	Provision of (Conduit including trenching and all other related activity) As per drawing and Technical Specification.	m	2800			
Total Amount (USD)						



Islamic Republic of Afghanistan
Kabul Municipality
Transport Deputy Mayor Office



BRT Buses for Kabul City

Date: 30/October/2018

I. Technical Data:

1. MAN BRT Low-floor Lion's City C Bus Specifications: 13.68 Meters (126 Passengers)

Number of Buses Required: 15

<i>Vehicle dimensions*</i>	Length/ Width/Overall height	13,680 mm/2,500 mm/2,880 mm - 3,320 mm
	Wheelbase/Clearance circle	5,875 mm/24,720 mm
<i>Interior equipment</i>	Seating arrangement	max. 45/76
<i>Running gear</i>	ZF EcoLife Step3	6-speed automatic
	Voith DIWA6	4-speed automatic
<i>Engine</i>	Diesel	D2066 LUH Euro 6
	Arrangement	6-cylinder in-line engine
	Per formance (Diesel)	235 kW/320 hp, 265 kW/360 hp
	Capacity (Diesel)	10,518 cm ³
	max.torque (Diesel)	1,600/1,800 Nm
	Doors	Two sides both Right and Left is preferred
<i>Volume Capacity**</i>	Fuel tank	280 l – 360 l



Figure 1. Lion's City C Bus (MAN Company)

2. MAN BRT Low-floor Lion's City GL Articulated Bus Specifications: 18.750 Meters (156 Passengers)

Number of Buses Required: 10

<i>Vehicle dimensions*</i>	Length/ Width/Overall height	18,750 mm/2,500 mm/2,880mm
	Wheelbase/Clearance circle	5,875 mm/24,446 mm
<i>Interior equipment</i>	Seating arrangement	max. 57/106
<i>Running gear</i>	ZF EcoLife Step3	6-speed automatic
	Voith DIWA6	4-speed automatic
<i>Engine</i>	Diesel	D2066 LUH Euro 6
	Arrangement	6-cylinder in-line engine
	Per formance (Diesel)	235 kW/320 hp, 265 kW/360 hp
	Capacity (Diesel)	10,518 cm ³
	Max torque (Diesel)	1,600/1,800 Nm
	Doors	Two sides both Right and Left is preferred
<i>Volume Capacity**</i>	Fuel tank	350 l



Figure 2. Lion' City GL (MAN Company)

II. Services:

1. Details of Warranty

The bus manufacturer warrants the design, manufacture, condition and function of the buses to be delivered as well as the use of materials in accordance with the provisions of the Specification.

The tenderer must submit as part of the tender a full warranty statement.

The warranty statement must include the conditions (oils, lubricants, detergents, etc.) and exclusions related to the warranty provided.

The warranty should be available for at least the following items and terms:

- The overall warranty period for the whole bus is at least twenty-four (24) months without limitation on the kilometers covered according to Afghan Law. The warranty period starts on the date of acceptance of the buses by the Purchaser for service at their destination.
- The warranty period for damages resulting from corrosion is ten (10) years starting on the date of the final take-over of each bus. In that period no corrective anti-corrosion measures should be necessary.
- The Supplier must state the type of process used for corrosion protection of the bodywork and the entrance parts.
- The warranty period for the engine, transmission and driven axle is twenty-four (24) months or 200,000km from the date of acceptance, whatever occurs first.

The bus manufacturers or any third party acting as authorized agents for the manufacturers shall repair any defect due to design, production or material during the warranty period without delay and free of charge. The Purchaser will not pay for the expendable spare parts, oil and cooling liquid losses required by the manufacturer in rectifying any defect of design, production or material.

The bus supplier will be charged for collateral technical damage to the vehicle due to defect of a component during the warranty period.

2. Supplier Documentation

The Supplier shall provide the documentation as specified below. All documentation to be in the Afghan and English languages.

All documentation should be delivered at the same time as the delivery of the first bus. The buses will not be taken-over without the required documentation being available.

Documentation shall include instructions on recycling of buses as well as their components and on re-use of their parts and components.

A. Hardcopies:

Documentation required	Quantity
Set of scaled drawings showing dimensions in four different views, showing full dimensions of passenger compartment arrangements, body panel plan, front, side, rear, roof and bottom carcass, floor and doors and other characteristic technical data.	1 set for every 2 buses delivered
Set of electrical, hydraulic and pneumatic systems diagrams. (schema and drawing of elements arrangement on bus)	
Set of heating, ventilation and air conditioning plans. (schema and drawing of elements arrangement on bus)	
Drivers operation manual	
Technical maintenance and repair manual	
Diagnostic equipment manual	5
Detailed spare parts catalogue comprising catalogue numbers for ordering parts of bus, engine, gear-box (hard copy plus electronic version)	

B. Electronic version

All documentation shall be delivered on USB-stick as well.

3. Training

The Supplier is required to train bus driver instructors and workshop staff to ensure proper handling and maintenance of the buses. The number of trainees is indicated below.

The training will take place in Kabul in connection with the arrival of the first buses.

The supplier shall provide training for currently employed bus driver instructors on how to operate delivered buses, including how the different systems of the bus operate.

The supplier shall provide training for currently employed repairs and maintenance staff listed below in order to ensure that the buses will be maintained and repaired skillfully and in accordance with the manufacturer's instructions.

Training Name	Number of Trainees
Bus driver instructor	10 persons
Diagnostic specialist	10 persons
Engine repairs specialist	10 persons
Gear-box repairs specialist	10 persons
Electrical system repairs specialists	10 persons
Technical servicing specialists	10 persons
Maintenance specialists	10 persons

All training should be delivered in Afghan or English (Afghan is preferred) language.

The tenderer shall submit a full description how to fulfil the above mentioned training requirements: subjects, number of days per subject, etc.



KABUL MUNICIPALITY
TRANSPORT DEPUTY
TRAFFIC DEPARTMENT

TERMS OF REFERENCE

Construction of Traffic: Signals, Poles, Controls and
Electrical Equipment

DIVISION 6 TRAFFIC SIGNALS

6.1 General

6.1.1 Scope of Work

The work shall include supply and installation of traffic signals system including signals poles, controllers, lamps, foundations, wiring, etc., and all equipment required for completion and operation of traffic signals system.

6.1.2 Standards and Codes

The traffic equipment furnished and installed shall meet the requirements of the internationally known standards or equivalent. Specific standards and codes used as a guide for the design are as follows:

AASHTO	American Association of State Highway and Transportation Officials (USA).
ASTM	American Society for Testing Materials (USA).
BSS	British Standard Specifications (UK).
CEE	International Commission on Rules for the Approval of Electrical Equipment.
IEC	International Electromechanical Commission.
IMSA	International Municipal Signal Association.
IPCEA	Insulated Power Cable Engineers Association (USA).
ITE	Institute of Transportation Engineers.
NEMA	National Electrical Manufacturers Association (USA).
UL	Underwriters Laboratories, Inc. (USA).

6.1.3 Shop Drawings

The Contractor shall prepare and submit shop drawings to the Engineer for approval of the complete traffic system for each intersection. In addition to shop drawings, the Contractor shall submit all related details and data for the furnishing and installing of the complete traffic system as described herein and as directed by the Engineer. It is the intent that the complete submission will fully and clearly indicate all components, details, arrangements, program, schedule and all related data for the initial and final, fully operational, traffic system. Further, the submission shall reflect the planning for future development of the state-of-the-art for traffic system.

6.2 Signal Controllers

6.2.1 Description

This section describes the operational, mechanical and constructional requirements for traffic signal controllers.

6.2.2 Definitions

For the purpose of this specification the following definitions shall apply:

a) Cyclic Operation:

A control scheme in which the stages are given in a fixed order.

b) Demand:

A request for the appearance of a phase which has not right of way when the request is made.

c) Inter Green Period:

The period of time between the finish of one phase and the start of the next phase to appear. The start and finish points of each type of phase are defined as follows:

Type of phase	Start point	Finish point
Vehicle	Start of green period	End of maximum or fixed green period
Pedestrian	Start of steady green man period	End of steady green man period

d) Maximum (or Fixed) Green Period:

The time that a green signal can continue after demand has been made by traffic on another phase.

e) Minimum Green Period:

The duration of a green signal following the extinction of a red signal during which no change of signal lights can occur.

f) Offset:

The difference in time between the start of stage 1 at a nominated signal controller and the start of stage 1 at another signal controller in the same linked group of controllers. The offset for the nominated controller is defined as zero. The offset for all other controllers in the linked group is the time, in seconds, of the start of stage 1 at those controllers after the start of stage 1 at the nominated controller.

g) Phase:

Any movement, or combination of movements, that are always signaled to proceed simultaneously and receive the same indications. Two or more phases may overlap in time. A phase is usually considered as commencing at the start of the green display and ending at the start of the amber display to the traffic streams for the phase in question. A

series of phases is usually arranged in a predetermined order but some phases may be omitted if not demanded and if it is safe to do so.

h) Stage:

A condition of the signal lights which permits a particular movement of traffic.

Any time period during which the movement pattern remains unchanged. A stage is usually determined from the start of an amber period and always ends at the start of the following stage. Stages usually, but not always, contain a green period. They are arranged to follow each other in a predetermined order, but stages can be omitted, if not demanded to reduce needless delay.

i) Stage Demand:

A call from a vehicle detector, or pedestrian push button for a particular movement to be served.

j) Stage Extension:

A call from a vehicle detector to extend for a predetermined time period, a green period currently being served.

k) Signal (or Timing) Plan:

The sequence of stages, and their duration and the mode of operation that governs the operation of a controller at a selected time. In linked systems, the plan also defines the offsets.

6.2.3 Standards

Operating facilities, timing ranges and other features described in these specifications represent the minimum standards with which traffic signal controllers shall comply and the Contractor shall state to which international standards the equipment has been designed.

6.2.4 Controllers

6.2.4.1 Controller Types

Controllers are required for both junction signals and for pedestrian crossings and all controllers shall employ microprocessor technology.

6.2.4.2 Junction Signal Controllers

The operational requirements described herein are expressed in terms of stages and signal phases for the sake of clarity. It is not the intention to exclude controllers designed on a different basis (e.g. those which step through a discrete number of steps in each cycle, and switch signal groups at programmable points in the cycle), provided the required signal aspect sequences are obtained, the basic timing intervals specified are timed, and the specified flexibility is obtained.

The vehicle signal aspect sequence shall be Red, Green, Amber, Red.

The pedestrian aspect shall be Red man, Green man, Flashing Green man, Red man.

Controllers shall be capable of operation in any of the following modes:

- **Automatic:** This is the normal mode of operation. When in this mode the controller shall operate automatically, with stages following each other cyclically in accordance with the operational requirements specified herein.
- **Manual:** In this mode the controller shall move from stage to stage under the control of manual stage selection push-buttons provided on the police panel, subject to not violating any minimum green period or prohibited stage to stage move.
- **Flashing Amber:** In this mode all amber aspects shall flash at a rate between 55 and 65 flashes per minute with approximately equal on and off intervals. This mode shall normally be introduced by the following sequence:
 - The running stage terminated by a steady amber leaving signal (subject to the expiry of the minimum green period);
 - All amber aspects shall flash and all other vehicle and pedestrian signal indications shall be extinguished.

The flashing mode shall be cancelled by the switch on sequence.

Controllers shall be capable of multi-plan operation, and of operating in a linked system.

All controllers shall be equipped as specified here in and shall be capable of expansion by the addition of at least two stages and two phases on site at future date.

Pedestrian phases shall be capable of running either concurrently with vehicular phases or separately.

The following timing intervals and ranges shall be provided for each phase:

Minimum Green	5-15 seconds in 1 second steps preset.
Maximum (or fixed) green (vehicle phases)	10-90 seconds in steps of not more than 2 seconds, adjustable.
Steady green (pedestrian phase)	5-20 seconds in 1 second steps adjustable.
Amber	3 seconds unalterable
Intergreen (minimum value)	0-12 seconds in 1 second steps, pre-set.

It shall be possible to set different intergreen periods for each possible phase / phase change. It shall be possible to extend an intergreen period under certain conditions when specified.

Pre-set and unalterable timings shall not vary between different plans. Facilities for different adjustable timings in different plans shall be provided where specified.

It shall be possible to allocate available phases to the stages in any combination subject to the method of control, traffic requirements and safety consideration. A phase may be defined as:

Fixed time. A fixed phase is a phase which is not dependent on detector or push-button operation. Fixed time phases will therefore appear at least once in a cycle (if required by

the plan in operation) and will operate for a fixed period. These phases may be considered to have a continuously stored permanent demand.

Signal changes shall normally operate in a predetermined cyclic order. When operating under manual mode, stages shall appear as called, subject to any constraints imposed. Facilities shall be provided for imposing constraints on stage to stage movements. These shall include prohibition of certain stage changes, and the automatic calling of stages to precede or follow certain stages.

Each controller shall be equipped to provide at least six timing plans. Each timing plan shall define the maximum green periods for each stage, the stage sequence and also the mode in which each stage shall operate. Plans for linked controllers shall also define offsets. One plan shall be designated as a "fall back" plan. The signal timings defined for this plan shall be used when the controller is operating in the isolated mode. Flashing amber shall be regarded as a plan additional to the specified changes of plan. It shall be possible to vary the stage sequence and to introduce or omit selected stages in different plans. It shall be possible to programme a plan change:

- a) On every day of the week.
- b) On every day, Saturday to Sunday.
- c) On every day, Monday to Thursday.
- d) On Friday only.

The number of programmable plan changes in a week shall not be less than 24.

Plans shall be changed automatically at times of the week defined by:

- a) Day of week.
- b) Hours.
- c) Minutes.

Plan changes shall occur within 1 second of the programmed time. Controllers in linked systems shall take up their new offset relationship within one cycle on change of plan. To achieve this, they may cycle rapidly through their sequence, but no green period shall be less than the pre-set minimum.

It shall be possible to introduce the manual or flashing modes by operations of a special switch on the police panel.

It shall not be possible to switch off all signal aspects without opening the main door of the controller.

6.2.4.3 Pedestrian Crossing Controllers

Pedestrian crossing signals normally display green signals to traffic and red signals to pedestrians.

A pedestrian demand (operation of a pedestrian push-button) shall initiate the sequence specified herein provided the fixed vehicle period which commenced timing after the previous pedestrian sequence has expired.

Vehicle and pedestrian signals and associated timings at pedestrian crossings shall be as follows:

Vehicle Signals	Pedestrian Signals	Timing
Green	Red Man	3 seconds unalterable
Red	Red Man	1 to 20 seconds in steps of 1 second, adjustable
Red	Steady Green Man	2 to 10 seconds in steps of 1 second, adjustable
Red	Flashing Green Man	2 to 15 seconds in steps of 1 second, adjustable
Red	Red Man	3 seconds, unalterable
Green	Red Man	Fixed vehicle period 20-90 seconds in steps of 1 second, adjustable.

A demand registered at any time after the end of the steady Green Man period shall be stored until the expiry of the fixed vehicle period. If no demand has been registered before the expiry of the fixed vehicle period the controller shall rest in its normal state until a demand is registered whereupon the signal sequence shall be immediately initiated.

6.2.4.4 Linking

Controllers may be required to operate in a coordinated network. These controllers shall operate on a common cycle time. Within the network the start of one controller will be designated "time zero" for reference purposes. Offsets for all other controllers in the network will be related to this reference and will be defined for each signal plan.

Co-ordination shall be implemented by either cabled or cable less techniques.

The designation of one controller in a network as a reference does not imply that it must be the source of co-ordinating signals (Master controller) in a cable linked network. The Contractor is free to choose which controller to equip as a master and which as local controllers.

In cable linked systems the controller equipped as a master shall, as a minimum, transmit a signal to all local controllers once per cycle to indicate time zero, and appropriate signals to indicate which plan is in operation.

Absence of any plan signal, or of the time reference signal, for more than 180 seconds shall cause the local controllers to operate in an isolated mode.

The controller equipped as the master shall also transmit signals to cause selected local controllers to operate in the flashing mode.

Pedestrian demands registered by pedestrian controllers in linked systems, shall be stored until the offset time is defined in the linking plan has expired whereupon the controller shall immediately commence the signal sequence. It shall be possible to define two independent offsets within the common cycle time.

6.2.5 Timing and Standby Power Sources

6.2.5.1 Real Time Clock

This facility shall be realized by a precision 24 hour / 7-day clock. This clock shall be used for plan selection and synchronization.

The seven-day clock shall maintain correct time with an error of less than 1 second in one month providing the ambient temperature is within the range detailed in this specification.

During mains power failure, the real time clock shall derive its power from a standby power source.

6.2.5.2 Power Supply Standby

In the event of a mains power failure or disconnection or the removal of circuit boards from the controller the following facilities shall be supported by a standby power source:

- a) The real time clock.
- b) The fault log.
- c) Plan data amendments.
- d) Timetable amendments.
- e) Timing amendments.

In addition, any other data that is required for the correct operation of the controller shall also be preserved during power failure.

The real time clock and other facilities shall be preserved for a minimum period of 24 hours in the absence of mains power.

6.2.5.3 Start-up Sequence

When mains power is applied to the controller, all the signal lamps are switched on, the controller shall enter the flashing amber mode for 5 seconds.

6.2.6 Microprocessor Integrity Checks

6.2.6.1 Phase Monitoring

The actual status of the phase drive outputs shall be continuously monitored. This status shall be checked against the switching commands as initiated at the microprocessor control level. If a discrepancy is detected the controller shall initiate a flashing amber sequence and full details shall be entered into the fault log. The status shall be checked by a sensor that monitors the voltage to the green signal lamps at the output of each phase drive. The controller shall check that the status of the sensor agrees with the switching commands issued by the microprocessor.

6.2.6.2 Green Conflict Monitor

The controller shall be equipped with facilities to prohibit the display of green signals on any two or more conflicting phases. Two independent systems shall be provided at least one of which shall be independent of the controller microprocessor.

The phase conflict checks shall utilize completely independent paths and shall involve reference to two separate conflict matrices.

The monitoring system shall operate in a failsafe mode and it shall not be possible for the system to be disabled.

Test facilities shall be provided for each phase green so that a conflicting condition can be simulated in order to check that both green conflict monitors operate.

The Contractor shall provide details of the techniques used to prohibit the display of conflicting green signals.

6.2.6.3 Flashing Amber Sequence

If the phase monitor(s), the green conflict monitor, or the watchdog detects a failure, the signal lamps shall be switched to flashing amber within 500 milliseconds of the failure being detected.

A contactor shall be used to switch off the signal lamps in the event of a failure. When the controller is operating correctly the contactor shall be held in the operated condition. In the event of a failure or power loss the contactor shall release.

A circuit separate from the main controller microprocessor shall be used to provide flashing amber. This circuit shall be operated and connected to the amber signal lamp drivers by the release of the contactor specified above.

6.2.6.4 Memory Devices

The controller firmware and site configuration data shall be held in non-volatile memory. In addition, a complete set of timing parameters shall be held in non-volatile memory. Any non-volatile memory used shall be re-programmable.

The controller shall be equipped with a facility such that the data contained in the non-volatile memory can be transferred to the read / write memory during normal operation, the controller will operate with the data held in this read / write memory.

A facility shall be provided to alter the timing data held in the read / write memory via the monitoring and control facilities. The controller shall perform a range check on the data, and display any faults, before the data is used to update the read / write memory. The range parameter (upper and lower limits) shall be stored in the non-volatile memory and shall be considered as site configuration data and thus not alterable on site.

6.2.6.5 Data Integrity Checks

Each of the individual memory devices used shall be tested by sum-check techniques. Each memory device shall incorporate its unique sum-check value set according to the information it contains. On startup, all memory devices shall be individually sum-checked.

The firmware and fixed data held in the non-volatile memory device shall not self-corrupt as a result of program / operating error or mains power disruption.

Following the detection of a sum-check error, the fault shall be logged, subject to the error not inhibiting this, and the controller shall initiate a flashing amber sequence.

In the event of corruption of timing data contained in the read / write memory being detected during normal operation, the data contained in the non-volatile memory shall be used for the operation of the controller. The fault shall also be logged.

6.2.6.6 Microprocessor System

The correct operation of the microprocessor system shall be monitored by means of a watched timer. This shall include the important parts of the operational program. The watched reset period shall not exceed 500 msec.

6.2.6.7 Fault Log

A fault log shall be provided in the read / write memory for storing information on faults detected during the operation of the controller. This information shall be protected against mains failure.

The fault log shall contain at least information relating to:

- a) Identity of faulty detector channel (s) (this shall include pedestrian push buttons);
- b) Green conflicts with identity of phases involved;
- c) Identity of phase monitor faults;
- d) Memory corruption (s) / failure (s);
- e) Pre-set timer faults;
- f) Plan and timer faults;
- g) Real time clock failure, and
- h) Pedestrian controller faults.

6.2.6.8 Diagnostic Facilities

Facilities shall be provided to assist the maintenance personnel to easily diagnose fault conditions.

Any fault that occurs relating to components, interfaces, peripheral equipment, functional integrity (e.g. program looping, excessive interrupts, intermittent errors, read / write access failure etc.) shall be stored. The diagnostic facilities will allow this information to be retrieved for analysis.

Facilities shall be provided for checking the correct operation of all input/ output devices.

Facilities shall be provided for testing the correct functioning of each memory component incorporated in the controller.

All intermittent errors shall be recorded.

6.2.7 Adjustment and Maintenance Facilities

6.2.7.1 Facilities

Facilities shall be provided for the monitoring and adjustment of the controller. These facilities shall be in addition to the manual control facility provided on the police panel.

Monitoring and control facilities shall be provided within the controller housing, accessible only after opening the main controller door. They shall be of two categories:

- Those accessible by traffic Engineers and maintenance personnel, and
- Those accessible by maintenance Engineers only.

Access to these facilities shall be either via a keyboard / switch assembly and displays built in to the controller, or via an interface into which a hand – held control device may be plugged. Any alternative interface proposed shall be fully described. The description shall include full details of electrical and mechanical design, and also of any transmission protocol employed.

6.2.7.2 Traffic Engineering Facilities

The following operational monitoring and display facilities shall be provided:

- a) System time / day.
- b) Fault log.
- c) Running stage.
- d) Phase status and the status of all the associated phase timers.
- e) Plan in operation.
- f) Operational mode.
- g) All phase timing periods.
- h) Plan data.
- i) Timetable data.

The following control functions shall be available at this level:

- a) Selection of operating mode.
- b) Manual stage control.
- c) Switch – off signal aspect lamps.

These facilities shall be directly available at the keyboard / display or interface.

6.2.7.3 Engineers Facilities

These facilities shall also be available via the same access means as for traffic Engineers, but shall in addition require the operation of a key switch. It shall only be possible to remove the key from the key switch when in the "off" position.

The following facilities shall be available:

- a) Alteration to all phase timed period values in the stored operational parameters (within the permitted limits).
- b) Alteration to all timetable and plan data.
- c) Set system time.
- d) Clear fault log.
- e) Display data in any memory address.
- f) Change data contained in a any read / write memory address.

6.2.7.4 Site Configuration Data and Firmware

Modification of a site configuration data or controller firmware, held in non-volatile memory, shall only be alterable by changing memory devices.

6.2.8 Electrical Requirements

6.2.8.1 Mains Supply

All equipment shall be suitable for operation on a nominal 220 volts 50 Hz single phase A.C. supply.

The equipment shall operate satisfactorily with any combination of variations of nominal voltages of +10%-20% and variations of the supply voltage frequency of + / - 4%.

In the event of mains supply interruption equal to less than 50 milliseconds, the controller shall continue to operate correctly. In the event of a mains failure greater than 50 milliseconds the controller shall shut down in an orderly fashion for the duration of the mains interruption without a malfunction occurring.

6.2.8.2 Controller Mains Power Supply

A double pole switch with a differential circuit breaker of minimum rating 16 amp in the live lead or approved alternative shall be provided to isolate the mains supply from all equipment in the controller housing. This shall incorporate an earth leakage circuit breaker.

A separate fused isolating switch or approved alternative, which does not break the neutral connection, shall be provided to isolate the controller equipment from the mains supply.

A separate fuse and isolating switch shall be provided for extinguishing the traffic signal lamps and pedestrian "WAIT" indicators without interfering with the supply to the controller operating circuits, phase monitors etc.

A separate fuse and isolating switch shall be provided for the power supply to detector equipment.

If internally illuminated regulatory signs (supplementary aspects) are required, they shall be fed from separate fuses.

A switch socket shall be provided as an outlet for maintenance tools and test equipment. This socket shall not be isolated by the fused isolating switch specified herein.

Contactors shall be installed as necessary, for the control of special signs.

6.2.8.3 Protective Requirements

A cable earth continuity connection bar of approved design shall be fitted within the controller housing. The cable earth connection bar shall be electrically connected to the controller housing including access doors.

A voltage greater than or equal to 50V DC or AC shall be rated as a dangerous voltage. All equipment or units working at a dangerous voltage shall be protected by an approved cover, which shall be removable. The cover shall have a label with the dangerous voltage value and the word "DANGER" in English and Dari. The voltage shall be indicated.

Terminal strips and terminals shall be clearly and indelibly coded. Terminals carrying mains electrical power shall be separated from other terminals. Not more than three cable cores shall be retained by any terminal.

6.2.8.4 Signal Lamp Switching

Traffic signal lamp switching shall be solid state devices. The Contractor shall provide full technical details of the device used and all associated features. Due consideration shall have been given to output monitoring, fail safe features, transient loading, heat dissipation and ease of replacement. The device shall be adequately protected to avoid damage due to short circuit or earth connection of the drive outputs, signal lamps or cable.

The signal lamp switching units shall have an expected life, under normal operating conditions, of at least five million switching operations when driving a load of 10 lamps on the same phase and of the same aspect color, complete with transformers and 50 metres of aspect cable to each lamp.

6.2.8.5 Detection (Not Provided)

The controller shall be capable of accepting inputs from a minimum of 16 detectors. These may be inductive loop units, microwave detectors or other approved detectors for vehicle detection, pedestrian push-buttons or switch inputs.

It shall be possible to allocate any detector input to any function.

It shall be possible to simulate the operation of any detector.

It shall be possible to cause any detector to demand and / or extend any stage / phase.

All detectors shall be monitored for changes of state. Any detector that does not change in state during a period which shall be adjustable between 6 and 18 hours shall be regarded as faulty and details shall be entered in the fault log.

6.2.9 Mechanical and Construction Requirements

6.2.9.1 Controller Housing

The controller housing shall be of galvanized steel, construction and suitably treated to protect against corrosion. Controller housings cooling fans will not be accepted. Double skin construction as an aid to cooling is acceptable.

The housing shall be dust and rainproof with doors protected by at least 2 locks. The doors must be secured against unauthorized entry by high security and vandal-proof, key operated locks. The type of locks to be used shall be subject to the approval of the employer. For each controller, not less than two keys for each type of lock used including that for the police facilities flap, shall be supplied.

All exposed metal parts of the housing shall receive a minimum of three coats of colour paint. A coating of sprayed molten zinc will be accepted in lieu of the first two coats mentioned.

Appropriate means shall be provided for the proper support of all cables.

Controller housings wider than 800mm shall require front access only.

The controller housing shall be capable of housing all of the following in addition to the controller:

- a) Detectors.
- b) Termination blocks for connections to remote equipment signs, detectors etc.
- c) Power supply termination.

The controller housing shall contain a pocket to hold the basic controller data sheets (A4 booklet).

6.2.9.2 Control Access

Access to basic manual control (Police) facilities shall normally be gained by a key without opening the main controller door. The key shall be the same for all controllers, but shall be different from the key required to open the main controller door. All of the push buttons and indications given below are called police facilities.

Access to other facilities and to the control modules shall be provided by means of the main controller door(s).

The police panel shall be equipped with push-buttons or switches to allow the following control actions to be carried out:

- a) Controller mode selection. It shall be possible to select any one of four operating modes:
 - Automatic (normal).
 - Manual
 - Flashing.
 - All red.
- b) Manual stage selection. One push-button shall be provided for each stage. These shall be operative when the manual mode has been selected.
- c) Manual selection of all red. This shall be effective when the manual mode has been selected.

Indications shall be provided to indicate:

- The running stage.
- The operating mode.
- Controller fault.

Push-buttons and indications shall be labelled.

It shall not be possible to switch off all signal aspect lamps from the police facility.

6.2.9.3 Identification of Equipment

All controls, indicators, and power protection devices shall be clearly marked in an approved manner to indicate their function.

All modules shall be clearly marked or labelled with a function code or title, type number and serial number.

Components shall not be marked with circuit references. The markings shall be either adjacent to the component or annotated on the diagram or photograph of the unit in a relevant handbook or manual. Marking required for controls, maintenance or warnings shall be adjacent to the parts concerned.

6.2.10 Environmental Tests

6.2.10.1 General

All traffic signal controllers shall be capable of passing the tests in this section or other equivalent tests as agreed by the Engineer. Where the Contractor proposes to test his equipment to other national testing standards, he shall provide full details. The general standards required are as specified in this section. Two samples shall be tested unless directed otherwise by the Engineer.

6.2.10.2 Dry Heat

No preconditioning is required.

The test shall be conducted with the equipment in an operating condition, and any loads simulated where this is likely to affect the tests. In particular, for traffic signal controllers, lamp loads should be simulated.

The severities shall be:

- Temperature 55 deg. C + / - 2 deg. C.
- Duration 16 hours.

The equipment under test shall operate in accordance with its specification:

- a) After introduction into the test chamber, but before the period of exposure;
- b) After the period of exposure but before the period of recovery;
- c) At about 5 deg C increments during the period of recovery; and
- d) After the period of recovery.

The equipment shall be visually and mechanically checked before and after the test.

6.2.10.3 Damp Heat

The equipment shall satisfactorily pass the damp heat test. The test shall be for one cycle only.

6.2.10.4 Simulated Solar Radiation

The equipment shall satisfactorily pass the simulated solar radiation test in accordance with international standards.

During the test, the temperature shall be monitored at points where, in the opinion of the testing officer, the temperature is likely to have most significant effect upon the equipment.

This might be adjacent to components which have the lowest specified operating temperature and in the area likely to become the hottest during the test. If the temperature measured at any point exceeds the specified operating temperature of any component, the equipment shall be judged to have failed the test.

The irradiation plan shall be that which, in the opinion of the testing officer, most accurately simulates the equipment's operating conditions.

The test shall be conducted with the equipment in an operating condition and any loads simulated where this is likely to affect the tests. In particular, for traffic signal controllers, lamp loads should be simulated.

Procedure shall be used, with the enclosure temperature kept at 40 deg. C during irradiation and a humidity of 90% for the test duration.

No forced air flow around the equipment shall be provided.

The test duration shall be 3 cycles.

The equipment under test shall operate in accordance with its specification:

- a) After introduction into the test chamber, but before the period of exposure.
- b) At the end of each irradiation period.
- c) At the end of each cycle.

After the test, the equipment shall be visually and mechanically checked.

6.2.10.5 Vibration

The equipment shall satisfactorily pass the vibration (sinusoidal) test in accordance with international standards.

The frequency ranges to be used shall be from 1-35 Hz.

The vibration amplitude shall be 0.75mm.

The endurance in each axis shall be 100 sweep cycles. Endurance testing by sweeping only is required.

The equipment shall be electrically tested to ensure that it meets its specified performance at the beginning and end of the test after the completion of testing in each axis.

The equipment is not required to be operational during the testing.

At the compellation of the test the equipment shall be visually and mechanically checked and inspected.

6.2.10.6 Driving Rain

The driving rain test shall be in accordance with international standards. The shower heads shall be aimed directly at all vulnerable points.

The equipment shall perform according to specification before and after the test. There shall be no evidence of water inside the equipment enclosure after the test. The controller shall provide details of any limitations which might be required to testing the controller with the police facilities flap open. If it cannot be so tested the controller shall provide evidence to the satisfaction of the Engineer that it will operate with the flap open in heavy driving rain.

6.3 Signal Heads and Pedestrian Push Buttons

6.3.1 Description

This section describes the operational and construction requirements for traffic signal heads and pedestrian push – buttons.

6.3.2 Definitions

For the purpose of this specification, the following definitions shall apply:

- **Signal aspect:** an optical system which produces light or a light pattern of specified size, color and shape.
- **Signal face:** A combination of signal aspects which together provide a continuous display of control information to a traffic stream.
- **Signal head:** An assembly of signal aspects presenting one or more signal faces, mounted on a signal pole.
- **Vehicle signals:** signal faces providing control information to vehicle drivers.
- **Pedestrian signals:** signal faces providing control information to pedestrians.
- **Phantom:** A reflection of sunlight and sky light from the internal optical surfaces for the signal aspect, normally the reflector.
- **Spectral reflection:** a reflection of sunlight and sky light from the outer surfaces of the optical system of the signal aspect, either from the lens surface or, in the case of a pedestrian, arrow or tram aspect, from the mask which defines the symbol displayed.

6.3.3 Arrangement of Aspects

6.3.3.1 Vehicle Signals

Each signal face shall, unless otherwise specified, contain three aspects, arranged vertically. The colored lens of the upper aspect shall be red, the middle one amber, and the lower one green. In addition, red, amber or green arrow aspects may be used and may either replace, or be in addition to the standard full aspects.

Supplementary aspects shall be provided where shown on the drawings or directed by the Engineer. Blue mandatory turn supplementary aspects shall be provided wherever directional arrow green aspects are to be installed. The Contractor shall provide details for the approval of the Engineer of supplementary aspects which are to be illuminated, showing his proposed method of fixing to the signal head. The following symbols will be required:

- No right turn.
- No left turn.
- No entry.
- Ahead only.
- Turn left.
- Turn right.

All aspects on pole mounted signal heads shall have a diameter of between 200 mm and 210 mm.

6.3.3.2 Pedestrian Signals

Each signal face shall contain two aspects arranged vertically. The aspects shall be circular with diameter of between 200mm and 210mm. The upper aspect shall show a standing red man on a black background. The lower aspect shall show a walking green man on a black background.

6.3.4 Optical Performance

The signal aspects shall provide an optical performance particularly with reference to phantom and spectral reflection which meets the requirements of at least one of the following standards:

- a) British standard.
- b) Institute of transportation Engineers.
- c) Germ DIN.
- d) European standards.
- e) Any other independent standard with full optical requirements similar to (a) or (b) or (c) or (d) above and which is approved by the Engineer.

The Contractor shall submit details of the standards that the aspects meet including details of differences between any other standard and the British or German standards

and shall submit copies of certified, independent test reports showing that their aspects meet the requirements of the standard.

- a) When the aspect is switched off it shall give a uniform, near black appearance with no visible phantoms, or spectral reflection.
- b) For the pedestrian and arrow aspects, when switched on, the contrast between the illuminated and non-illuminated portions of the aspect shall be such that the intended indication is completely clear.

It is the responsibility of the Contractor to satisfy the Engineer that the signal aspects meet these requirements.

6.3.5 Construction of Signal Heads and Visors

The materials used shall be polycarbonate, resistant to high temperatures and ultraviolet light, and the form of construction used shall be such as to ensure that the signal head has adequate mechanical strength and durability to withstand the conditions of installation, operation and maintenance. In particular it should be capable of withstanding winds of up to 160kph. The colour of the signal body and visors shall be black.

Materials, fixings and fastenings used shall either be inherently corrosion resistant, or shall be treated to prevent corrosion.

The material, shall be capable of withstanding the action of direct sunlight, and temperatures of between 0 deg. C and + 70 deg. C without significant deterioration of mechanical strength, or change of color.

The signal head assembly shall employ sub-unit construction such that aspects can be arranged into the various configurations required. It shall be possible to replace individual sub-units reasonably easily for maintenance or other reasons, and also add sub-units, such as green arrow units, when required.

The design of the signal head shall be such that the overall assembly is as compact as possible, particularly regarding width.

The signal head assembly shall be provided with facilities which will allow it to be mounted on a standard signal pole. The mounting arrangement shall be such that, after attachment to the pole, the signal aspects can be adjusted, both horizontally and vertically to aim them appropriately for the traffic situation.

The construction of the signal head shall be such as to prevent rain and dust entering the aspect. The access provided for lamp replacement and any necessary cleaning shall be such that access can be easily obtained and when maintenance is complete, access doors or flaps can be easily and securely closed and sealed.

All signal aspects shall be fitted with visors. Visors shall be of sufficient size to adequately shade the aspects and to minimize phantom effects. Where specified, or made necessary by site conditions, deep or specially designed visors shall be provided which give a very directional view of the signal aspect.

Lamps shall be of a long life, incandescent gas-filled traffic signally type, of sufficient wattage to produce the required optical performance. The lamp holder shall provide a

positive and accurate location for the lamp and a reasonable heat conduction path to the reflector. Location and heat conduction by lamp pins alone is not acceptable.

The material used for lenses shall also be of polycarbonate.

The Contractor shall submit full constructional and assembly details and illustrations to show how the requirements of this section will be met.

6.3.6 Fixings

Suitable means shall be provided to firmly fasten brackets and signal heads to poles and to allow adjustment where required. All nuts, bolts, fastenings, hinges, brackets and other fixings shall be of non-corrodible material or suitably treated other material to prevent corrosion.

Vehicle signal heads shall normally be fixed with the center of the amber aspect 2.8m from pavement level. Signal heads on high masts shall be fitted so that the lower part of the signal head is at least 5.5 m from the carriageway surface.

Pedestrian signal heads shall be fixed with the center of the red man aspect 2.3 m from pavement level.

Tram signals shall be fixed with the center of the lower aspect approximately in line with the eye of a driver stopped in front of the signal.

The combined assembly of signal head, fixings and pole shall be such as to provide adequate stability in wind velocities up to 160 km/h.

6.3.7 Termination

Signal heads shall incorporate terminations for signal cables.

6.4 Signal Installation

6.4.1 Description

This work shall consist of the supply, installation, testing and placing into service of traffic signal equipment, all as shown on the drawings or established by the Engineer.

6.4.2 Materials

Materials and equipment shall comply with the requirements of specification.

6.4.3 Installation

The Contractor shall be responsible for the complete installation of all wiring, distribution of power from the power source to the control foundation and to all equipment and components of all system, the complete Traffic System with all subsystems, control systems, and all related work as specified herein, as requires for the complete installations and as directed by the Engineer.

The Contractor shall contact the power Distribution Division of the Kabul Municipality by the help of PMU of Kabul Municipality to arrange for the electrical supply for the

controllers. The Contractor shall comply with the requirements of the Power Distribution Division for the service connection. There shall be no separate payment for service connection deemed to be including in the quoted rate. The cost of service connection work shall be an incidental part of the bid prices of other items of work in the Bills of Quantities.

Unless otherwise approved by the Engineer in writing, no installation shall take place without the Engineer's presence and supervision. Such presence and supervision of the Engineer shall in no way relieve the Contractor from his responsibility of installing the traffic system and its component properly and according to proven Engineering standards and practices so that the Traffic System will function and operate to the satisfaction of the Engineer after installation.

If the Engineer determines, as the sole judge of such determination, any time prior to the issuance of the written final acceptance certificate, that any equipment, competent part and / or appurtenance of the Traffic Control System is improperly installed, such equipment, competent part and / or appurtenance shall be removed and reinstalled, with new parts and components if necessary in the judgment of the Engineer, by the Contractor at his own expense.

The work of trenching road and placement of ducts shall also be undertaken by the Contractor. The supply and installation of cabling shall be the responsibility of the Contractor.

6.4.3.1 Controllers

The Contractor shall set out the positions of all signal controller cases, at the locations shown on the Drawings. If during the course of setting out or after excavation he discovers any obstructions that will prevent the placing of any controller in its designated position he shall propose an alternative position for the approval of the Engineer.

After the controllers at each junction have been installed, the Contractor shall assemble and install all other equipment of his supply, including the laying and terminating of all cables.

The ends of all cables that have been cut to length shall be properly sealed immediately they are cut, unless they can be terminated the same day. The armoring of all cables shall be electrically bonded together in the controller case, and to controller cases and signal poles. Cable ends shall be bound with PVC tape after termination of the conductors. All cables shall be adequately supported on cable clamps or gland plates.

When each signal installation has been completed and has passed its Test after Installation, the base of the controller case shall be sealed with epoxy resin and damaged paint work on any part of the installation made good, to the satisfaction of the Engineer.

6.4.3.2 Signal Heads

Signal heads shall be comprised of up to four signal faces, together with necessary mounting devices capable of holding signal heads rigidly in place against wind and other external effects.

The Contractor shall adjust the direction of beam of all signal faces as directed by the Engineer.

After installation and prior to testing and commissioning, the Contractor shall fix white crosses over all signal heads, to indicate that the signals are not in use.

All installation work and materials shall be to the satisfaction of the Engineer.

6.4.3.3 Cables

Signal cables shall be 4-cores, armored, 600 / 1000 v grads, with a conductor cross – section of 1.5 sq. mm (nominal). Linking cables shall be 5-pairs, each conductor of 0.9 – 1 sq. mm (nominal). No voltage in excess of 60v (d.c.) or RMS (a.c.) shall be applied to linking cables. Cable terminations shall be mechanically and electrically sound and able to withstand all traffic – induced vibration.

At least one signal head associated with each phase shall be connected to the controller via a cable separate from the cable feeding the remaining signal head(s).

The signal cables will be laid in ducting. The ducting will be 100 mm dia PVC duct and will have been provided with pull wires and draw pits.

Signal cables shall provide continuous conductors and shall not contain joints. Any interconnections required between cables shall be carried out on terminals installed above ground within signal poles. Each signal cable shall have 2 m of spare cable coiled in the draw pit (pull box) at the controller base, and 3 m of spare cable coiled in the draw pit by the pole. All signal cables shall be marked at each end to indicate their function and connection. They shall also be marked in each draw pit they pass through. Cable marking shall be designed to last the life of the cable.

6.4.4 Tests and Placing in Service

Traffic Signal Equipment and Installations will be accepted for installation by the Engineer following inspection and tests:

- a) At the Contractor's Depot;
- b) Pre – installation tests and
- c) Post – installation tests.

6.4.4.1 Tests at the Contractors Depot

Tests shall be carried out at the Contractors Depot to demonstrate the correct operation of the equipment. The Contractor shall provide suitable test facilities and assistance, including dummy loads, test switches, etc. These facilities shall allow the equipment to be tested over the whole of the specified voltage range. The test equipment shall not include temperature or frequency tests.

The tests of controllers shall demonstrate the correct functioning of all standard functions of the controller, in addition to those required for the particular installation to which it is destined.

The Contractor shall furnish to the Engineer a certificate for each controller supplied that it has satisfactorily passed the appropriate tests and that it conforms to the specifications.

6.4.4.2 Pre – installation Testing

Each piece of equipment, component, element and appurtenance, of the Traffic System shall be individually tested by the Contractor under the supervision and to the satisfaction of the Engineer before installation.

Pre – installation tests shall emphasize proper operation and functioning of each unit of equipment, component, element and appurtenance, whether manufactured and / or assembled by the Contractor himself or supplied by a sub-Contractor or a manufacturer other than the Contractor.

No pre – installation test shall be considered complete unless the unit being tested meets, in the judgment of the Engineer, all the material, operating and performs criteria established in the Contract Documents.

Any unit that fails to pass any pre – installation test shall be so marked by the Engineer and shall be replaced by the Contractor at his own expense until the replacement passes all pre – installation tests to the satisfaction of the Engineer. Repairing a faulty unit shall not be acceptable. All costs associated with the pre – installation tests shall be borne by the Contractor as an incidental part of his bid price for the unit being tested. No separate payment shall be made for pre – installation tests.

No unit shall be installed in the field unless the Engineer issues a pre – Installation Test Certificate indicating that the unit has passed required tests to his satisfaction.

The Engineer shall have the option of waving pre – installation testing requirements for a group of like units, after testing a sufficient number of units, randomly selected by him, from such group of like units.

Satisfactory passage of any unit in pre – installation tests shall not relieve the Contractor from any of his responsibilities of equipment performance under this contract.

6.4.4.3 Post – Installation Tests

Following the installation of equipment, components, elements and appurtenances of the Traffic System, the Contractor shall perform post – installation tests under the supervision and to the satisfaction of the Engineer.

Post installation test shall emphasize the functional operation and performance of a system as well as the performance of its components.

Post – installation tests shall be considered complete unless the system and its components being tested meet, in the judgment criteria established in the Contract Documents.

Any system or its components that fail to pass any post – installation test shall be replaced by the Contractor at his own expense until the replacement passes all post – installation tests to the satisfaction of the Engineer.

The Contractor shall provide and set up all the test equipment necessary for post – installation tests and shall conduct the tests under the supervision and to the satisfaction of the Engineer.

All costs associated with the post – installation tests shall be borne by the Contractor as an incidental part of his bid price for the system being tested. No separate payment shall be made for post – installation tests.

No system shall be started – up unless the Engineer issues a post – Installation Test Certificate that the system has passed required tests to his satisfaction.

Satisfactory passage of any system in post – installation tests shall not relieve the Contractor from any of his responsibilities of system performance under this Contract until a final Acceptance Certificate is issued by the Engineer.

6.4.4.4 System Start-up and Initial Operation

Following the issuance of a Post – Installation Test Certificate by the Engineer, the Contractor shall start-up the system that passed the post – installation tests, and shall continuously operate the system for an initial operation period of one month.

The Engineer and the Employer's personnel shall be present at the start-up and initial operation of all equipment, components and systems.

During the initial operation period the Contractor shall continuously observe and monitor the operation of the system and shall make final adjustments and corrections to the system to the satisfaction of the Engineer. If during the initial operation period major system and / or component defects are identified which, in the judgment of the Engineer, require modifications to the system and / or its components, the initial operation period shall restart following the completion of the subject modifications to the satisfaction of the Engineer.

6.4.4.5 Taking Over

When a system, started – up and initially operated according to the requirements of clause 6.4.4.4 above, performs to the satisfaction of the Engineer during the initial operation period of one month, the Employer shall take over the work in accordance with the Contract conditions. The taking over shall not relieve the Contractor from his responsibilities concerning the performance of the system and maintenance responsibilities.

6.5 Poles and Mast Arms

6.5.1 General Description:

The signal poles and mast arms shall be designed to support the traffic signal loading as required by the Engineer, specified herein or shown on the drawings. The design and fabrication shall conform to the requirements of the Standard Specifications for the Structural Supports for Highway Signs, Luminaries and Traffic Signals, as published by the American Association of State Highway and Transportation Officials. The components of traffic signal poles and mast arms shall meet the requirements specified herein.

The traffic signal poles and mast arms shall be of durable, visually acceptable design and the poles shall be installed on concrete foundation all as approved by the Engineer.

Minimum distance between the center of the pole and nearest pavement edge shall be 1.0 meter.

The clearance between top of pavement and bottom of lowest vehicular signal head mounted on mast arms shall be no less than 6 meters.

The horizontal distance between the free end of the mast arm and the axis of the shaft shall not be less than 4.5 meters.

6.5.2 Materials:

1. The poles and mast arms shall be made of galvanized steel and as approved by the Engineer with minimum outside diameter of 11.4 cm. the poles shall be welded to the base plate as shown on drawings.
2. The steel mast arm assembly and pole shall consist of a mast arm assembly, a pole, and a base, together with anchor bolts and other appurtenances. The configuration of the mast arm assembly, pole, and base shall be as approved by the Engineer.
3. The steel mast arm assembly and pole shall be designed to support one 3 aspect-300 mm signal head at the free end of the mast arm, one 3 aspect –300 mm signal head mounted 3 meters inward on the mast arm and two, 3 aspect 210 mm signal heads mounted 3 meters high on the shaft or the signal loading shown on the plans, whichever is greater, based on a 160 kilometer per hour wind velocity plus 30 percent gust factor.
4. The design and fabrication of the mast arm assembly, pole, and the base shall conform to the requirements of the Standard Specifications for Structural Supports for Highway Signs Luminaries and Traffic Signals, as published by the American Association of State highway and Transportation Officials. No other design criteria are acceptable. The mast arm and pole shall be fabricated from steel of structural quality with specific ASTM designations, having minimum yield strength of 48,000 psi, either of steel tubing or from welded sheets and plates. The base and flange plates shall be of structural steel conforming to AASHTO M 183 or better as approved by the Engineer.
5. The mast arm and pole may be of single length or sectional design. If sectional design is used, the overlap shall be at least 150 percent of the maximum diameter of the overlapping section and shall be assembled in the factory. A handhold with reinforced frame shall be provided on each pole near the base the handhold cover shall be fastened with stainless steel screws. All mast arm assemblies, poles and bases, shall be galvanized in accordance with AASHTO M 111.
6. The mast arm assembly shall be attached to the pole in an angle from the horizontal of 5 degrees unless otherwise directed by the Engineer and shall provide the minimum clearances specified herein. When fully loaded with signal heads as specified herein or as directed by the Engineer, maximum deflection at the free end of the mast arm shall not be more than 5 centimeters.

6.6 Technical Support and Spares

6.6.1 Training and Technical Support

6.6.1.1 Training Requirements

As Part of This Contract the Contractor shall prepare and conduct a training program for the Employer's personnel designated to undergo such training for the eventual takeover by the Employer of all operating and maintenance function of the entire Traffic System. The Contractor shall conduct the subject training program under the supervision and to the satisfaction of the Employer and the Engineer.

The Contractor, upon execution of the Contract, shall prepare a detailed training program and time schedule, and submit them to the Engineer for approval.

Following the review, revision and approval of the Engineer, the Contractor shall conduct the training program in accordance with the approval time schedule. It is essential that the training program be completed to the satisfaction of the Engineer at least one month ahead of the scheduled takeover (final acceptance) by the employer of the operating and maintenance functions.

The training program shall include theoretical classroom training, Laboratory training, practical field training and participation of the trainees in installation, testing, start-up, operation and maintenance of the Traffic System installed.

This shall be in two main work areas:

- a) Street equipment (signals, controllers, transmission equipment, etc.)
- b) Signal plan generation, etc. and general traffic engineering as applied to traffic signal design and operation.

The training program shall be conducted in English.

6.6.1.2 Contractor's Staff

One qualified Engineer shall be permanently committed to the works for the full period of the Contact. He shall provide both formal training and continuous technical support to the employer's staff.

6.6.1.3 Employer Staff

It is the intention of the Employer to make available to the Contractor a limited number of technical Staff to work with the Contractor in the installation and testing of all site equipment.

It is also the intention of the Employer to make available to the Contractor Staff to assist in the supervision of traffic surveys and in the development traffic plans. The Contractor will be encouraged to make full use of their assistance.

6.6.1.4 Plan Generation

The Contractor is to undertake full pedestrian and vehicular surveys between two and four weeks after completing a new signal installation. With this new data the Contractor is to

update signal plans and timings for all periods throughout the week. The timings are to be optimized for capacity and delay.

6.6.2 Maintenance Equipment

1. The Contractor is to prepare, in conjunction with the Employer a report which outlines the requirements to enable it to effectively undertake the maintenance of the installations at the conclusion of the projects. The report will identify the appropriate staffing levels and experience required to adequately undertake the additional tasks.
2. The report will specify, including costs, all other items necessary to the Employer for the efficient maintenance operation. This is likely to include, but not be limited to:
 - Storage system for spares.
 - Spares inventory procedure.
 - Small equipped workshop for repair.
 - Adequate tools and equipment.
 - Electrical tester's equipment.
 - Vehicles "equipped for repair work".
 - Radio linkage to vehicle.
3. The report is to be completed within 2 – 3 weeks of the commencement of the Contract and is to be submitted to the Engineer for approval.
4. On the approval of the Engineer the Contractor is to provide and install all such equipment as considered necessary. The Employer is responsible for providing the appropriate office stores and workshop space.

6.6.3 Spares

The Contractor shall supply spare equipment in the numbers specified in the bill of quantities.

The spares shall be handed over to the Employer on issue of the Certificate of completion for the first section of the works. The Contractor may draw upon the stock of spares to meet his obligations during the warranty period, but shall replace each item used within 6 weeks. The stock (including consumables) shall be complete at the time of issue of the final Certificate.

6.7 Maintenance

6.7.1 Description

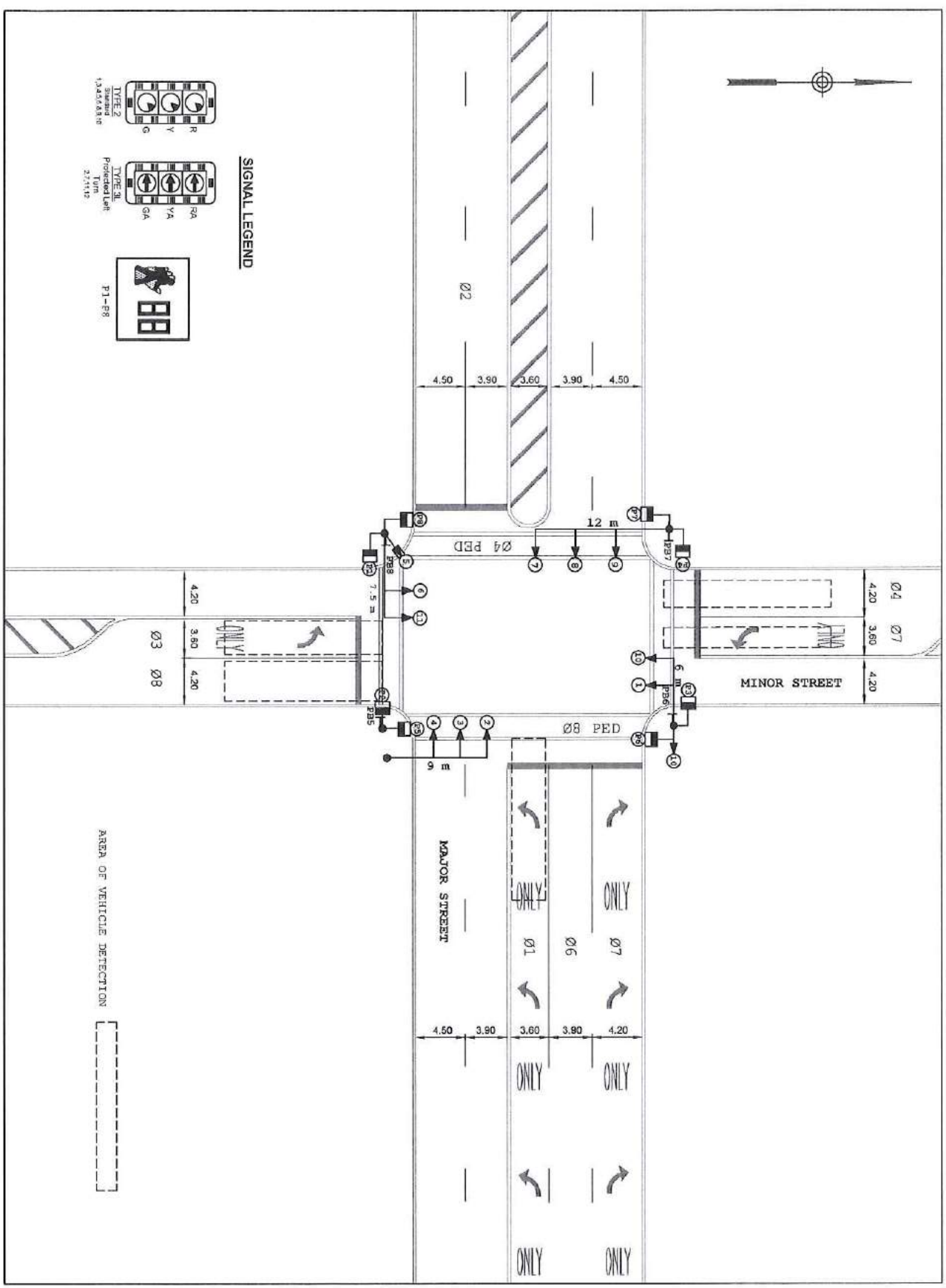
The Contractor shall fully maintain and keep in satisfactory working condition all equipment supplied under this Contract, during the periods of time specified as below:

One year from the date of the Certificate of Completion for complete intersection including controller, signal poles, vehicular signals, pedestrian signals, cable and wiring, and all components, parts and appurtenances:

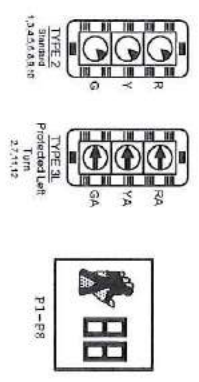
The Contractor's system operation responsibilities during the time period specified above shall include, but not by way of limitation, continuous monitoring of system performance and traffic conditions; adjustment and modification of timing patterns and time plans to satisfy requirements of changing traffic and field conditions; malfunction diagnosis and implementation of corrective measures; and other operational activities as specified in the Contract Documents and as directed by the Employer and the Engineer.

All costs associated with operations and maintenance activities for the period specified herein shall be borne by the Contractor as an incidental part of his bid price for the items shown on the bills of Quantities, operated and maintained by the Contractor. No separate

General Note:
1. All Dimensions are in Centimeters
Unless Otherwise Indicated.



SIGNAL LEGEND


















AREA OF VEHICLE DETECTION

Client	KABUL MUNICIPALITY		
Design Consultant	Kabul Municipality Traffic Engineering Team		
Project Name	Traffic Signal Construction and Installation		
Drawing Title	SIGNAL PLAN SCALE: 1:500 DATE: 31-Oct-18		
Drawn By	Shahinullah	Checked By	Dr. Tawfik
Scale	1:500	Sheet No.	16
Design Status	FINAL DESIGN		
Design Code	AP		
Drawing Number	16	Revision	00

LEGEND

General Notes:
1. All Dimensions are in Centimeters
Unless Otherwise Indicated.

- TRAFFIC SIGNAL CONTROLLER – GROUND MOUNTED 
- TRAFFIC SIGNAL CONTROLLER – POLE MOUNTED 
- TRAFFIC SIGNAL PULLBOX 
- TRAFFIC SIGNAL VEHICULAR HEAD WITH IDENTIFIER 
- TRAFFIC SIGNAL VEHICULAR HEAD (LOUVERED) WITH IDENTIFIER 
- TRAFFIC SIGNAL PEDESTRIAN HEAD WITH IDENTIFIER 
- TRAFFIC SIGNAL PEDESTRIAN PUSH BUTTON WITH IDENTIFIER 
- MAST ARM POLE 
- TRAFFIC SIGNAL POLE 
- VIDEO DETECTION ZONE 
- VIDEO DETECTOR 
- TRAFFIC SIGNAL UNDERGROUND CONDUIT 
- POLE MOUNTED REGULATORY OR WARNING SIGN 
- STREET NAME SIGN MOUNTED ON MAST ARM 
- SERVICE MANHOLE 
- DUCTBANK 
- DUCTBANK ENCASED IN CONCRETE 
- PEDESTRIAN MOVEMENT 
- VEHICLE MOVEMENT 

- DENOTES INSTALLING NEW CONDUIT WITH NEW CABLES OR WIRES
- DENOTES SPARE CONDUITS

DUCTBANK FORMATION – THE NUMBER OF CONDUIT AND ARRANGEMENT FOR EACH DUCTBANK SHALL BE PREPARED FROM THE FOLLOWING SYMBOLS:

Drawn	Checked	Project Code	Drawn No.
AP	AF	17	01
<p>Project Name: INDIAN SIGNAL CONSTRUCTION AND INSTALLATION</p> <p>Project Location: KARLA MANGINMALAY</p> <p>Project Date: 31-Oct-18</p> <p>Project No.: 1/00</p>			
<p>Drawn: AP</p> <p>Checked: AF</p> <p>Project Code: AF</p> <p>Drawn No.: 17</p> <p>Drawn Date: 01</p>			

ABBREVIATIONS (FOR SG DRAWINGS ONLY)

C	CONDUIT	TSA-15M-1	TRAFFIC SIGNAL ASSEMBLIES, TYPE 15M-1
CCS	CONTROLLER CABINET SKIRT	TSA-15M-2	TRAFFIC SIGNAL ASSEMBLIES, TYPE 15M-2
CFP	CONTROLLER FOUNDATION, TYPE P	TSA-20M-1	TRAFFIC SIGNAL ASSEMBLIES, TYPE 20M-1
DWG	DRAWING	TSA-20M-2	TRAFFIC SIGNAL ASSEMBLIES, TYPE 20M-2
FSC	FLEXIBLE LIQUID-TIGHT STEEL CONDUIT	TSA-25MK-1	TRAFFIC SIGNAL ASSEMBLIES, TYPE 25MK-1
GNB	GROUND	TSA-25MK-2	TRAFFIC SIGNAL ASSEMBLIES, TYPE 25MK-2
NO	NUMBER	TSA-30S-1	TRAFFIC SIGNAL ASSEMBLIES, TYPE 30S-1
NFS	NOT TO SCALE	TSA-30S-2	TRAFFIC SIGNAL ASSEMBLIES, TYPE 30S-2
PEA	PEDESTRIAN PUSH BUTTON ASSEMBLY	TSA-35S-1	TRAFFIC SIGNAL ASSEMBLIES, TYPE 35S-1
PLX	POINT OF INTERSECTION OF CURB LINE EXTENDED	TSA-35S-2	TRAFFIC SIGNAL ASSEMBLIES, TYPE 35S-2
PTS	PEDESTRIAN TRAFFIC SIGNAL (CLAMP MOUNTED ON A SIGNAL POLE)	TSA-40S-1	TRAFFIC SIGNAL ASSEMBLIES, TYPE 40S-1
PV-1	VEHICLE SIGNAL, POST TOP MOUNTED ON A SIGNAL PEDESTAL	TSA-40S-2	TRAFFIC SIGNAL ASSEMBLIES, TYPE 40S-2
PV-2	2 VEHICLE SIGNALS, POST TOP MOUNTED ON A SIGNAL PEDESTAL	TSA-45S-1	TRAFFIC SIGNAL ASSEMBLIES, TYPE 45S-1
RGS	RIGID GALVANIZED STEEL CONDUIT	TSA-45S-2	TRAFFIC SIGNAL ASSEMBLIES, TYPE 45S-2
RMMHC-C	RIGID NON-METALLIC CONDUIT, TYPE PVC-H, ENCASED IN CONCRETE	TSA-50S-1	TRAFFIC SIGNAL ASSEMBLIES, TYPE 50S-1
SME	SIDE MOUNT ENCLOSURE	TSA-50S-2	TRAFFIC SIGNAL ASSEMBLIES, TYPE 50S-2
SFF	FOUNDATIONS, TYPE SFF	TSA-55S-1	TRAFFIC SIGNAL ASSEMBLIES, TYPE 55S-1
SFT	FOUNDATIONS, TYPE SFT	TSA-55S-2	TRAFFIC SIGNAL ASSEMBLIES, TYPE 55S-2
SFK	FOUNDATIONS, TYPE SFK	TSA-60S-1	TRAFFIC SIGNAL ASSEMBLIES, TYPE 60S-1
STF	FOUNDATIONS, TYPE STF	TSA-60S-2	TRAFFIC SIGNAL ASSEMBLIES, TYPE 60S-2
SFOCK*)	SIGNAL PEDESTAL (POLE HEIGHT ABOVE GROUND)	TSA-C-1	TRAFFIC SIGNAL ASSEMBLIES, TYPE C-1
TSS-T	TRAFFIC SIGNAL SUPPORTS, TYPE T	TSA-MM-1	TRAFFIC SIGNAL ASSEMBLIES, TYPE MM-1
TSS-K	TRAFFIC SIGNAL SUPPORTS, TYPE K	TSA-H-1	TRAFFIC SIGNAL ASSEMBLIES, TYPE H-1
TSS-S	TRAFFIC SIGNAL SUPPORTS, TYPE S	2/C	TRAFFIC SIGNAL CABLE, 2 CONDUCTOR
UPS	UNINTERRUPTIBLE POWER SOURCE	5/C	TRAFFIC SIGNAL CABLE, 5 CONDUCTOR
VIP	VIDEO INPUT PROCESSOR	10/C	TRAFFIC SIGNAL CABLE, 10 CONDUCTOR
VS (X)	VIDEO SENSOR (WITH RESPECTIVE SENSOR NUMBER(S))		
VSC (X)	VIDEO SENSOR CABLE (WITH RESPECTIVE SENSOR NUMBER(S))		

DESCRIPTION OF TRAFFIC SIGNAL ASSEMBLY ABBREVIATIONS

- TRAFFIC SIGNAL ASSEMBLIES SHALL CONSIST OF TRAFFIC SIGNAL ARM, FURNISHED AND INSTALLED ON A TRAFFIC SIGNAL SUPPORT COMPLETE WITH MAST HANGER AND SPRIG ASSEMBLIES, OR MOUNTING BRACKET ASSEMBLY, AS REQUIRED, SAFETY CHAINS, TRAFFIC SIGNAL HEADS, MISCELLANEOUS HARDWARE AND FITTINGS, AND TRAFFIC SIGNAL CABLE FROM THE TERMINAL BLOCK OF EACH SIGNAL FACE TO THE BASE OF THE TRAFFIC SIGNAL SUPPORT.
- TRAFFIC SIGNAL ASSEMBLIES DESIGNATED WITH THE LETTER M SHALL CONSIST OF ASSEMBLIES HAVING A TRAFFIC SIGNAL ARM OF THE ALUMINUM MAST ARM TYPE WHICH SHALL FIT A SIGNAL POLE, TYPE T.
- TRAFFIC SIGNAL ASSEMBLIES DESIGNATED WITH THE LETTERS K, SHALL CONSIST OF ASSEMBLIES HAVING A TRAFFIC SIGNAL ARM OF THE ALUMINUM MAST ARM TYPE WHICH SHALL FIT A SIGNAL POLE, TYPE K.
- TRAFFIC SIGNAL ASSEMBLY DESIGNATED WITH THE LETTER S SHALL CONSIST OF ASSEMBLIES HAVING A TRAFFIC SIGNAL ARM OF THE STEEL MAST ARM TYPE WHICH SHALL FIT A SIGNAL POLE, TYPE S.
- TRAFFIC SIGNAL ASSEMBLY, TYPE C-1 SHALL CONSIST OF ONE TRAFFIC SIGNAL HEAD WITH POLE CLAMP MOUNTING FURNISHED AND INSTALLED ON A TRAFFIC SIGNAL SUPPORT. THE ITEM SHALL ALSO INCLUDE MISCELLANEOUS FITTINGS, THE DRILLING OF THE SUPPORT, INSTALLING THE GROMMET, AND TRAFFIC SIGNAL CABLE FROM THE TERMINAL BLOCK OF EACH SIGNAL FACE TO THE BASE OF THE SUPPORT.
- TRAFFIC SIGNAL ASSEMBLY, TYPE MM-1 SHALL CONSIST OF A UNMOUNTED TRAFFIC SIGNAL HEAD FURNISHED AND INSTALLED ON A MAST ARM, COMPLETE MOUNTING HARDWARE, DRILLING THE ARM, GROMMET, MOUNTING BRACKET ASSEMBLY, SAFETY CHAIN, ONE TRAFFIC SIGNAL HEAD, AND TRAFFIC SIGNAL CABLE FROM THE TERMINAL BLOCK OF EACH FACE TO THE BASE OF THE TRAFFIC SIGNAL SUPPORT.
- TRAFFIC SIGNAL ASSEMBLIES DESIGNATED WITH THE LETTER H SHALL CONSIST OF FINISHING AND INSTALLING A TRAFFIC SIGNAL HEAD AT THE END OF AN EXISTING TRAFFIC SIGNAL MAST ARM. THE ITEM SHALL ALSO INCLUDE THE REQUIRED MAST ARM HANGER OR MOUNTING BRACKET, SAFETY CHAIN, MISCELLANEOUS FITTINGS, AND TRAFFIC SIGNAL CABLE FROM THE TERMINAL BLOCK OF THE TRAFFIC SIGNAL HEAD TO THE BASE OF THE STANDOFF.

8. TRAFFIC SIGNAL ASSEMBLIES SHALL CONFORM TO THE FOLLOWING TABLE.

TYPE	ARM LENGTH (FEET)	NO. OF SIGNAL HEADS	NO. OF SPRIG ASSEMBLIES
15M-1	15	1	0
15M-2	15	2	1
20M-1	20	1	0
20M-2	20	2	1
25MK-1	25	1	0
25MK-2	25	2	1
30S-1	30	1	0
30S-2	30	2	1
35S-1	35	1	0
35S-2	35	2	1
40S-1	40	1	0
40S-2	40	2	1
45S-1	45	1	0
45S-2	45	2	1
50S-1	50	1	0
50S-2	50	2	1
55S-1	55	1	0
55S-2	55	2	1
60S-1	60	1	0
60S-2	60	2	1
C-1	N/A	1	0
H-1	N/A	1	0
MM-1	N/A	1	0

General Notice
 1. All Dimensions are in Centimeters
 Unless Otherwise Indicated.

DATE: 31-08-18
 DRAWING NO: 18

PROJECT: AT-
 CLIENT:
 DESIGNER:
 CHECKER:
 APPROVED:
 DATE: 31-08-18

18

GENERAL NOTES (TRAFFIC SIGNALS):

1. PRIOR TO BEGINNING ANY WORK ON THE CONTRACT, NOTIFY THE ENGINEER IN WRITING OF THE DATE MAINTENANCE RESPONSIBILITY OF THE TRAFFIC SIGNAL IS ASSUMED BY THE CONTRACTOR. ASSUME MAINTENANCE RESPONSIBILITY OF THE TRAFFIC SIGNAL UNTIL THE ISSUANCE OF CERTIFICATE OF FINAL COMPLETION BY THE AUTHORITY.
2. EXERCISE CARE WHEN REMOVING AND INSTALLING TRAFFIC SIGNAL EQUIPMENT SHOWN ON THE CONTRACT DRAWINGS. REPAIR OR REPLACE ANY TRAFFIC SIGNAL EQUIPMENT THAT IS DAMAGED DURING THE PERFORMANCE OF THE WORK. NOTIFY THE ENGINEER REGARDING ANY TRAFFIC SIGNAL EQUIPMENT MALFUNCTIONS THAT THE CONTRACTOR DEMONSTRATES TO THE SATISFACTION OF THE ENGINEER ARE NOT THE RESULT OF HIS WORK.
3. MAINTAIN EXISTING TRAFFIC SIGNALS OPERATION DURING CONSTRUCTION. CHANGES TO THE EXISTING TRAFFIC SIGNAL OPERATION SHALL BE AS APPROVED BY THE ENGINEER AT NO ADDITIONAL COST TO THE AUTHORITY.
4. THE VIDEO DETECTION SYSTEM SHALL BE (Specify model number) MANUFACTURED BY (Specify vendor) INCLUDING MOUSE AND MONITOR IN EACH CONTROLLER CABINET. NO SUBSTITUTIONS PERMITTED. ALL VIDEO DETECTION EQUIPMENT SHALL BE FURNISHED BY (Specify vendor), ALONG WITH INSTALLATION PROGRAMMING, AND TESTING OF VIDEO EQUIPMENT INSIDE CONTROLLER CABINET. NO SUBSTITUTION ALLOWED. PERSONNEL AT THE (Specify location) ELECTRICAL SHOP SHALL BE TRAINED AT THE CONSTRUCTION SITE FOR TWO HOURS IN THE INSTALLATION, SETUP, AND OPERATION OF THE VIDEO DETECTION SYSTEM INSTALLED IN CABINET. NOTIFY THE ENGINEER ONE WEEK IN ADVANCE IN WRITING, ON WHEN THE TRAINING WILL COMMENCE.
5. PROVIDE AN UNINTERRUPTIBLE POWER SOURCE (UPS) CAPABLE OF SUPPORTING THE LOAD FOR THE EQUIPMENT SHOWN ON THE DESIGN DRAWINGS FOR AN UNINTERRUPTIBLE PERIOD OF (Specify number of hours). THE UPS SHALL BE (Specify model number), AS MANUFACTURED BY (Specify vendor), OR APPROVED EQUAL. MOUNTING FRAME SHALL BE VIBRATIONAL RESISTANT.
7. PUSHBUTTON SHALL BE (Specify model number) (LATCHING LED MODEL) AS MANUFACTURED BY (Specify vendor), OR APPROVED EQUAL.
8. SUBMIT SPECIFICATION FROM THE CONTROLLER MANUFACTURER THAT THE CONTROLLER HAS BEEN FACTORY TESTED TO VERIFY THAT IT MEETS THE REQUIREMENTS OF THE SPECIFICATIONS AND CONTRACT DRAWINGS AND THAT ALL THE TRAFFIC SIGNAL CONTROLLER SHALL ALSO BE EQUIPPED WITH THE FOLLOWING FEATURES:
 - A. FIBER OPTIC DATA PATCH PANEL (Specify model number)
 - B. MODERN (Specify model number)
 - C. GENERATOR SWITCH HOOK-UP
9. PROGRAM THE CONTROLLER TO PERFORM THE SIGNAL OPERATION AS SHOWN ON THE CONTRACT DRAWINGS. EMPLOY A REPRESENTATIVE OF THE CONTROLLER MANUFACTURER TO PERFORM THE PROGRAMMING.
10. THE CONFLICT MONITOR SHALL BE (Specify vendor and model number) OR APPROVED EQUAL.
11. CONDUCT A TRAFFIC SIGNAL PRE-FINAL INSPECTION FOR EACH INTERSECTION IN THE PRESENCE OF THE ENGINEER. UPON COMPLETION OF THE PUNCHLIST ITEMS FROM THE PRE-FINAL INSPECTION, CONDUCT A FINAL INSPECTION IN THE PRESENCE OF THE ENGINEER. NOTIFY THE ENGINEER AT LEAST TWO WEEKS PRIOR TO THE REQUESTED DATES OF BOTH INSPECTIONS. THE SIGNAL OPERATION SHALL UNDERGO A 30-DAY ACCEPTANCE TEST PERIOD AFTER ALL FINAL INSPECTION ITEMS ARE ADDRESSED.
12. PRIOR TO THE PRE-FINAL/TURN-ON INSPECTION, SUBMIT A TEST RESULT LETTER TO THE ENGINEER THAT THE CABINET INTERNAL AND REAR BOARD CONNECTIONS, THE CONTROLLER, AND CONFLICT MONITOR HAVE BEEN TESTED.
13. MAKE ANY CORRECTION OR MODIFICATIONS TO THE WORK THAT ARE REQUIRED DURING TRAFFIC SIGNAL PRE-FINAL/TURN-ON AND FINAL INSPECTIONS IN ORDER TO COMPLY WITH THE CONTRACT DRAWINGS AT NO ADDITIONAL COST TO THE AUTHORITY.
14. INSTALLATION OF ELECTRICAL SYSTEM SHALL COMPLY WITH REQUIREMENTS AS SPECIFIED IN DIVISION 16 SPECIFICATIONS.
15. TAG ALL WIRES AT POINT OF TERMINATION AT BOTH ENDS AND IN ALL PULL BOXES.
16. FURNISH SPARE TRAFFIC SIGNAL EQUIPMENT ACCORDING TO THE FOLLOWING LIST:
 - A. (1) CONTROLLER
 - B. (1) SIGNAL CONFLICT MONITOR UNIT
 - C. (1) VIDEO DETECTION SENSOR (IF APPLICABLE)
 - D. (1) VIDEO DETECTION PROCESSOR (IF APPLICABLE)
 - E. (2) LOAD SWITCHES
 - F. (1) FLASHER UNIT
 - G. (1) FLASH TRANSFER RELAY
17. TEST ALL CIRCUITS AND EQUIPMENT FOR PROPER CONNECTIONS BEFORE THE ELECTRICAL SYSTEM IS ENERGIZED (CONTINUITY CHECKS).
18. FURNISH AND INSTALL GROUND WIRE (GND), 1/2" #8 AWG, INSULATED (COLOR GREEN) CONTINUOUSLY THROUGHOUT THE TRAFFIC SIGNAL SYSTEM AND SECURE TO ALL GROUND RODS, CHAINS AND TRAFFIC SIGNAL BASES.
19. HERE EXISTING DUCTBANK IS SHOWN ON THE CONTRACT DRAWINGS AS ABANDONED. REMOVE ALL CABLES AND WIRES FROM THE DUCTBANK AND PLUG EACH CONDUIT OF THE DUCTBANK.
20. UNLESS OTHERWISE SHOWN ON CONTRACT DRAWINGS, CONCRETE SHALL HAVE A MINIMUM 28 DAY COMPRESSIVE STRENGTH (P_c) OF 4000 PSI IN ACCORDANCE WITH SPECIFICATION. SUBMIT MIX DESIGN TO THE ENGINEER FOR APPROVAL.
21. ALL REINFORCING BARS SHALL BE ASTM A615, GRADE 60, 709-01, UNLESS OTHERWISE NOTED.
22. DELIVER ALL REMOVED EXISTING ABOVE GROUND TRAFFIC SIGNAL EQUIPMENT TO (Specify applicable facility) ELECTRICAL SHOP LOCATED IN (Specify location), NOTIFY THE ENGINEER PRIOR TO DELIVERY.
23. DISCONNECT (OR CONNECT) MANUAL CONTROL FOR TRAFFIC SIGNAL CONTROLLER.
24. ALL VEHICULAR AND PEDESTRIAN TRAFFIC SIGNAL INDICATIONS SHALL BE LED.

GENERAL NOTES (PULLBOXES AND SPLICE BOXES):

1. THE LOCATIONS OF THE PULLBOXES AND SPLICE BOXES ARE APPROXIMATE AND ARE SUBJECT TO APPROVAL BY THE ENGINEER PRIOR TO CONSTRUCTION.
2. PULLBOXES AND SPLICE BOXES SHALL NOT BE INSTALLED AT A PEDESTRIAN ACCESS RAMP.
3. IF INSTALLED WITHIN A SIDEWALK, THE PULLBOX AND SPLICE BOXES SHALL BE ALIGNED FLUSH WITH THE SURFACE OF THE SURROUNDING SIDEWALK.
4. PULLBOXES AND SPLICE BOXES INSTALLED IN ROADSIDE BERMS, SIDEWALKS OR MEDIANS, PAVED OR UNPAVED, SHALL BE ALIGNED FLUSH WITH THE SURROUNDING SURFACE.

General Notes:
1. All Dimensions are in Centimeters
Unless Otherwise Indicated.

Date	Revision	By	Checked

Using Consultant:
Kohli Minipally
Traffic Engineering Team

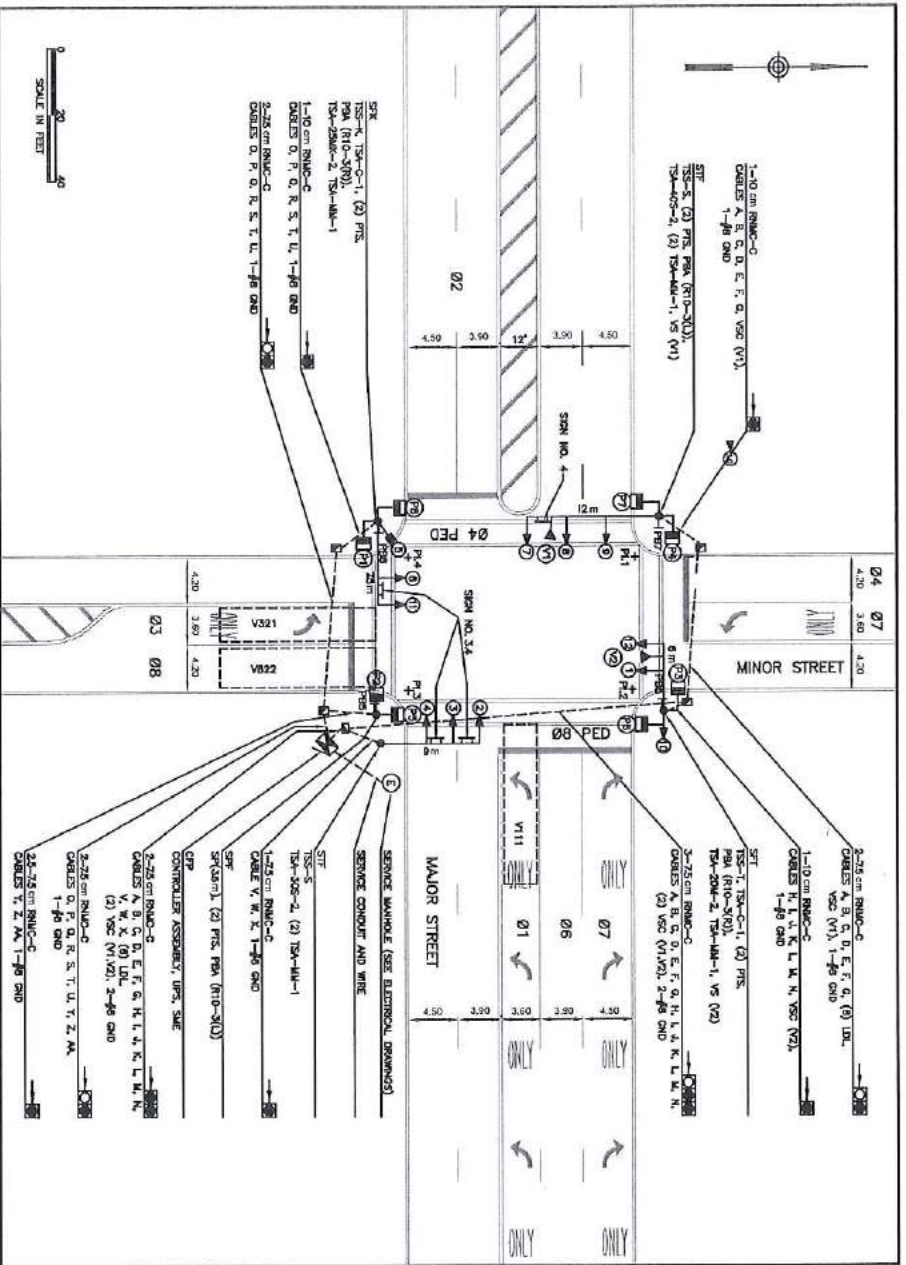
Contractor:
Traffic Signal Construction
and Installation

Drawing Title:
General Notes

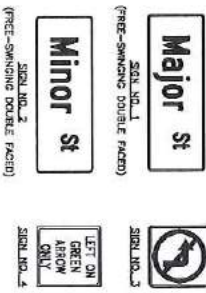
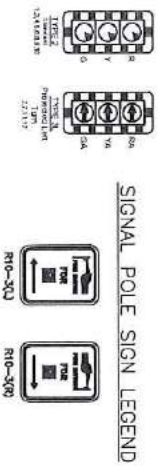
Drawn	Checked
A. Resal/Inze	Zobair-Adnan
Designed	Checked
SK/ML/Inz	DR/Trayant
Scale	Scale
31-06-18	1:500

FINAL DESIGN

Drawn By: AF



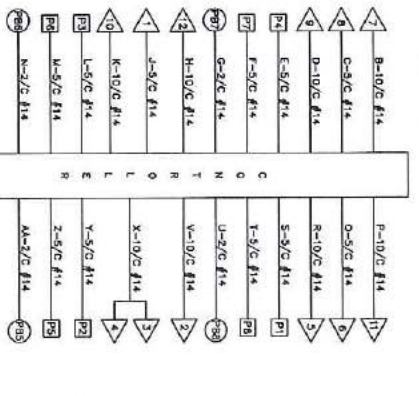
SIGNAL LEGEND



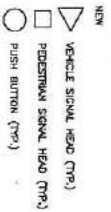
MAST ARM SIGN LEGEND

- NOTES:**
1. THE LOCATIONS OF TRAFFIC POLES AND SIGNALS ARE SHOWN AS SHOWN IN THE CONTRACT DOCUMENTS. ANY CHANGES IN TRAFFIC POLE OR SIGNAL LOCATIONS DUE TO FIELD CONDITIONS SHALL BE APPROVED BY THE ENGINEER.
 2. VEHICLE SIGNAL HEADS #11, #12, SHALL BE ALUMINUM.
 3. TRAFFIC SIGNAL INDICATORS #2, #3, #4, #7, #8, AND #9 SHALL BE EQUIPPED WITH BACKLITES.
 4. VANE VEHICLES SHALL BE DIMENSIONED AND INSTALLED ON ALL APPROACHES FOR SIGNAL HEAD #8 TO BECOME VISIBLE FROM THE P1 APPROACH.
 5. PEDESTRIAN PLACARDING SHALL BE INSTALLED AT THE OPERATIONAL SIGNALS. SIGNAL HEAD #8 TO BECOME VISIBLE FROM THE P1 APPROACH.
 6. SIGNAL #10-11/12 SHALL SHOW THE ARROW POINTING TO THE CROSSWALK ACQUIRED BY THE DISTRIBUTION.
 7. ALL PEDESTRIAN SIGNAL HEADS SHALL BE MOUNTED AT 24".
 8. REFER TO SIGN DATA TABLE FOR SIGN DETAILS.
 9. SIGN NO. 3 SHALL BE INSTALLED FACING WEST (CONTAINING TRAFFIC) AND SIGN NO. 4 SHALL BE INSTALLED FACING EAST (PEDESTRIAN TRAFFIC).
 10. THE CONTROLLER CABINET SHALL BE INSTALLED AT AN OPERATOR AS SHOWN ON THE PLAN.
 11. SPARE WIRES SHALL TERMINATE AT THE TERMINAL BLOCK IN THE SIGNAL HEAD.

BLOCK WIRING DIAGRAM



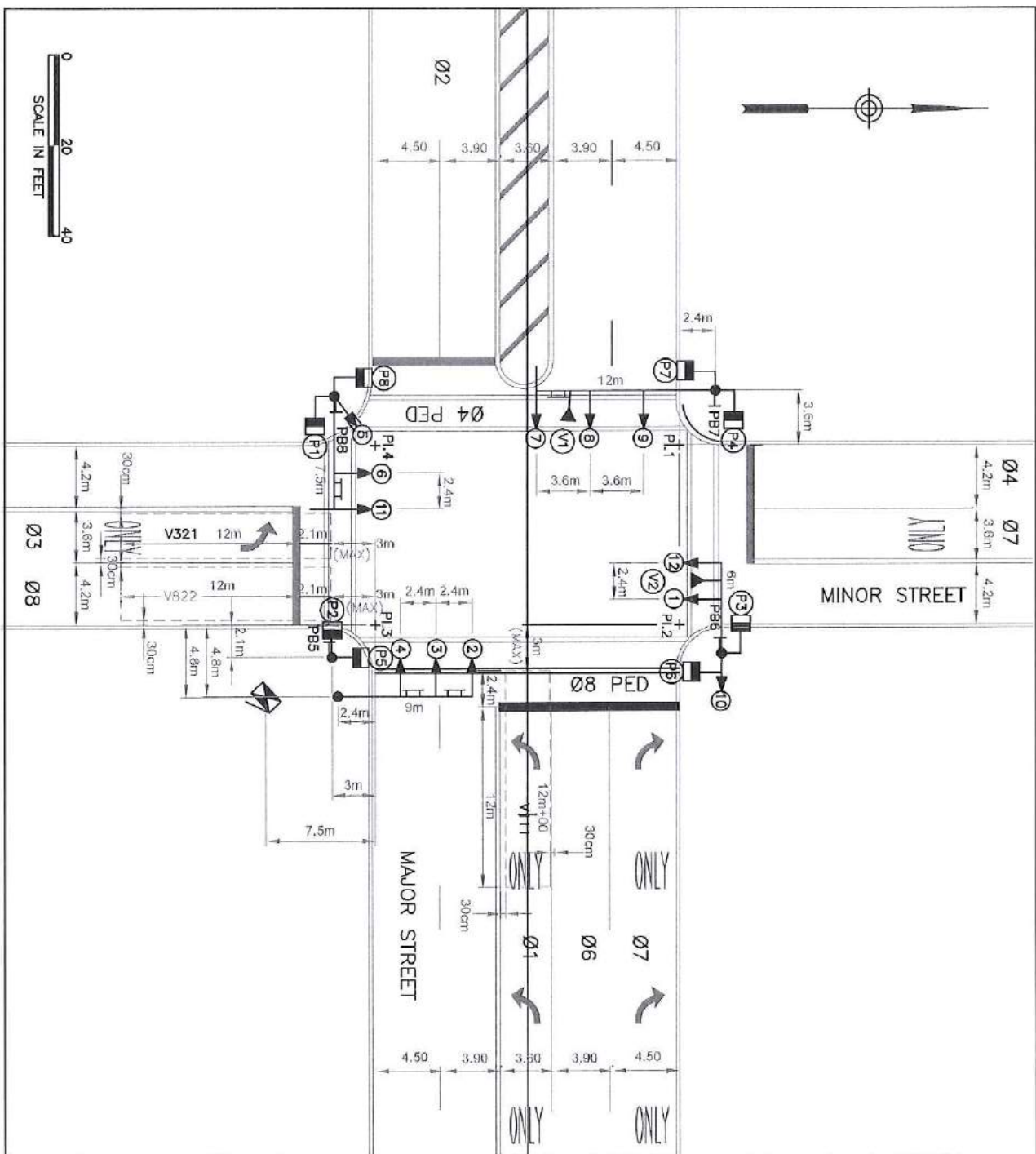
LEGEND



General Notes:
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Unless Otherwise Indicated.

Drawn/Checked:	KARL MINICHAULT
Reviewed:	Karl Minichault
Project Name:	Traffic Signal Construction and Installation
Drawing Title:	Sample Traffic Signal Wiring Plan
Drawn/Checked:	AP
Reviewed:	AP
Project Code:	AP
Drawn/Checked:	AP
Reviewed:	AP
Project Number:	19
Sheet Number:	00

TRAFFIC SIGNAL DIMENSION DIAGRAM



General Notes:
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Project Name	Brahmavaram - Smart Signal Project
Client	KARNATAKA STATE ROAD TRANSPORT CORPORATION
Contract No.	
Site No.	
Drawn By	
Checked By	
Approved By	

Project Manager
 KARNATAKA STATE ROAD TRANSPORT CORPORATION

Design Consultant
 KARNATAKA STATE ROAD TRANSPORT CORPORATION
Traffic Engineering Team
 Traffic Signal Consultant and Installation

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Checked By
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Date
 31-Oct-18
Scale
 1:50

Project Name
 BRAHMARAM

Drawn By
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Checked By
 SRINIVAS S

Approved By
 SRINIVAS S

Date
 31-Oct-18

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Project No.
 20