SECTION 3800 − TRAFFIC SIGNALS

TRAFFIC SIGNALS

PART 1 − GENERAL

1.01 Section Summary

A. Traffic Signal construction requirements and materials.

B. Traffic signal design and installation shall comply with the NDDOT "Standard Specification for Road and Bridge Construction," 2014 Edition, as Revised, except as modified herein.

1.02 References

A. North Dakota Department of Transportation "Standard Specifications for Road and Bridge Construction, "2014 Edition, as Revised.

1. Section 772 − Highway Traffic Signals.

2. Section 896 − Highway Traffic Signals.

B. Manual on Uniform Traffic Control Devices for Streets and Highways, 2009 Edition, as revised.

1. Chapter 4 − Highway Traffic Signals.

C. National Electric Code, as revised.

D. North Dakota State Electrical Board, recommendations as revised.

E. City of Minot Ordinances, as approved.

F. Serving franchise utilities, as recommended.

1.03 Submittals

A. Contractor shall follow submittal instructions found in the General and Supplementary Conditions.

1. Before any of the materials are delivered to the job, submit to Engineer complete Shop Drawings for each item indicated.

2. Include catalog numbers, performance data, dimensions and other descriptive information.

3. Provide manufacturer warranties and guarantees with the City listed as owner.

4. Shop Drawings may be in the form of printed catalog sheets showing all necessary information and shall be bound together, neatly, indexed, and tabbed.

5. Each Shop Drawing folder shall be stamped, initialed, and dated by Contractor to indicate the Contractor has thoroughly reviewed them.

6. Shop drawings not in conformance with Specifications will be returned to Contractor without review.

7. Two copies will be retained by Engineer after review and the balance will be returned to Contractor.

8. Provide Shop Drawings / Product Specifications for:

    a. Cable.

    b. Conduit.

    c. Feed Point Cabinet including a safety switch and lightning Protector in device.

    d. Traffic Signal Standards.

    e. Combination Standards including all necessary calculations and drawings used tin designing these poles.

    f. Traffic Signal Heads.

    g. Pedestrian Heads.

    h. Beacon Heads.

    i. Pedestrian Push Buttons.

    j. Traffic Signal Controller and Components, including:

        i. Controller

        ii. Flasher

        iii. Conflict Monitor

        vi. Coordination Equipment

        v. External Logic Unit

        vi. Solid state Load Switches

        vii. Detection Amplifiers

        viii. Lightening Protector Device

k. Traffic Signal Controller Cabinet.

l. Flashing Beacon Controller Cabinet.

m. Video Detection.

n. Emergency Vehicle Pre-Emption.

o. Astro Bracket Signal Head Mounts.

p. Paint Type and Application Method.

B. The Engineer shall provide two detailed sets of the traffic signal cabinet wiring diagrams to the City of Minot. Schematic diagrams of the circuitries shall be included in the wiring diagram submittal. Place the wiring diagram in the signed cabinet at the location approved by the Engineer.

1. Show all equipment and associated connecting cable and termination points.

2. Identify each wire in each connecting cable on the wiring diagram as to its function and terminal number. At each terminal on the wiring diagram, list the cable description and connection letter of the use and the function.

C. Manuals

1. Upon completion of the Work in the Section and as condition of final acceptance, Contractor shall compile one Operators and Maintenance Manual in a 3-ring binder.

2. List project name, date, Contractor's name, address and telephone number on exterior label of Manual.

3. Include an index sheet indicating each major piece of equipment, supplier and supplier's telephone number. Provide tabbed dividers indicating major groupings of equipment.

4. Manual information shall be included for all equipment/material where Shop Drawings are required. Also, include all installation, operation and maintenance data packaged with all equipment.

5. All wiring diagrams and schematic diagrams shall be included as specified in Section 772.03.D of the NDDOT Specification.

PART 2 - PRODUCTS

2.01 Rigid Conduit

A. Shall conform to NDDOT Specification Section 896.01.

2.02 Conductors

A. Shall conform to NDDOT Specification Section 896.02.

2.03 Pull Box

A. Shall be of a polymer concrete type, Quazite Enclosure, minimum 13 inches x 24 inches, stackable, PG Style as Manufactured by Hubbell Power System, Inc. or an equal approved but the City of Minot Traffic Department.

B. The cover shall clearly state "Signal".

2.04 Saw Slot Sealant

A. Shall conform to NDDOT Specification Section 896.03.

2.05 Feed Points

A. Shall conform to NDDOT Specification Section 896.04.

2.06 Foundations for Traffic Signal Standards

A. Shall conform to NDDOT Specification Section 772.04.B.

2.07 Traffic Signal Standards

A. Shall conform to NDDOT Specification Sections 772.04.G and 896.05 except as modified herein:

1. The pole of the traffic signal standard shall be mounted on a transformer base.

2. Traffic signal system bases, shafts/poles, and mast arms shall be galvanized steel and zinc powder coated gloss black. The color shall be No. 17038 of Aerospace Material Specification Standard No. 595.

2.08 Traffic Signal Heads

A. Shall conform to NDDOT Specification Section 896.06 except as modified herein:

1. Traffic signal head mounting hardware shall be painted gloss black. The color shall be No. 17038 of Aerospace Material Specification Standard No. 595.

2. Shall be GE GTX City VLA model.

3. Traffic signal backplates shall be aluminum and shall be louvered.

4. Traffic signal head backplates shall have a yellow 1-inch wide retroreflective border. The border shall be installed around the perimeter of the face of the backplate. Sheeting shall be Type IX reflective sheeting with a smooth

surface, a distinct interlocking diamond seal pattern, and orientation marks visible on the face. The border shall have an aggressive pressure sensitive adhesive that is protected by a removable liner. Border shall have a sheeting that consists of prismatic lenses formed in a transparent synthetic resin that is sealed.

2.09 Pedestrian Signal Heads

A. Shall conform to NDDOT Specification Section 896.07 except as modified herein.

B. Pedestrian heads shall be Aluminum alloy die cast.

2.10 Pedestrian Push Button and Pedestrian Push Button Post

A. Shall conform to NDDOT Specification Section 896.08 except as modified herein:

1. Pedestrian pushbutton posts and pushbutton housing shall be galvanized steel and zinc powder coated gloss black. The color shall be No. 17038 of Aerospace Material Specification Standard No. 595.

2.11 Traffic Signal Cabinet

A. Shall meet one of the following cabinet standards:

1. ATC Cabinet – 67-inch H x 45-inch W x 26-inch D, 5052-H32 Aluminum, 0.125-inch thick, 24 or 48-channel input assemblies, 2 or 4-channel industry standard detection modules, 48-channel detector, PPB, EVP, 32-channel output assembly, 32-channel CMU, CMU auxiliary display unit, cabinet power supply, DC power / common assembly, Clean AC power assembly, Police panel with On/Off, MCE, Auto/Flash, and Interval Advance push button cable, Slide-out drawer for storing programming blocks, plans, etc., Fan panel assembly, ATC Controller and Video Detection Assembly, and light to adequately allow work at night.

2. NEMA Cabinet – TS2-1, , 5052-H32 Aluminum, 0.125-inch thick, SDLC serial data bus, serial bus interface to detectors and load switches is via Bus Interface Unites (BIUs), shelf rack detector assembly with 4 channel detector cards – 6 detector inputs – full-width Bus Interface Unit (BUI) – 4 channels of EVP preemption, 16 total phase capability – 8 vehicle phases, 4 pedestrian phases, 4 overlaps. Slide-out shelf/drawer storage unit, one slot for two-circuit flasher. Receptacles for up to six flash transfer relays, fan panel assembly, ATC Controller and Video Detection Assembly, and light to adequately allow work at night.

a. NEMA Cabinet with Attached Battery Backup - 57.4 inches H x 58.6 inches W x 26.3 inches D.

3. The traffic signal cabinet shall be fully compatible with the controller and equipment.

4. One spare camera, interface panel, and video detection processor shall be provided to the City of Minot.

B. The traffic signal cabinet shall be pad-mounted.

1. Traffic signal cabinets shall come with their own installed lock and key.

2. Concrete pad shall extend a minimum of 6 inches beyond the enclosure on all four sides. Provide 1-inch chamfer all around and down vertical sides to a minimum of 2 inches below grade. Concrete shall have a minimum strength of 4000 PSI in 28 days. Minimum of 6 sack cement per cubic yard. Location of concrete pad and cabinet location to be approved by the Engineer.

C. Each signal system shall be metered separately and shall not include street lighting feed points.

2.12 Traffic Signal Controller

A. Shall conform to NDDOT Specification Section 896.11, except as modified herein.

B. The traffic signal controller shall be Econolite Cobalt, or traffic department approved equivalent and shall utilize Aries Software.

C. The controller shall have traffic counting capability.

2.13 Battery Backup System

A. The Battery Back-up System (BBS) shall include, but not be limited to the following:

1. UPS with Inverter, charger, Tap Switching Transformer and Internal Power Switch

2. Automatic / Manual Bypass Transfer Switch unit

3. Batteries

4. Battery Management System

5. Cabinet shall have an external generator hook up.

6. Mounting Hardware

7. Wiring

B. The BBS shall provide the following operational modes when operating on battery power:

1. Full operation of all traffic signal devices

2. Flash operation

3. Combination of full and flash operation

4. External power indication

C. The BBS shall provide a minimum run time of 8.0 hours of full-time operation with a 450-watt load. The minimum battery size requirement is listed in section 7.0, Battery Type.

D. The BBS shall be compatible with ATC and NEMA cabinets and controllers; and all cabinet components for full-time operation.

E. The BBS shall provide a minimum of 1100W/ 1100VA@25° Celsius active output capacity with 83 percent minimum inverter efficiency with 30% minimum loading. When operating in backup mode, the BBS output shall be 120VAC ± 2%, pure sine wave output, ≤ 3% THD, 60Hz ± .3 Hz.

F. The maximum transfer time allowed, from disruption of normal utility line voltage to stabilized inverter line voltage from batteries, shall be 5 milli-seconds (ms). The same maximum allowable time shall also apply when switching from the inverter line voltage to utility-line voltage. Transfers to and from battery operation shall not interfere with the operation of the other equipment in the intersection.

G. The BBS and all components shall operate without performance degradation over a temperature range of -40°C (-40°F) to 74°C (165°F) with a maximum load of 70% of rated output of the BBS inverter.

H. The BBS feedback level shall be tested and certified to Electrical Standards UL 1778 and CSA 107.3.

I. The BBS shall have surge protection compliant with IEEE/ANSI C.62.41 Cat. A & B.

J. The BBS system shall have a Mean-Time-Before-Failure (MTBF) of 174,955 hours at a temperature of 25°C (77°F) and 103,030 hours at a temperature of 50°C (122°F) per Telcordia SR− 232, 100% duty cycle, full load. Telcordia SR-232 certificate shall be included with the bid.

K. The BBS shall be easily installed, replaced, or removed by using easily removable cables for AC input, AC output, DC input, external transfer control/alarm and battery temperature sense.

L. The AC input and output shall hard wire connections.

M. The DC connection shall be a recessed one-piece Anderson Style connector rated to handle the maximum DC current required by the inverter while running on batteries.

N. The battery temperature probe connection inputs shall be panel-mounted Telco style connector.

O. In the event of inverter/charger failure, battery failure or complete battery discharge, the automatic bypass transfer switch shall revert to Normally Closed (ND) (de-energized) state, where utility line power is connected to the cabinet.

P. The BBS Inverter Module shall be able to shut down in order to protect against internal damage in the event of an over load at the output. The Inverter shall support an overload up to 115% for 2 minutes and then turn off the inverter output. The fault recovers when the overload is removed and line power returns.

Q. The BBS shall provide a (2) time-of-day schedule settings programmable by the user.

1. The time-of-day schedule shall allow the user to program schedule operational modes as required, per intersection.

2. The BBS time-of-day function when programmed shall automatically change operational modes based on the time-of-day schedule.

3. The BBS shall not switch from Flash Operation to Full Operation mode when the remaining battery capacity is ≤40 percent.

R. The BBS shall prevent a malfunction feedback to the cabinet or from feeding back to the utility service.

S. In the event of BBS failure (inverter/charger or battery) or complete battery discharge, the internal power transfer relay shall revert to Normally Closed (de-energized) state and provide utility power to the intersection when utility line power is available to the cabinet.

T. The BBS shall initiate an automatic shutdown when battery output reaches 42.0VDC.

U. The BBS shall be equipped with an integral system to prevent the battery from destructive discharge or overcharge.

V. The BBS shall include an Automatic/Manual Transfer Switch rated at 120VAC/30 amps.

1. Automatic Bypass Transfer Switch shall be a combination automatic/manual bypass switch. Placing the bypass switch in the ″Bypass″ mode shall transfer the intersection load from the UPS output directly to commercial power. AC commercial power must still be available to the UPS input,

allowing the UPS to keep the batteries charged. An Inverter Input breaker shall be provided and located on the Bypass Switch so to shut off commercial power to the UPS input, allowing safely disconnecting and removing the inverter. With the inverter turned off, the batteries can be safely disconnected from the system.

2. The Automatic Bypass Transfer Switch shall include a bypass indicator light that automatically notifies the user when the Manual bypass switch is in Bypass position. The indicator light shall be illuminated when in UPS mode.

3. The Automatic Bypass Transfer Switch shall have an optional bypass status relay with normally open, dry contacts that automatically close when the Manual bypass switch is in Bypass position.

4. The manual bypass switch and the automatic transfer relay shall be integrated together within the Automatic Bypass Transfer Switch allowing the manual bypass switch to be rated at 15 Amp and to be integrated with the bypass indicator light.

5. The Automatic Bypass Transfer Switch shall have terminal blocks capable of accepting #6 AWG wiring for the AC input and output with #10 AWG from the Automatic Bypass Transfer Switch to inverter/charger module.

W. Functionality

1. The BBS shall be Double Buck/Double Boost – Line Interactive, True UPS.

2. The Double Buck/Double Boost mode shall have a minimum range of 88 – 175 VAC.

3. There shall not be any user definable transfer set points for the buck boost mode.

4. Whenever AVE mode is selected the output of the system shall be regulated between 108-130 VAC. When the output of the system can no longer be maintained with this range, the BBS shall transfer to Backup Mode.

5. The BBS shall be equipped with an AC Input circuit breaker that protects both the UPS and the loads connected to the output. Should the AC Input breaker on the UPS trip, it shall allow the UPS to go to inverter mode to power the intersection off the batteries. Should an overload condition still exist when the inverter is energized the inverter will revert to its internal electronic protection, preventing damage to the inverter due to the over load or short circuit condition, on the output. Once this over load condition is cleared the inverter will energize and power the intersection utilizing the available battery power. If the condition does not clear itself, the inverter will stay in the standby mode until manually cleared by a technician.

6. The BBS shall have a flush mounted Battery circuit breaker installed on the front panel of the BBS inverter module.

7. The BBS shall have a user definable line quality time. The user shall be able to select a minimum of six (6) possible settings. The settings shall be 3, 10, 20, 30, 40 and 50 seconds. The default line qualify time shall be 3 seconds.

8. The BBS shall have an integral charger that is compatible with Gel and AGM battery topology. The charger shall be an intelligent charger with control systems that automatically incorporates bulk, absorption and float charging modes.

9. The integral intelligent charger shall use temperature compensation. The charging system shall compensate over a range of 2.5 – 6.0mV/°C per cell user adjustable when required.

10. A temperature probe which plugs into the front panel of the BBS shall be used to monitor the internal temperature of the batteries. The temperature sensor shall be 2 meters in length, external to the inverter/charger module and taped to the side of a center battery within the battery string.

11. The batteries shall not be recharged whenever the battery temperature exceeds 50°C (122°F).

12. The recharge time for the batteries from "protective low-cutoff" to 90% or more of full charge capacity shall not exceed 2-4 hours, subject to temperature compensation. The BBS charger shall be capable of providing 15 amps at 54VDC.

X. User Interfaces and Displays

1. The BBS inverter/charger unit shall include a backlit LCD display for viewing all status and configuration information. The screen shall be easily viewable in both bright sunlight and in darkness.

2. The screen shall be large enough to display the following information with the use of menu scrolling buttons to read required information. All active readings shall be real time.

   a. Operating Mode (Line, Standby, Backup, Buck/Boost)

   b. Utility input voltage

   c. BBS output voltage and current

   d. Battery Temperature

   e. Input Frequency

   f. Output Power

g. Battery Voltage

h. Charger Current

i. Shed Timer Relays time to activation

j. Ethernet MAC Address and IP Address

k. Accumulated output power in kW hours

l. Battery Runtime Remaining

m. Unit Serial Number

n. Unit Firmware Version

o. Any alarms and faults

p. Keypad

3. The BBS inverter/charger unit shall include a keypad for navigating system information.

4. The BBS shall be provided with a web-based-interface for user configuration and management through a web browser.

5. The BBS shall allow the user to do the following through the web browser:

   a. View Logs

   b. Change modes of operation

   c. Configure email alarms

   d. Adjust line qualify time

   e. Program relay contacts

   f. Configure network parameters.

   g. Inverter/charger firmware to be upgradeable remotely via Ethernet

   h. Communication module firmware upgradeable remotely.

6. The BBS shall have discrete status LED indications on the front of the inverter/charger

7. Green Output LED shall be ON any time that the output of the BBS is in normal mode. When the BBS output is either in Backup Mode or AVR Modes the LED will flash On and Off.

8. Red Fault LED shall be Solid On any time that there are any faults in the system.

9. Red Flashing Alarm LED shall Flash On and Off any time that there are any alarms in the system.

10. The BBS shall maintain an event log containing a minimum of 200 of the most recent events recorded by the BBS. These events shall be down loadable remotely via Ethernet and automatically reported to the central monitoring software. The Events Log shall be date and time stamped.

11. The BBS shall display and log the following events, alarms and faults.

    a. Operating Mode

    b. Weak Battery

    c. Overload

    d. High and Low Temperatures

    e. User Input, S2 is shorted

    f. Line Frequency out of specifications

    g. No temperature probe

    h. Low Battery

    i. Battery Breaker Open

    j. BBS is performing a Self-Test

    k. Fan Fail

    l. Incorrect Firmware

    m. AC Input Breaker Open

    n. Short Circuit

    o. Output Voltage High

    p. Output Voltage Low

    q. Battery Voltage High

    r. Battery Voltage Low

    s. Isolation Relay Fail

    t. Temperature High

u. Counters

12. The BBS shall keep track of the Following:

    a. The number of times that the unit was in Backup Mode

    b. The accumulated number of hours and minutes that the unit has operated in Backup mode since the last reset.

13. The BBS shall provide the user six (6) programmable dry relay contacts and one (1) 48 DC relay contact. As a minimum, the programmable options shall be On Battery, Low Battery, Timer, Alarm, Fault and Off. The BBS shall also have three (3) input dry relay contacts. BBS Self-Test, User Alarm, and BBS Shutdown.

14. The relay contacts shall be made available on the front panel of the BBS via 6, 3 position plug-in terminal blocks with screw down wiring connections.

15. Each relay, C-1 through C-5 shall have their own common and their own set of normally open (NO) and normally closed (ND) terminals. The terminals for each relay shall be oriented as NO-C-NC on the terminal block. C-6 shall provide continuous 48 VDC voltage for powering of enclosure DC fan.

16. The contacts on the terminal block shall be labeled 1-18, left to right. Additionally, each set of contact shall be labeled with the NO-C-NC designation, as well as C1 through C6 from left to right. Printed labels noting all alarms and faults shall be provided with the BBS Inverter/Charger to be installed when required.

17. The relay contacts shall be rated at a minimum of 1 amp @ 250 VAC.

18. The dry relay contact that are configured for "on battery' shall only reenergize when the Inverter is operating in Backup Mode.

19. The BBS shall include a timer that will energize the "timer" configured dry relay contact after the user configured time has elapsed. The timer is started when the BBS enters Backup Mode. The user shall be able to configure the timer to the required time. The format shall be Hours, Minutes, Seconds.

20. The BBS shall have an adjustable so that the user can set the point at which the low battery relay contact is energized.

21. The BBS shall be equipped with an industry standard RS-232 serial Connection for user configuration and management. The serial port shall be an EIA-232 (DB9-Female) connector.

22. The BBS shall have an internal Ethernet communication interface for user configuration and management. The Ethernet Port shall be an RJ-45, EIA 568B Pin Out Connector.

23. The BBS shall include remote monitoring and alarms transmission capabilities through the Ethernet RJ-45 IP Addressable Port, using SNMP protocol.

24. System shall have the capability of notifying Operations, Maintenance or TMC via email of any alarms, faults or events, user selectable. Email set up must allow for different levels of notifications based on the criticalness of the alarms.

25. Email notification shall support 6 different users.

26. All BBS configuration and System menus shall be accessible and programmable from the RS-232 and Ethernet Port.

27. The BBS shall Support TCP and UDP over I P protocol communications.

28. The BBS shall support FTP, Telnet, and HTTP.

29. The BBS shall be SNMP compliant.

Y. Batteries

1. The battery shall be comprised of extreme temperature, float cycle, GEL VRLA (Valve Regulated Lead Acid). Individual batteries shall meet the following specifications:

   a. Voltage Rating: 12V

   b. Amp-hour rating: 109 AH, at the 20-hour rate, to 1.75 Volts per cell, minimum battery rating. Larger AH batteries are acceptable providing they do not exceed the group size listed below.

   c. Group size: Case 31

2. Batteries shall be easily replaced and commercially available off the shelf.

3. Batteries shall provide 100% runtime capacity out-of-box. Each battery must meet its specification without the requirement of cycling upon initial installation and after the initial 24-hour top off charge.

4. Batteries used for the BBS shall consist of 4 batteries configured for a 48 VDC battery buss system.

5. The battery system shall consist of one or more strings of extreme temperature; float cycle GEL VRLA (Valve Regulated Lead Acid) batteries.

Batteries shall be certified to operate at extreme temperatures from -40°C to 71°C.

6. The batteries shall have maintenance-free threaded insert terminals eliminating annual torqueing. Battery terminals that require annual torqueing of each post connection shall not permitted.

7. An integral lifting handle shall be provided on the batteries for ease of removal/installation.

Z. Maintenance

1. The BBS shall provide voltmeter standard probe input-jacks (+) and (-) to read the exact battery voltage drop at the inverter input.

2. The BBS Inverter Module shall be programmable to preform automatic self-testing, programmed in weekly intervals and programmed by the user to meet their specific requirements or manufacturer's recommendation.

AA. Vendor Support

1. The BBS manufacturer shall provide at no charge, a toll-free technical support phone number. The toll-free phone number shall be included in the BBS manual.

2. Equipment manuals shall be provided for each BBS cabinet. Equipment manuals shall include installation, operation, programming, maintenance and troubleshooting.

BB. Quality Assurance (QA)

A. Each BBS shall be manufactured in accordance with a written manufacture's Quality Assurance (QA) program. The QA program shall include, as a minimum, specific design and production QA procedures.

B. The BBS Power Module manufacturer shall be ISO 9001 or ISO 9002 certified.

C. The BBS Power Module shall be Telcordia SR-232 certified.

D. The manufacturer shall be certified to carry out the CSA and UL Standards testing on the BBS system.

2.14 Emergency Vehicle Pre-Emption (EVP)

A. Shall conform to NDDOT Spec Section 896.14, except as modified herein:

1. Shall be Opticom™

2. Shall be entirely compatible with existing EVP equipment used in the City of Minot.

3. The Contractor shall notify the City of Minot Fire Chief of EVP testing and date of operation.

2.15 Video Detection System

A. The video detection system shall utilize Aeries Software and be fully compatible with the traffic signal controller.

B. Each camera in the video detection system shall be IP-addressable.

C. The video detection system shall be designed to withstand and operate in all weather conditions.

D. The video detection system shall accurately detect all vehicles.

E. The video detection system shall transmit real-time, continuous, digital video to a remote computer utilizing digital subscriber lines (DSL) or radio/wi-fi. Each video camera at the intersection shall exhibit these digital video capabilities.

F. Digital streaming shall be MPEG-4 video output.

G. Shall be capable of traffic data collection.

H. Housing for each camera shall be a completely dust and water-tight NEMA-4 enclosure.

J. Each camera shall be manufactured with a temperature-controlled faceplate heater.

K. The video detection system and its outputs shall be fully compatible with the controller system.

2.16 Span Wire

A. Shall conform to Section 896.15 of the NDDOT Specification.

2.17 Stabilization Wire

A. Shall conform to Section 896.16 of the NDDOT Specification.

2.18 Service Poles

A. Poles for temporary traffic signals shall conform to Section 896.17 of the NDDOT Specification.

PART 3 – EXECUTION

3.01 General

A. Installation shall comply with Section 772 and Section 896 of the North Dakota Department of Transportation "Standard Specifications for Road and Bridge Construction," 2014 Edition, as revised.

1. A minimum of two additional conduit runs of a 2-inch diameter shall be installed in each new controller foundation. The spare conduits shall be capped.

2. A spare conduit of a 2-inch diameter shall be installed in each signal standard foundation. The spare conduit shall be capped.

3. A working slab shall be designed and provided for the controller. The working slab shall be 6 feet wide, extend past the controller foundation at a minimum of 4 feet, and shall tie-in with the controller foundation. The top of the slab shall extend 2 inches above finished grade and, if applicable, matched to adjacent sidewalk grade.

4. When setting cabinet enclosures directly on the concrete slab, sealant shall be placed on the concrete slab prior to setting the enclosure. Also caulk the concrete/enclosure interface both inside and outside of the enclosure.

5. All field cables installed by the Contractor shall be labeled. The labeling materials shall be approved by the City of Minot and the labels shall be readable without moving the cables. The cabinet wiring system shall include the following labels, in addition to information required by the NDDOT Standard Specifications:

   a. Labels shall be provided for the video detection cameras and shall be located on the detector panel adjacent to their termination point.

   b. The signal head control cables shall be labeled on the field wire terminals and shall include the corresponding direction and phase number.

   c. The Emergency Vehicle Pre-Emption field wire terminals and the associated indicator lights shall be labeled with the corresponding phase number and direction.

   d. The pedestrian push button cables shall be labeled on the field wire terminals and shall include the corresponding direction and phones number.

6. All conduits entering and exiting pull boxes shall be sealed with duct seal. All conduit ends shall have bushings , per N.E.C.

7. The traffic counting capability of the controller shall be fully operational.

8. The confirmation light for the EVP shall be at the same location on the mast arm as the EVP detectors.

9. Coordination with the appropriate electrical company shall be the responsibility of the Contractor.

10. Traffic signal system installation shall meet or exceed all requirements set forth by the Contractor.

3.02 Field Quality Control and Acceptance

A. The Contractor shall preform a complete controller conflict monitor test prior to placing the signal in operation. The traffic heads shall not be unveiled prior to the complete controller conflict monitor test being performed. A conflict monitor maintenance form will be supplied by the City of Minot. The instruction on the form must be followed completely before the signals are used.

The Contractor shall be responsible for the traffic signal system and any damage or maintenance required prior to final acceptance by the City of Minot. Completion of the inspection checklist and submittal of record drawings to the Engineer shall constitute acceptance by the City of Minot.

PART 4 - MEASUREMENT AND PAYMENT

A. Saw Slot: Shall be paid by Linear Foot (LF). Price for item shall include saw slot sealant and the installation of the saw slot sealant.

B. Conduit: Shall be paid by Linear Foot (LF) for each size of conduit including installation, regardless of the installation method.

C. Underground Conductors: Shall be paid by Linear Foot (LF).

D. Concrete Foundation: Shall be paid per Each (EA).

E. Pull Box: Shall be paid per Each (EA).

F. Feed Point: Shall be paid per Each (EA).

G. Signal Standard: Shall be paid per Each (EA), to include the signal pole, mast arm, transformer base, and paint.

H. Pedestrian Signal: Shall be paid per Each (EA).

I. Controller Cabinet: Shall be paid per Each (EA).

J. Controller: Shall be paid per Each (EA).

K. ___- Section Traffic Signal Head: Shall be paid per Each (EA), based on the type of section head.

L. Pedestrian Push Button Post: Shall be paid per Each (EA).

M. Emergency Vehicle Pre-Emption Unit: Shall be paid per Each (EA).

N. Traffic Signal System: Shall be paid per Each (EA). This work includes furnishing labor, materials, tools, machinery, and equipment necessary to install and construct an operating traffic signal system conforming to these specifications, complete in place, including:

1. Installing the electrical service and metering facilities and paying for the electric company's charges;

2. Trenching, structural excavating, backfilling, restoring work, and installing pull boxes;

3. Providing a complete and operating traffic signal system with controller, cabinet, auxiliary and support equipment, vehicle detectors, signal standards, traffic signals and appurtenances, signal head mounting, concrete foundations, cables, wiring, cleaning and adjusting signal heads, painting and restoration work, and all incidentals;

4. Coordinating work and arranging for inspection of work with the Engineer and other agencies as required;

5. Turning over to the City a complete and operating traffic signal system according to the contract.

O. All costs to properly complete the work specified herein and/or shown on the Plans shall be included in the prices bid for these or other items unless applicable bid items are included on the Bid Form.

END OF SECTION