SPECIAL SPECIFICATION

7722

Fixed Anti-icing Sprayer Technology

1. Description. This Item shall govern for furnishing and installation of Fixed Anti-Icing Sprayer Technology (FAST) system, at locations specified in the plans, and in accordance with system manufacturer’s specifications, as approved by the Engineer. Each FAST system will be equipped with an integrated Roadway Weather Information System (RWIS).

The system utilizes RWIS weather station information, with pavement sensors to sense the roadway surface freeze point temperature prior to ice formation. The RWIS station then automatically initiates the FAST system to spray a calibrated application of anti-icing liquid to prevent the formation of ice. The RWIS/FAST system equipment and software communicate by phone modem to a Windows server that will be linked to the Lubbock District Office computer network.

A. RWIS System Description. The contractor installed RWIS equipment at the site shall include Remote Processing Unit (RPU) with sensors specifically designed for monitoring and displaying pavement surface conditions, pavement temperature, freeze point temperature, chemical percentage, and atmospheric temperatures and conditions from the location as shown in the contract plans. Pavement surface conditions shall include dry, wet, frost, chemical wet, and snow/ice warning. Atmospheric conditions shall include air temperature, relative humidity, dew point, precipitation type and classification, and wind/speed direction. The system shall include all hardware, software, and licenses to operate as follows:

- Active and passive in-pavement surface sensors shall measure bridge deck and roadway pavement surface temperature, chemical concentration, surface conditions, and communicate these signals to the RPU.
- Atmospheric sensors shall measure their respective weather parameters and communicate the signals from each to the RPU.
- The RPU shall process the output from the sensors and/or atmospherics, store the data temporarily, and send the data via telephone modem to the Network Server (NS) located at the TxDOT District Office in Lubbock, Texas. Data exchanges shall utilize TCP/IP network protocols.
- The RPU shall determine the roadway surface freeze point temperature prior to ice formation and automatically activate the FAST system prior to ice formation.
- The NS shall store the RWIS data in a database for access by TxDOT end users on a PC connected to the TxDOT network running current user interface software (UI).
- TxDOT shall own and control all equipment, information, and data.
**B. FAST System Description.** The Fixed Anti-Icing Spray Technology (FAST) System is a fixed system that provides anti-icing treatment of a bridge, ramp or other targeted roadway location. The FAST system dispenses an anti-icing agent by pumping the chemical through a sequence of high-pressure spray nozzles, individually controlled by a series of solenoid valves. Upon actuation, the system activates the pump and automatically sequences the solenoid valves to spray the anti-icing liquid over the targeted area.

Automatic activation of FAST is provided via a fully integrated RWIS system employed to accurately measure pavement surface/atmospheric conditions. The RWIS system utilizes active and passive pavement sensors to sense the roadway surface freeze point temperature prior to ice formation. The RWIS station then automatically initiates the FAST system to spray a calibrated application of anti-icing liquid to prevent the formation of ice.

Upon actuation, a programmable controller activates the motorized pump and solenoid valves to dispense the anti-icing liquid over the targeted area. The actuation of this cycle provides a signal, which can be used by TxDOT to activate an upstream warning light or message sign to alert motorists of the anti-icing operation in progress. The anti-icing cycle can also be initiated by software command from an authorized logged-in user of the RWIS system, by telephone using a PIN number, or by manually pushing a button on the controller assembly in the pump house. The system will provide notification of actuation to TxDOT personnel by pager message, phone message and signal the RWIS network server. Whenever the FAST is fired, the system controller shall send acknowledgement that it has fired to the RWIS RPU and the RWIS server displays when the FAST system is firing to the TxDOT system users. Additionally, historical records are kept in the RWIS server database on when the FAST system was fired.

2. **Materials** The FAST system shall use Magnesium Chloride (MgCl₂) as the anti-icing agent and all components of the system shall be designed to be compatible with Magnesium Chloride operation.

3. **Equipment.** All equipment furnished on this project shall be state of the art and in current manufacture at the time of purchase.

   **A. RWIS Equipment.** The instruments and data processing equipment to be supplied are specified in the following sections. The contractor shall install the RWIS equipment according to the project plan sheets, detailed drawings and guidelines provided by the system vendor.

   **1. Passive Pavement Sensor.** The Passive Surface Sensor shall be a single solid-state electronic device that is installed in the roadway and bridge deck pavement at the locations as shown on the plans. Exact sensor placement shall be as determined by the Project Engineer with guidance from the system vendor. The sensor shall come with a limited lifetime warranty.

   The sensor shall be constructed of materials that have thermal characteristics similar to common pavement materials. The top of the sensor shall approximate
the roadway pavement color and texture. It shall be installed with epoxy sealer so the top is flush with the surrounding roadway surface.

The sensor shall be thermally passive, providing stable operation over a temperature range from -40°F to 176°F. Weather conditions, traffic, or ice control chemicals shall not degrade its performance.

The sensor shall be supplied with attached molded cable that is waterproofed and sealed as an integral part of the assembly. The sensor shall electronically sample the following pavement parameters:

- Surface temperature at the sensor head.
- Dry pavement condition.
- Wet pavement condition above 0°C (32°F).
- Pavement status information.

In addition, the pavement sensors shall supply data for the RWIS to determine pavement surface conditions when sufficient water is present on the pavement, using atmospheric data from precipitation, RH, and air temperature sensors:

- Water on the pavement at or below 0°C (32°F).
- Snowy or icy pavement at or below 0°C (32°F).
- Freezing point temperature of the water/ice-control-chemical solution present on the surface of the pavement sensor for selected ice-control-chemicals.
- Depth of the water/ice-control-chemical solution present on the surface of the pavement sensor up to a depth of 12 mm (0.5 inches).
- Percentage of ice particles present in the water/ice-control-chemical solution resident on the surface of the pavement sensor.

Each sensor shall be capable of operating at extended cable lengths from the RPU.

2. **Active Pavement Sensor.** The active surface sensor shall be a single solid-state electronic device that is installed in the roadway pavement at the bridge deck locations shown in detail drawings provided by the system vendor. The Project Engineer shall determine exact sensor placement with guidance from the equipment supplier. The sensor shall be installed with epoxy sealer so the top is flush with the surrounding roadway or bridge deck surface.

The sensor shall measure the freeze point temperature of solution on the road. At the point when the liquid/moisture changes state from liquid to solid, the temperature of the cell shall be measured and reported as the freeze point to the RPU. The sensor must electronically measure the freeze point of the solution on its surface regardless of the anti-icing chemical concentrations present.

The sensor shall operate in a temperature range of -22°F to 50°F. Sensor freeze point range shall be accurate from 14°F to 50°F. Sensor performance shall not be degraded by weather conditions, traffic, or road contaminants.
3. **Air Temperature/Relative Humidity Sensor.** The Air Temperature/Relative Humidity Sensor shall have an air temperature-sensing element that operates over the temperature range of -40°F to 176°F. The relative humidity sensing element shall have a measuring range of 10 to 100% RH. The operating temperature range shall be -31°F to 158°F.

System dew point temperature shall be calculated from the air temperature and relative humidity.

4. **Wind Speed/Direction Sensor.** The Wind Speed/Direction Sensor shall have an operating range of 0 to 100 mph. The sensor survival operation limit shall be 180 mph with an operating azimuth of 360°. The temperature operating range shall be -40°F to 140°F.

5. **Optical Weather Sensor.** The optical weather sensor shall be capable of differentiating between rain, snow, and freezing rain. It shall also be capable of accurately detecting precipitation rates.

6. **Remote Processing Unit (RPU).** A single RPU shall be provided at the location shown in the detail drawings provided by the system vendor. The RPU shall gather data from all connected sensors, and process, store and transmit this data to the NS.

   The RPU shall be located inside the pump house.

   The RPU shall operate in a range of 100-130 VAC at 50-60 Hz. The primary power shall be installed and fused at 15A with over-voltage protection.

   The RPU shall incorporate protective measures to monitor its own operation and reset itself if the RPU software enters an indeterminate state. It shall have the capability to be reset by a “user administrator” from the NS. The RPU shall be capable of remote alignment, reconfiguration, and accepting downloads of updated software from the NS over the same communication link used to collect data from the RPU when TCP/IP protocols are used.

   The RPU design shall maximize the use of solid-state components and modular circuit cards for ease of maintenance. All circuitry of the RPU, the voltage inputs, the sensor inputs, and the communications ports shall be designed and tested to provide transient and surge protection. The RPU shall provide stable operation over a temperature range of -40°F to 160°F and 0-90% RH non-condensing.

   The RPU software shall be capable of calculating the 24-hour precipitation accumulation and storing this information for subsequent transfer to the NS and display on the UI.

   The RPU shall be supplied with software to control firing of the FAST system based on measured parameters from its atmospheric and pavement sensor arrays. It shall be software adjustable to fine-tune the firing of the FAST system to the site winter road conditions. The RPU shall be hardwired to the FAST system controller.
7. **RWIS Network Server (NS) Data Communications.** The Network Server located at the Lubbock TxDOT District Office shall be capable of polling the RPU via telephone modem to collect the data.

8. The RWIS server will signal when the FAST system is firing to TxDOT system users via phone message, pager message, and network server. Historical records shall be kept in the RWIS server database on when the FAST system was fired. The anti-icing cycle can also be initiated by software command from an authorized logged-in user of the RWIS system, or by telephone with a PIN number.

The system shall transfer data from the RPU to the NS by the NS polling each RPU at a time interval specified by the agency and configured by the system vendor.

**B. FAST Equipment.**

1. **Pump Assembly.** The pump assembly shall consist of an electric motor driven, self-priming, positive displacement pump. The pump shall be directly coupled to a totally enclosed, fan cooled motor. A pressure relief valve shall be attached to the pump discharge with an over-pressure line routed back to the storage tank. A stainless steel pressure sensor shall be installed to actuate the pressure relief valve. The pressure relief sensor and valve shall be set at the pressure recommended by the system vendor.

The pump and relief valve shall be constructed of AISI 316 stainless steel. Chromium steel alloys shall be used for internal valve components.

The pump assembly shall be contained in the pump house. Electric pipe heating cable (120 VAC) shall be included on the pump discharge, regulating valve and suction line.

2. **Piping.** The main line of the pressure piping system shall either be cast inside the bridge rail, or suspended from the back of the rail, per system vendors detail drawings.

All anti-icing liquid carrying components of the system shall be constructed of corrosively inert materials.

All 120VAC wiring must go through conduit. All low voltage control wiring and pressurized chemical piping (outside pump house) shall be enclosed in schedule 40 galvanized steel pipe or conduit. If the conduit is exposed it shall be galvanized steel.

Any pressure piping or electrical wiring passing through the bridge rail, or the bridge deck shall be enclosed in conduit cast into the concrete unless otherwise approved by the Engineer.

Any sawcut approved by the Engineer will be sealed with class 5 low modulus silicone conforming to Item 433, “Joint Sealants and Fillers.”

3. **Motor-Controlled Ball Valves shall be employed.** These valves shall consist of stainless steel. The valve control components shall be housed in a gasket sealed,
watertight enclosure. If approved by the Engineer these components may be
installed in block-outs in the bridge rail.

4. **Storage Tank.** The chemical storage tank shall be installed inside the pump house
per the system vendor details. Tank capacity shall be sized according to area to be
treated, and average estimated number of events per winter, based on historic
weather data. The storage tank will be installed in the pump house so it can be
accessed for filling by a tank truck. The storage tank will be provided with
agitators for the anti-icing chemical.

5. **Pump House.** A pump house shall be erected at the site according to system
vendor details, to achieve an insulation rating of R-8 or greater. The roof shall be
capable of withstanding 2,000 lbs vertical loading, and the assembled structure
shall be capable of withstanding 100-mph wind loading.

The pump house shall be sized to contain all equipment necessary to operate and
control the system including: pump(s), hoses, piping, conduit, circuit breaker(s),
RPU, controller, 1500 W heater, anti-icing liquid storage tank and system flush
tank.

A six foot minimum chain link fence enclosure shall be constructed around the
pump house and weather sensor tower. This fence shall be constructed in a manner
to allow access to the anti-icing storage tank and the flushing tank for refilling.

The site of the pump house will be located outside the required horizontal clearance
of all roadways, or the structure will be protected by metal beam guard fence. The
site will be accessible to maintenance service vehicles and anti-icing liquid tank
trucks.

Unless otherwise approved by the Engineer, the exterior of the building shall have
a stucco finish, colored “Desert Sand.” and the roof shall be covered with metal
roofing panels, colored “Terra Cotta Red”.

The double steel doors shall be coated with a primer and have a minimum opening
of 72" wide and 69" high.

The floor of the pump house shall be level concrete, constructed to support the
weight of the filled anti-icing storage tank.

The pump house shall be equipped with a water tank of sufficient size to flush the
system, and the water tank shall be valved to the pump.

A 240 VAC, 100 Amp, 60 Hz, single phase electrical service shall be installed by
the contractor to a breaker box inside the pump house for powering the FAST
system. The contractor must supply and install a circuit breaker panel and
enclosure for one 240 VAC, 30 Amp service to the pump motor, and 120 VAC, 20
Amp services for the controller and RPU, power for the 1500W heater, and a dual
outlet wall socket.

6. **Nozzle Assemblies** shall be either flush mounted in-pavement or mounted in the
bridge rail at a height no greater than ten inches (10”) above the bridge deck. The
standard nozzle assembly shall be capable of spraying 22 feet across the bridge deck when installed. Specific nozzle design may be dependent on the area to be treated. An 80% coverage of the travel lane is required.

7. **Controller.** The controller employs programmable control modules for system cycling and manual override. The controller shall be capable of addressing the individual solenoid valves. A low anti-icing fluid level warning switch and an empty anti-icing fluid level shut-off switch shall be used to notify TXDOT of the need to replenish anti-icing fluid, and to prevent damage to the pump.

The RWIS RPU shall be hardwired to the FAST system controller. This cable will be used for the RPU to fire the sprayer and confirm that it has been fired.

4. **Construction Methods**

   A. A conference shall be held between the Engineer, the Contractor and the system vendor prior to any construction work being performed.

   B. The Contractor shall require the system vendor to make and furnish detailed drawings showing dimensions and locations of all RWIS/FAST equipment, to be approved by the Engineer prior to any installation. Because some components of the system will be cast in the bridge rail and bridge deck, it is the Contractor’s responsibility to insure detailed drawings are approved by the Engineer, and the required conduits and block-outs are provided prior to construction of the bridge deck and rail.

   Block-out sizes for all components will be kept to minimum dimensions to not diminish the structural integrity of the bridge components. Any block out in the bridge rail or bridge deck must be approved by the Engineer. Additional reinforcement may be required around blockouts. Any additional reinforcement required will not be paid for directly, but will be subsidiary to this item.

   C. The RWIS/FAST System shall be installed as per project plans, and in accordance with detailed drawings, and specifications provided by the system vendor. Installation may be made only under the direction of an approved system vendor.

   D. **RWIS/FAST System Commissioning.** After completion of the RWIS/FAST system equipment installation, the system vendor shall provide an on-site field engineer to start-up and test the entire system. This engineer will make all final hook-ups; perform all final system checks, sensor alignments, software setup, and software configuration to provide a fully operational RWIS/FAST system.

   E. **RWIS/FAST Equipment Warranty.** The system vendor shall provide TXDOT limited, on-site warranty coverage on all equipment for a 12-month period after RWIS/FAST system completion, acceptance, and commissioning. The system will be tested prior to acceptance and opening the roadway to the public. The system will be commissioned prior to or during the first winter season the roadway is opened to the public.

   F. The system vendor shall provide any training necessary to ensure proper operation of the system.
5. Measurement. This Item will be measured as each “Fixed Anti-Icing Sprayer Technology” system, complete in place.

6. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for “Fixed Anti-Icing Sprayer Technology.” This price shall be full compensation for furnishing all materials required; fencing, warranty, and for all labor, tools, equipment and incidentals necessary to complete the work and make the system operational.

Any software required to activate, control, or monitor the system will be provided by the system vendor. The cost for this software will not paid directly but will be subsidiary to this item.

Providing and installing any conduit and wiring required to provide electrical power or phone connections to the system will not be paid for directly, but will be subsidiary to this item.

Any metal beam guard fence provided and installed to protect the pump house shall be paid for under the pertinent bid items.