| **Lateral Launch System** | **Exception** | |
|---|---|---|
| **Desktop Control**<br>*The Desktop Controller shall have* | | |
| | **Yes** | **No** |
| 1. Two 3 axis joysticks with push function to control crawler and camera functions | | |
| a. Joystick functions will be switchable to alternate between left and right. | | |
| b. One joystick will control pan & tilt, aiming camera pan & tilt, aiming chute pan & tilt, and camera launching | | |
| c. Second joystick will control crawler movement – forward, reverse, left and right. | | |
| d. Functions will alternate by a double tap of the joystick or selecting with the selectable icon | | |
| 2. 10.4” monitor to display system status, functions | | |
| a. Capable of displaying crawler pitch angle | | |
| b. Capable of displaying crawler roll angle | | |
| c. Capable of displaying Pan and Tilt position | | |
| d. Display light intensity settings | | |
| e. Display three footage counters – Main, Sectional, and Lateral Launch footage | | |
| f. Visual warning to indicate lower pressure situation | | |
| g. Visual warning to indicate severe roll angle to minimize roll over. | | |
| 3. Controller shall have a built in touch screen monitor capable of activating all camera, reel, and crawler functions | | |
| 4. Shall have an automated function that will stop crawler in the event of severe roll angle. This function can be activated / deactivated by user. | | |

| Lateral Launch System | Exception | |
|---|---|---|
| **Desktop Control**<br>*The Desktop Controller shall have* | | |
| | **Yes** | **No** |
| 5. Moisture protection class IPXO – protect from humidity and moisture | | |
| 6. Overall dimension shall not exceed 31.5” x 15.75” x 4.75” | | |
| 7. Weight shall not exceed 27lbs. | | |
| 8. Desktop controller shall be powered by an independent CCU to provide adequate power and connectivity | | |
| 9. CCU shall have 2 USB ports on the front face for easy access | | |
| 10. CCU shall have 1 RS232 port on the front face for easy access | | |
| 11. CCU shall have 1 Ethernet connection on the back panel | | |
| 12. CCU shall have 2 USB ports on the back panel | | |
| 13. CCU shall have integrated emergency stop switch. | | |
| 14. CCU shall have 1 RX232 port on the back panel | | |
| 15. Controller shall be capable of saving multiple user profiles so that function display can be customized. | | |
| 16. Controller shall have 8 customizable soft keys that can be assigned camera, crawler, or reel functions | | |
| 17. Pendant shall have a cruise control function that allows the crawler to continuously drive without input from the joystick. | | |
| 18. Controller shall be able to toggle between automatic and manual cable reel functions. | | |
| 19. Controller must be able to control the retrieval power of the cable reel in both automatic and manual mode. | | |
| 20. Controller shall be capable of engaging and disengaging the crawler clutch. | | |

| Lateral Launch System | Exception | |
|---|---|---|
| **Desktop Control**<br>*The Desktop Controller shall have* | | |
| | **Yes** | **No** |
| 21. Camera zoom shall be controlled by twisting the Pan and Tilt joystick handle. | | |
| 22. Light Intensity shall be controlled by intensity roller on the controller. | | |
| 23. Controller shall be capable of toggling between automatic and manual focus and capable of adjusting focus in manual mode. | | |
| 24. Controller shall have embedded macros to enable one button access to preset panning movements of the camera. | | |

| **Lateral Launch Crawler**<br>*The Lateral Launch Crawler shall have:* | Exception | |
|---|---|---|
| | **Yes** | **No** |
| 1. Crawler shall be eight wheel drive. | | |
| 2. Crawler be capable of entering a 6”ID pipe. | | |
| 3. Crawler shall be Steerable with four independently controlled motors. | | |
| 4. Crawler shall contain pitch and roll sensors that feeds information to the control unit for constant monitoring. | | |
| 5. Crawler shall contain a pressure sensor that feeds information to the control unit for constant monitoring. | | |
| 6. Crawler shall be waterproof to 1 bar. | | |
| 7. Shall have a drive mechanism that is capable of pushing a min of 150 feet of push rod into lateral. | | |

| **Lateral Launch Crawler**<br>*The Lateral Launch Crawler shall have:* | **Exception** | |
|---|---|---|
| | **Yes** | **No** |
| 8. Cable drive mechanism shall utilize two friction bands to push lateral camera. | | |
| 9. Cable drive mechanism shall be mounted on the top of the crawler to minimize contact with debris on the bottom of the pipe. | | |
| 10. Drive mechanism shall be a snap in configuration for easy mounting of the push rod. | | |
| 11. Crawler shall have an integrated back-eye camera with LED lighting. | | |
| 12. Crawler shall have forward viewing camera to assist with aiming the launch camera into laterals. | | |
| 13. Forward view camera must be cable of digital pan, tilt, and zoom to accommodate launching in larger main lines | | |
| 14. Crawler shall be capable of launching lateral camera in pipe from 6” – 78” | | |
| 15. An aiming tube but shall be mounted to the front of the crawler. Variable lengths ranging from 9.5” – 90.5”. | | |
| 16. Aiming mechanism shall be capable of Panning and Tilting for maximum aiming capability. | | |
| 17. Crawler dimension shall not exceed (WxHxD) 5.35” x 4.6” x 32” | | |
| 18. Crawler weight shall not exceed 70lbs. | | |
| 19. Crawler shall be capable of accepting an auxiliary light for use in large lines. | | |
| 20. Crawler must have a mid-body hinge point to accommodate accessing smaller diameter manholes. Hinge must be capable of locking to create a rigid crawler. | | |
| 21. Crawler shall contain a locating sonde that can be switched to 512, 640, and 33Hz frequencies. | | |

| **Pan and Tilt Camera**<br>*The Camera shall have:* | **Exception** | | |
|---|---|---|---|
| | **Yes** | **No** | |
| 1. Ability to produce a high-quality color video image with a readable resolution of no less than 500 HTV lines. | | | |
| 2. Pan and tilt motors with no exposed gears or wires. | | | |
| 3. Ability to pan a full 360 degrees and tilt -90 - +120 degrees for full viewing of laterals and joints. | | | |
| 4. Dual lasers to gauge the size of pipeline pipe features and defects. | | | |
| 5. Able to fit into a minimum pipe diameter 2.5” | | | |
| 6. Solid-state circuitry designed to withstand shock and vibration while being pushed, pulled or propelled through the pipe. | | | |
| 7. Front housing made of aluminum and stainless steel, with windshield made of impact-resistant, distortion-free material. | | | |
| 8. Camera Module Light sensitivity – 0.4 Lux | | | |
| 9. Sonde for pipe locating – 512Hz / 640Hz | | | |
| 10. Housing that is fully sealed and waterproof per IP68 to withstand external pressure up to 1 bar without damage or leaking. | | | |
| 11. Ability to run off 12-volt DC solid-state power source for diagnostics and service. | | | |

| **Pan and Tilt Camera**<br>*The Camera shall have:* | **Exception** | |
|---|---|---|
| | **Yes** | **No** |
| 12. Encoders to measure pan and tilt position, allowing Camera to be controlled using macros stored in the operator pendant. | | |
| 13. A valve for purge and pressurization of Camera-body. (Pressurization helps prevent ingress of water and helps prevent internal condensation and fogging.) | | |
| 14. A total weight of no more than 2.15 lb. | | |
| 15. A maximum size of 2” x 11.5” | | |
| 16. Integral clutches to protect pan and tilt motors. | | |
| 17. 360 degree rotation | | |
| 18. Tilt ranger from -90 degrees to 122 degrees | | |
| 19. LED illumination | | |
| 20. Camera is auto upright to display a constant upright image. | | |
| 21. Camera contains an internal pressure sensor that constantly communicates with the control unit. | | |
| 22. Camera shall not exceed a weight of 2.7lbs. | | |

| **Forward View Push Camera**<br><br>*The Camera Shall Have:* | **Exception** | |
|---|---|---|
| | **Yes** | **No** |
| 1. Shall be capable of inspecting 2” – 8” diameter pipe | | |
| 2. Shall be capable of negotiating a 90 degree bend in a 3” diameter pipe. | | |
| 3. Must be waterproof to 1 bar | | |
| 4. Shall include an LED light ring with 4 focused LED’s | | |
| 5. Shall have a 75 degree angle of view. | | |
| 6. Shall have a depth of focus of 1.6” – infinity | | |
| 7. Shall be capable of 500 TVL of resolution | | |
| 8. Shall have light sensitivity of 0.4 lux. | | |
| 9. Shall contain a location sonde capable of 512Hz/640Hz/33kHz frequencies | | |
| 10. Shall have an internal pressure sensor capable of consistently monitoring camera pressurization. | | |
| 11. Camera housing shall be constructed of stainless steel | | |
| 12. Dimensions shall not exceed 1.6” x 9.9” | | |
| 13. Weight shall not exceed 1.75 lbs. | | |
| 14. Camera module shall be auto upright to constantly display an upright image | | |

| **Forward View Push Camera**<br><br>*The Camera Shall Have:* | **Exception** | |
|---|---|---|
| | **Yes** | **No** |
| **Motorized Lateral Launch Cable Reel**<br><br>*The system cable reel shall have:* | **Exception** | |
| | **Yes** | **No** |
| 1. Cable Reel must have a hub equipped with a continuous-contact slip-ring assembly to allow the cable to be dispensed and retrieved while the camera and tractors are operational. | | |
| 2. Motorized feed system shall utilize friction bands to minimize cable wear. | | |
| 3. Cable reel must include 984 feet of standard crawler drive cable. | | |
| 4. Cable reel must include 150 feel of lateral push rod cable. | | |
| 5. Cable reel must utilize a motorized feed system that is synchronized with reel motors and desk top controller. | | |
| 6. Push rod cable must be connected to the standard cable with a tool-less connector to allow easy replacement of push rod cable | | |
| 7. Ability to perform all forward, backward and different speed functions from the desktop controller without the operator having to control any cable reel functions directly. | | |
| 8. Emergency stop switch mounted on the front of the cable reel. | | |
| 9. Ability to operate in both automatic and manual modes. | | |
| 10. External cable reel chassis to be made of strong and lightweight aircraft grade aluminum. | | |

| | | |
|---|---|---|
| 11. Work with pendant based speed and torque controls to adjust for different pipe conditions and user preferences. | | |
| 12. Weight of no more than 240 lbs. (including cable). | | |
| 13. CAN-bus control architecture allowing for precision control, diagnostic monitoring and future upgradeability. | | |
| 14. Work with a remote wireless pendant granting control of crawler and reel while away from the primary control pendant. | | |
| 15. Ability to operate manually, with direct control of speed, direction and torque. | | |
| 16. Teflon coated integral drip tray at bottom beneath stored cable. Allows for liquids to drain and be collected in a specific area for health and safety reasons. Can be slid out the front without tools for emptying and cleaning. | | |
| 17. Size of no larger than (W x H x D) 14.5” x 30” x 32.3” | | |
| 18. Extended roll bar to be able to be placed back against the reel for storage and shipment without the need for additional fasteners or tools. | | |
| 19. All moving hazardous components to be completely covered/enclosed to prevent injury – hand or clothing can’t reach dangerous moving parts. Open access design of the front, top and sides where an operator can touch level-wind mechanism, gears, chains and belts will be deemed unacceptable. | | |

| **Motorized Main Line Automatic Cable Reel**<br>*The system cable reel shall have:* | **Yes** | **No** |
|---|---|---|
| 1. Capacity for the systems 984’ of cable. | | |

| **Motorized Main Line Automatic Cable Reel**<br>*The system cable reel shall have:* | **Yes** | **No** |
|---|---|---|
| 2. A hub equipped with a continuous-contact slip-ring assembly to allow the cable to be dispensed and retrieved while the Camera and tractors are operational. | | |
| 3. An environmentally sealed slip ring whose contacts shall be of an alloy of gold. | | |
| 4. A motorized system with sensors that monitor cable tension in order to coordinate cable feed/retrieval with direction and exact speed of the crawler. | | |
| 5. Ability to perform all forward, backward and different speed functions without the operator having to control any cable reel functions directly. | | |
| 6. An emergency stop switch. | | |
| 7. Ability to operate in both automatic and manual modes. | | |
| 8. External cable reel chassis to be made of strong and lightweight aircraft grade aluminum. | | |
| 9. Work with pendant based speed and torque controls to adjust for different pipe conditions and user preferences. | | |
| 10. Weight of no more than 145 lbs. (including 984’ of cable). | | |
| 11. CAN-bus control architecture allowing for precision control, diagnostic monitoring and future upgradeability. | | |

| **Motorized Main Line Automatic Cable Reel**<br>*The system cable reel shall have:* | **Yes** | **No** |
|---|---|---|
| 12. Work with a remote wireless pendant granting control of crawler and reel while away from the primary control pendant. | | |
| 13. Ability to operate manually, with direct control of speed, direction and torque. | | |
| 14. Large extension pulley arm option for extending the cable drop point 15” from the cable reel. | | |
| 15. Teflon coated integral drip tray at bottom beneath stored cable. Allows for liquids to drain and be collected in a specific area for health and safety reasons. Can be slid out the front without tools for emptying and cleaning. | | |
| 16. BNC video output for local video connection. | | |
| 17. BNC video input for external video feed | | |
| 18. Mechanical footage encoder | | |
| 19. Size of no larger than 14.5 x 22.6 x 24.6” (LWH) with standard cable roll bar that extends 15” from the front of the reel. | | |
| 20. Two handles to be at the top left and right of the cable reel for moving and transport. | | |
| 21. Extended roll bar to be able to be placed back against the reel for storage and shipment without the need for additional fasteners or tools. | | |
| 22. Pendant-based power/torque controls for winching back crawler in optional free-wheel mode. | | |

| **Motorized Main Line Automatic Cable Reel**<br>*The system cable reel shall have:* | **Yes** | **No** |
|---|---|---|
| 23. All moving hazardous components to be completely covered/enclosed to prevent injury – hand or clothing can't reach dangerous moving parts. Open access design of the front, top and sides where an operator can touch level-wind mechanism, gears, chains and belts will be deemed unacceptable. | | |