CLAIMS

1. A system comprising:

a gate valve comprising:

a valve body having a flow path;

a gate disposed within the flow path, wherein the gate substantially blocks fluid flow through the flow path while the gate is in a closed position, and allows fluid flow through the flow path while the gate is in an open position;

an actuator configured to transition the gate between the open position and the closed position, wherein the actuator comprises:

an outer casing;

a permanent magnet, direct current (DC) motor comprising a stator rigidly coupled to an interior of the outer casing, and a rotor configured to rotate with respect to the stator; and

an actuating rod assembly engaged with the rotor by a ball screw connection such that rotation of the rotor drives the actuating rod assembly along a longitudinal axis of the actuator, wherein the actuating rod assembly is directly and rigidly coupled to the gate without any gears and without any clutch between the permanent magnet DC motor and the gate.

2. The system of claim 1, wherein the actuator is configured to transition the gate toward the closed position with sufficient force to sever a conduit extending through the flow path of the valve body.

3. The system of claim 1, comprising a spring coupled to the actuating rod assembly, ~~and~~ wherein the spring ~~configured to~~ bias~~es~~ the gate toward the closed position.

4. The system of claim 3, comprising a fusible lock-open device configured to engage the actuating rod assembly to hold the gate in the open position against the spring bias while the actuator is disengaged, wherein the fusible lock-open device is configured to disengage the actuating rod assembly in the presence of a fire.

5. The system of claim 1, comprising a battery electrically coupled to the actuator and configured to power the motor.

6. The system of claim 5, comprising a solar panel electrically coupled to the battery, and configured to maintain a charge within the battery sufficient to power the motor.

7. The system of claim 1, comprising a controller communicatively coupled to the actuator, and a sensor communicatively coupled to the controller, wherein the sensor is configured to send a signal to the controller indicative of a fire adjacent to the gate valve, and the controller is configured to instruct the actuator to transition the gate toward the closed position in response to the signal.

8. The system of claim 1, comprising a controller communicatively coupled to the actuator, ~~and~~ wherein the controller is configured to measure a torque applied by the motor to determine a valve signature, and the valve signature comprises a relationship between the torque and distance of travel of the gate.

9. A system comprising:

a gate valve comprising:

a gate disposed within a valve body; and

a motorized ball screw actuator having an electric motor, a ball screw connection directly coupled to a rotor of the electric motor, and an actuating rod assembly directly coupled to the ball screw connection and the gate, wherein the motorized ball screw actuator is configured to linearly actuate the actuating rod assembly to drive the gate between an open position and a closed position.

10. The system of claim 9, comprising a controller configured to receive a signal indicative of actuating force applied by the motorized ball screw actuator to the gate, ~~and~~ wherein the controller is configured to compute a valve signature

based on the signal, and the valve signature comprises a relationship between the actuating force and distance of travel of the gate.

11. The system of claim 10, comprising a load cell disposed within the actuating rod assembly, a strain gauge coupled to the actuating rod assembly, or a combination thereof, wherein the load cell, the strain gauge, or a combination thereof, is configured to output the signal indicative of actuating force.

12. The system of claim 10, wherein the signal indicative of actuating force comprises an electrical current applied to the motorized ball screw actuator.

13. The system of claim 9, wherein the motorized ball screw actuator is configured to transition the gate toward the closed position with greater than approximately 40,000 pounds of force to shear a line disposed within a fluid passage of the gate valve.

14. The system of claim 9, wherein the motorized ball screw actuator is configured to transition the gate to the closed position within approximately 5 seconds while substantially maintaining structural integrity of the gate and the valve body.

15. A method of operating a gate valve, comprising:

applying electrical current to a motorized ball screw actuator having an actuating rod assembly directly coupled to a gate of the gate valve such that the actuating rod assembly drives the gate between an open position and a closed position, wherein the motorized ball screw actuator comprises an electric motor, a ball screw connection directly coupled to a rotor of the electric motor, and the actuating rod assembly directly couples to the ball screw connection and the gate.

16. The method of claim 15, comprising receiving a signal indicative of a fire adjacent to the gate valve, and driving the gate to the closed position based on the signal.

17. The method of claim 15, comprising:

receiving a first signal indicative of a gate displacement of the gate;

receiving a second signal indicative of the electrical current applied to the motorized ball screw actuator, and the electrical current is indicative of an actuating force applied to the gate from the electric motor; and

determining a valve signature based on the first signal and the second signal, wherein the valve signature comprises a relationship between the actuating force and the gate displacement of the gate.

18. The method of claim 17, comprising:

applying electrical current to the motorized ball screw actuator while the gate is in the open position to transition the gate a minute distance toward the closed position without substantially reducing a flow rate through the gate valve;

receiving the first signal, receiving the second signal, and determining the valve signature; and

applying electrical current to the motorized ball screw actuator to transition the gate back to the open position.

19. The method of claim 15, comprising supplying the electrical current from a battery, and charging the battery with a solar panel.

20. The method of claim 15, comprising inserting a fusible lock-open device into the actuating rod assembly to hold the gate in the open position while the motorized ball screw actuator is deactivated, wherein the fusible lock-open device is configured to disengage the actuating rod assembly in the presence of a fire such that the gate transitions to the closed position via a spring bias.