

3R VALVE CONTROL VALVE ASR CONTROL NARRATIVE

PART 1 - GENERAL

- 1.1 Introduction: The following information describes the 3R Valve ASR Well Control Valve System.
- 1.2 Supplemental Information: 3R Valve, LLC Control Valve P&ID (Process & Instrumentation Design) Schematic.
- 1.3 Definitions:
 - A. "ASR": Aquifer Storage and Recovery.
 - B. "HMI" is the Human Machine Interface. This is the component mounted in the face of the Local Control Panel containing text and graphics.
 - C. "PLC" is the Programmable Logic Controller. PLC's contain the control algorithms that accomplish the actual operation of the 3R Valve Control Valve. The Operator can communicate with the 3R Valve PLC via Ethernet or PLC I/O.
 - D. "H-O-A" is the HAND-OFF-AUTO selector switch (HS-31-03) located in the face of the 3R Local Control Panel. In the HAND position, the Operator has control of the system via the "OPEN-CLOSE" selector switch. In the AUTO position, the 3R Valve system is controlled via a PLC located in the 3R Valve Control Panel.
 - E. "OPEN-CLOSE" selector switch (HS-31-02) is in the face of the 3R Valve Local Control Panel. The Operator has manual control of the 3R Control Valve.
 - F. 3R Control Valve, "FCV-2" is placed during well column installation by 3R Valve, LLC.
 - G. "Well Pump" is provided by others and is NOT provided by 3R Valve, LLC.
 - H. Valve Block Actuating Solenoid, "FCV-1" is a 2 position actuating solenoid valve mounted on top of the Hydraulic Reservoir, "HR-1". The Valve Block Actuating Solenoid's purpose is to direct the Hydraulic Fluid flow and is controlled via an electrical connection from the PLC.
 - I. Hydraulic Reservoir, "HR-1" is the reservoir containing hydraulic fluid.
 - J. Hydraulic Linear Piston, "P-O" is the OPEN hydraulic linear piston.
 - K. Hydraulic Linear Piston, "P-C" is the CLOSE hydraulic linear piston.
 - L. Linear Potentiometer, "ZS-1" is the linear position feedback to the 3R Valve PLC for the position of the OPEN Hydraulic Linear Piston, "P-O".
 - M. Submersible Well Level Transducer, "LT-1" (provided by others) is located down the well. 3R Control Valve PLC has available inputs for well level monitoring and trending.
 - N. Well Discharge Flow Meter Element, "FE-1" (provided by others) is located on the discharge piping of the well pump.
 - O. Well Discharge Flow Meter Transmitter, "FIT-1" (provided by others) is either mounted to the flow meter element or remotely in a separate location from the element. 3R Valve PLC has available inputs for well discharge flow meter transmitter for monitoring and trending.
 - P. Well Pump Discharge Pressure Transducer, "PT-3" (provided by others) is pipe mounted to the discharge side of the well pump. 3R Valve PLC has available inputs for well discharge pressure monitoring and trending.

PART 2 – CONTROL PROCESS

- 2.1 System in HAND;

- A. The Operator has placed the H-O-A selector switch in the 'HAND' position.
- B. The Operator can operate the control valve manually with use of the 'OPEN-CLOSE' selector switch.
 - 1. The Operator has visual confirmation of the valve being 'OPEN' or 'CLOSED' by the linear piston(s), "P-O" and "P-C", position and via the HIM.

2.2 System In AUTO;

- A. The Operator has placed the H-O-A selector switch in the "AUTO" position.
- B. The 3R Valve PLC program shall control the operation of the valve.
 - 1. The 3R Valve PLC monitors the discharge pressure of the well head via the pipe mounted pressure transducer.
 - a. The well head discharge pressure signal can be sent to the 3R Valve PLC via;
 - 1) Ethernet communications from master PLC to 3R Valve PLC.
 - 2) Analog 4-20mA wiring from well head discharge pressure transducer to 3R Valve PLC.
 - 3) Analog 4-20mA wiring from master PLC to 3R Valve PLC.
 - b. The 3R Valve PLC can determine if the well pump is running in the recovery mode by the well pump PCL control signal and per the well pump discharge pressure transducer analog signal.
 - 2. When the well pump is NOT running, the 3R Valve PLC will OPEN/CLOSE the 3R Control Valve to allow water to be injected under pressure back down the well.
 - 3. Call to OPEN 3R Valve:
 - a. The 3R Valve PLC calls for the Hydraulic Motor, "M-1" to operate.
 - b. After a short period of time, the 3R Valve PLC will actuate the Valve Block Actuating Solenoid, "FCV-1" to the OPEN position.
 - 1) Hydraulic Fluid will flow from the Hydraulic Reservoir, "HR-1" to the Hydraulic Linear Piston, "P-O".
 - 2) Hydraulic Fluid will flow from the Hydraulic Linear Piston, "P-C" to the Hydraulic Reservoir, "HR-1".
 - c. Hydraulic Linear Piston, "P-O" will operate expanding the linear shaft for visual reference.
 - 1) Hydraulic Linear Piston, "P-O" linear shaft is mechanically coupled to the Linear Potentiometer, "ZS-1".
 - d. Hydraulic Linear Piston, "P-C" will operate retracting the linear shaft for visual reference.
 - e. Linear Potentiometer, "ZS-1" has an electrical analog output signal providing position feedback to 3R Valve PLC.
 - 1) Linear Potentiometer, "ZS-1" analog value will be at its maximum when the Hydraulic Linear Piston, "P-O" is completed actuating to the OPEN position.
 - f. Pressure Transmitter, "PT-O" analog signal will be at its maximum indicating the Linear Piston, "P-O" linear shaft has completely opened. This indication directly correlates to the 3R Control Valve, "FCV-2" down the well is in the "OPEN" position allowing water to flow back down the well.
 - 4. Call to CLOSE 3R Valve:

- a. The 3R Valve PLC calls for the Hydraulic Motor, "M-1" to operate.
- b. After a short period of time, the 3R Valve PLC will actuate the Valve Block Actuating Solenoid, "FCV-1" to the CLOSE position.
 - 1) Hydraulic Fluid will flow from the Hydraulic Reservoir, "HR-1" to the Hydraulic Linear Piston, "P-C".
 - 2) Hydraulic Fluid will flow from the Hydraulic Linear Piston, "P-O" to the Hydraulic Reservoir, "HR-1".
- c. Hydraulic Linear Piston, "P-C" will operate expanding the linear shaft for visual reference.
- d. Hydraulic Linear Piston, "P-O" will operator retracting the linear shaft for visual reference.
- e. Linear Potentiometer, "ZS-1" has an electrical analog output signal providing position feedback to the 3R Valve PLC.
 - 1) Liner Potentiometer, "ZS-1" analog value will be at its minimum when the Hydraulic Linear Piston, "P-O" has completed retraction to the CLOSED position.
- g. Pressure Transmitter, "PT-C" analog signal will be at its maximum, indicating the Linear Piston, "P-C" linear shaft has completely closed. This indication directly correlates to the 3R Control Valve, "FCV-2" down the well is in the "CLOSED" position allowing the well pump to pump water to the distribution piping.