## 2.2 Surge Vessel

The test bed will have the following surge vessels. The equipment and automation for each will be identical.

**Vessel Description**

SV01 ProA Surge Vessel
SV02 Viral Inactivation Surge Vessel
SV03 Depth Filtration Surge Vessel
SV04 Polishing 1 Surge Vessel
SV05 Polishing 2 Surge Vessel
SV06 Viral Filtration Surge Vessel
SV07 UltraFiltration Surge Vessel

### 2.2.1 Addition Control:

The addition control equipment module class is used to control vessel pH or conductivity. The setpoints for the equipment module are Hold, Shutdown, and Addition Polynomial Control.

In the Hold setpoint, vessel weight monitoring and addition control is disabled.

In the Shutdown setpoint, vessel weight monitoring and addition control is disabled.

In the Addition Polynomial Control setpoint, vessel weight monitoring is enabled. When vessel weight is above the minimum vessel weight, the vessel weight monitoring logic will enable the Addition Control logic. If the vessel weight is above high weight limit, then Addition control logic is disabled. The Addition Control logic works as follows:

If Hi side addition is enabled and the measured pH/conductivity is below the setpoint (by an amount greater than a configurable deadband) or Lo side addition is enabled and the measured pH/conductivity is above the setpoint (by an amount greater than a configurable deadband), and the system is not waiting a post-addition mixing time, then the Addition Control logic will add solution for a calculated length of time. For pH control, base will be used for Hi Side control and acid will be used for Lo Side control. The addition time is calculated by the polynomial equation below but cannot exceed a configurable maximum limit for Lo side and Hi side addition, respectively.

Addition Time = [C1 × (SP – PV)^2] + [C2 × │(SP – PV)│] + C3

where SP is the pH/conductivity control setpoint, PV is the measured pH/conductivity process value, and C1, C2, and C3 are constants. The values of C1, C2, and C3 are unique for Lo side and Hi side additions and are dependent on whether the PV is above or below a configurable Lo side pH/conductivity break point or Hi side pH/conductivity break point.

After an addition is complete, the Addition Control logic waits for a configured mixing time before allowing another addition to occur.

The EM shall allow flexibility to perform control and ability to select one of the two pumps for each sided control.

An alarm is triggered in each SUSV during Feed if the incoming flow rate into the SUSV minus Outgoing flow rate minus the SUSV rate of weight change is not zero within a configurable tolerance for a configurable time.

### 2.2.2 Divert Valve

The divert valve is used to divert flow if the skid feed SUSV weight is high or operator overrides manually.

Divert Valve will be assigned to the SUSV. The valve logic will monitor feed SUSV weight assigned to the skid to divert the flow. Operator can manually override the flow path using the skid EM operating parameter to which the SUSV is actively connected. When the weight control functionality is disabled, the divert valves are placed in a hold state.

### 2.2.3 Alarm

An alarm is triggered in each SUSV during Feed if the incoming flow rate into the SUSV minus Outgoing flow rate minus the SUSV rate of weight change is not zero within a configurable tolerance for a configurable time.