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| **STREAM** | **PROCESS** **PARAMETERS** | **DEVIATIONS** | **POSSIBLE CAUSES** | **CONSEQUENCES** | **ACTION REQUIRED** |
| Feed (ST1)Reactant (ST2)Catalyst (ST3)Catalyst (ST4)Reactant (ST5) | Flow | HighLowNo | Valve failure/fully openValve failure/closedFlow control failureFlow control sensorfailureOperator failurePlugged pipePipe breakageEmpty storage tank  | Possible upset in downstreamOverflowIncreased reaction rateDownstream process backed-upPipe damageReaction rate ReducedNo reactionPump cavitation | Install HAInstall LAInstall check valveRegular maintenance and calibrationOperator trainingImplementation of absorbing material to avoid leaks to groundInspection prior to startup |
| Reactant (ST2)Catalyst (ST3)Catalyst (ST4)Reactant (ST5) | Pressure | Low | Valve failure/fully openOperator failureLeak in pipePlugged pipePumps fails  | Possible upset in downstreamMeOH may partial vaporizedPipe breakagePump damagePump cavitation | Check differential pressure across valve during routinemaintenanceFail-closed mechanism Inspection prior to startup |
| Feed (ST1)Reactant (ST2)Catalyst (ST3)Catalyst (ST4)Reactant (ST5) | Temperature | HighLow | Excessive heatingOperator failureTemperature controlFailureTemperature sensorFailureNot sufficient heatingCooling occurs | Increase pressurePipe meltCH3OH boilWCO boilPump damageReduced pressureViscosity increaseWCO solidify upon cooling | Install HA + thermo couplesOperator trainingInstall throttleInstall LA + thermo couples installedRegular maintenance |