Create an extended cause & process action matrix for the interlocks for a chemical reactor. The column headings shall be the safety actions performed using the actuators in the system.

An extended cause and process action matrix for the interlocks of a chemical reactor can help identify potential hazards, their causes, and the appropriate safety actions to be taken. Here is an example of such a matrix, with column headings representing the safety actions performed using the actuators in the system. Keep in mind that this is a simplified example, and an actual matrix would need to be tailored to the specific reactor design and operating conditions.

Hazardous Event	Cause(s)	Safety Interlock	Actuator Action	Process Control Action
Overpressure	Runaway reaction	High pressure interlock	Emergency vent or pressure relief valve	Shutdown or reduce feed rate
	Blocked vent	High pressure interlock	Emergency vent or pressure relief valve	Shutdown or reduce feed rate
	Equipment failure	High pressure interlock	Emergency vent or pressure relief valve	Shutdown or reduce feed rate
Underpressure	Leak in reactor	Low pressure interlock	Isolation valve	Shutdown or reduce feed rate
	Equipment failure	Low pressure interlock	Isolation valve	Shutdown or reduce feed rate
Overtemperature	Runaway reaction	High temperature interlock	Cooling system	Shutdown or reduce feed rate
	Cooling system failure	High temperature interlock	Cooling system	Shutdown or reduce feed rate
Undertemperature	Insufficient reaction heat	Low temperature interlock	Heating system	Increase feed rate or adjust heating system
	Heating system failure	Low temperature interlock	Heating system	Increase feed rate or adjust heating system
High level	Overfilling	High level interlock	Inlet valve	Shutdown or reduce feed rate
	Outlet blockage	High level interlock	Inlet valve	Shutdown or reduce feed rate
Low level	Leak in reactor	Low level interlock	Outlet valve	Shutdown or reduce feed rate
	Inadequate feed	Low level interlock	Outlet valve	Shutdown or reduce feed rate
Toxic release	Leak in reactor	Gas detection interlock	Isolation valve	Shutdown or reduce feed rate
	Equipment failure	Gas detection interlock	Isolation valve	Shutdown or reduce feed rate
Fire	Flammable vapor release	Flame detection interlock	Isolation valve	Shutdown or reduce feed rate
	Equipment failure	Flame detection interlock	Isolation valve	Shutdown or reduce feed rate

This matrix can help engineers and operators visualize the potential hazards, causes, and corresponding safety actions for a chemical reactor. The information provided here should be reviewed and refined based on the specific details and requirements of the reactor system in question.