



LAPD _____
 Location PC4 _____
 Date 7/8/11 _____
 By Terry Tope _____

WHAT-IF WORKSHEET

WHAT-IF	CONSEQUENCE/HAZARD	CONCLUSION/RECOMMENDATIONS
Loss of liquid nitrogen	Argon boil off will vent thru vent valve PCV-351-Ar or relief valve PSV-377-Ar and cryostat pressure control is lost.	Safe condition. Operational impact only.
Loss of "instrument air" (argon in this case)	Loss of pneumatic valve control	Safe condition. Operational impact only. Purification will stop and tank will vent.
Loss of insulating vacuums on LAr purification piping	System potentially frosts over. Higher heat load on LN2 system from LAr piping. Potential for LAr piping relief valves to open. May cause high consumption of liquid nitrogen.	Safe condition. Liquid argon purification piping is protected by trapped volume relief valves. Operational impact. Safe condition. Operational impact.
Loss of instrumentation	May cause system instability with respect to cryostat pressure control or regeneration heater control.	Safe condition. PSV-377-Ar can relieve both internal and external pressure. Operational impact.
Power outage occurs at PC4	All control and instrumentation eventually fails if the outage is longer than the UPS capacity.	Safe condition. Operational impact – Historical values no longer recorded, no pressure control, relief valves vent. UPS provides several hours of back up power during which the automatic dialer will notify the project personnel. Sump pumps are tied into FIRUS.
Leaking stem packing on a cryo valve	Gas will vent into room.	Safe condition (see ODH analysis).
LAr purification piping inner line leaks	Loss of insulating vacuum and pressurization of the vacuum space.	Safe condition. Gas will vent into room thru vacuum reliefs into room (see ODH analysis).

PLC failure	Pressure control and heater control lost.	Safe condition. Operational impact. LAr will vent thru relief valves.
A fire in PC4	<p>Fire detectors go into alarm and Fire Department dispatched.</p> <p>Equipment damage likely to be limited due to limited amounts of combustible material in the vicinity of the cryo system.</p> <p>Fire could cause significant damage to controls hardware, wiring, and instrumentation.</p> <p>Superinsulation on LAr purification piping could be damaged.</p> <p>Heat input into cryogenic liquids builds pressure in piping and cryostat.</p> <p>Insulating vacuums may spoil if o-rings are subjected to intense heat.</p>	<p>Safe condition. Operational problem - Control system not required for system safety but required for operation.</p> <p>Safe condition. Operational problem - Heat leaks during normal operation would be unacceptable if radiation blankets are damaged.</p> <p>Safe condition. Pressure vessels and piping protected by relief valves (see relief calculations and FMEA). Tank insulation is not flammable based on flame tests performed by Jim Priest.</p> <p>Safe condition. System is protected with relief valves. Operational problem - Heat leaks during normal operation would be unacceptable if insulating vacuums are spoiled.</p>