

Instr Code	Tag #	Serv. Code	PID	GRID	LOC	Service Description	Instrument Type	Failure or Error Mode	Hazard or Effect	Hazard Class	Remarks	Operator intervention required*
MV	101	Ar	SHT-1	7-	C	connection to HP Ar dewar #1	manual valve	fails closed	no hazard	safe	operational problem - can't connect dewar	no
								fails open	no hazard	safe	operational problem - can't isolate dewar	no
MV	102	Ar	SHT-1	7-	D	connection to HP Ar dewar #2	manual valve	fails closed	no hazard	safe	operational problem - can't connect dewar	no
								fails open	no hazard	safe	operational problem - can't isolate dewar	no
MV	103	Ar	SHT-1	7-	D	connection to HP Ar dewar #3	manual valve	fails closed	no hazard	safe	operational problem - can't connect dewar	no
								fails open	no hazard	safe	operational problem - can't isolate dewar	no
PI	104	Har	SHT-1	6-	E	regeneration gas trailer pressure	local pressure indicator	incorrect reading	no hazard	safe	operational problem	no
PT	105	HAr	SHT-1	6-	B	HP Ar header pressure	pressure transmitter	incorrect reading	no hazard	safe	operational problem	no
PRV	106	HAr	SHT-1	7-	F	Ar/H2 from trailer	pressure regulator	fails open	high discharge pressure	safe	PSV-108-H relieves excess pressure	no
								fails closed	no hazard	safe	operational problem - no regeneration gas supply	no
PSV	108	HAr	SHT-1	7-	F	Ar/H2 from trailer relief	relief valve	fails open	no hazard	safe	operational problem - regeneration gas vents outside	no
								fails closed	unprotected downstream piping	safe	Low probability of a quality ASME certified relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
PRV	110	Ar	SHT-1	7-	E	header from HP Ar dewars	pressure regulator	fails open	no hazard	safe	operational problem - argon gas vents outside	no
								fails closed	unprotected downstream piping	safe	Low probability of a quality Circle Seal relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
PT	111	Ar	SHT-1	6-	E	Ar/H2 trailer pressure	pressure transmitter	incorrect reading	no hazard	safe	operational problem	no
MV	113	Ar	SHT-1	7-	D	HP Ar header	manual valve	fails open	no hazard	safe	spare valve - vents outside	no
								fails closed	no hazard	safe	spare valve	no
PSV	114	Ar	SHT-1	7-	E	header from HP Ar dewars	relief valve	fails open	no hazard	safe	operational problem - regeneration gas vents outside	no
								fails closed	unprotected downstream piping	safe	Low probability of a quality Circle Seal relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
MV	115	Ar	SHT-1	7-	E	HP Ar header blow down	manual valve	fails open	no hazard	safe	operational problem - argon gas vents outside	no
								fails closed	no hazard	safe	operational problem - can't purge argon supply by venting	no
MV	116	Ar	SHT-1	7-	E	HP Ar supply to LAPD tank	manual valve	fails open	no hazard	safe	operational problem - argon supply can't be isolated for purging	no
								fails closed	no hazard	safe	operational problem - argon supply is isolated	no
MV	118	Ar	SHT-1	4-	D	Argon Source #2 vent valve	manual valve	fails open	no hazard	safe	operational problem - argon gas vents outside	no
								fails closed	no hazard	safe	operational problem - argon supply is isolated	no
MV	119	Ar	SHT-1	6-	D	Argon Source #2 hookup #1	manual valve	fails open	no hazard	safe	operational problem - argon supply can't be isolated for bottle changing	no
								fails closed	no hazard	safe	operational problem - argon bottle is isolated	no
MV	120	Ar	SHT-1	6-	D	Argon Source #2 hookup #2	manual valve	fails open	no hazard	safe	operational problem - argon supply can't be isolated for bottle changing	no
								fails closed	no hazard	safe	operational problem - argon bottle is isolated	no
MV	121	Ar	SHT-1	6-	D	Argon Source #2 hookup #3	manual valve	fails open	no hazard	safe	operational problem - argon supply can't be isolated for bottle changing	no
								fails closed	no hazard	safe	operational problem - argon bottle is isolated	no
MV	122	Ar	SHT-1	6-	D	Argon Source #2 hookup #4	manual valve	fails open	no hazard	safe	operational problem - argon supply can't be isolated for bottle changing	no
								fails closed	no hazard	safe	operational problem - argon bottle is isolated	no

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PT	123	Ar	SHT-1	6-	D	Ar bottle header	pressure transmitter	incorrect reading	no hazard	safe	operational problem	no
PRV	124	Ar	SHT-1	5-	D	Ar bottle header	pressure regulator	fails open	high discharge pressure	safe	PSV-125-Ar relieves excess pressure	no
								fails closed	no hazard	safe	operational problem	no
PSV	125	Ar	SHT-1	4-	D	Ar bottle header	relief valve	fails open	no hazard	safe	operational problem - regeneration gas vents outside	no
								fails closed	unprotected downstream piping	safe	Low probability of a quality Circle Seal relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
MV	126	Ar	SHT-1	4-	D	Argon source #2	manual valve - 3 way	fails open - plug	no hazard	safe	operational problem	no
								fails closed - block	no hazard	safe	operational problem - argon gas isolated	no
								fails open - process	no hazard	safe	operational problem - argon gas can't be isolated for bottle changes	no
MV	128	Ar	SHT-1	6-	E	Argon Source #3 hookup #1	manual valve	fails open	no hazard	safe	operational problem - argon supply can't be isolated for bottle changing	no
								fails closed	no hazard	safe	operational problem - argon bottle is isolated	no
MV	129	Ar	SHT-1	6-	E	Argon Source #3 hookup #2	manual valve	fails open	no hazard	safe	operational problem - argon supply can't be isolated for bottle changing	no
								fails closed	no hazard	safe	operational problem - argon bottle is isolated	no
MV	130	Ar	SHT-1	6-	E	Argon Source #3 hookup #3	manual valve	fails open	no hazard	safe	operational problem - argon supply can't be isolated for bottle changing	no
								fails closed	no hazard	safe	operational problem - argon bottle is isolated	no
MV	131	Ar	SHT-1	6-	E	Argon Source #3 hookup #4	manual valve	fails open	no hazard	safe	operational problem - argon supply can't be isolated for bottle changing	no
								fails closed	no hazard	safe	operational problem - argon bottle is isolated	no
PT	132	Ar	SHT-1	6-	E	Argon Source #3 manifold pressure	pressure transmitter	incorrect reading	no hazard	safe	operational problem	no
PRV	133	Ar	SHT-1	5-	E	Argon source #3 header	pressure regulator	fails open	high discharge pressure	safe	PSV-134-Ar relieves excess pressure	no
								fails closed	no hazard	safe	operational problem	no
PSV	134	Ar	SHT-1	4-	E	bottle header	relief valve	fails open	no hazard	safe	operational problem - argon gas vents outside	no
								fails closed	unprotected downstream piping	safe	Low probability of a quality Circle Seal relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
MV	135	Ar	SHT-1	4-	E	Argon Source #3 vent valve	manual valve	fails open	no hazard	safe	operational problem - argon gas vents outside	no
								fails closed	no hazard	safe	operational problem - argon supply is isolated	no
MV	137	Ar	SHT-1	4-	E	Argon Source #3	manual valve - 3 way	fails open - plug	no hazard	safe	operational problem	no
								fails closed - block	no hazard	safe	operational problem - argon gas isolated	no
								fails open - process	no hazard	safe	operational problem - argon gas can't be isolated for bottle changes	no
PT	138	N2	SHT-1	7-	G	N2 trailer	pressure transmitter	incorrect reading	no hazard	safe	operational problem	no
LT	139	N2	SHT-1	7-	G	N2 trailer	press diff (level) transmitter	incorrect reading	no hazard	safe	operational problem	no
SP	140	N2	SHT-1	5-	G	liq. N2 from N2 trailer to phase sep. outdoor section	Y-strainer (particulate filter)	plugs	no hazard	safe	operational problem - reduced LN2 refrigeration	no
TE	141	N2	SHT-1	5-	G	liq. N2 from N2 trailer to phase sep. outdoor section	temperature element	incorrect reading	no hazard	safe	operational problem	no
MV	142	N2	SHT-1	5-	G	liq. N2 from N2 trailer to vaporizer	manual shutoff valve	fails open	no hazard	safe	operational problem - can't isolate GN2 supply from Lar supply	no
								fails closed	no hazard	safe	operational problem - no GN2 supply	no
PSV	143	N2	SHT-1	4-	G	liq. N2 from N2 trailer to vaporizer	relief valve trapped volume	fails open	LN2 dumps on ground outside	safe	operational problem - nitrogen vents outside, potential loss of refrigeration in PC4	no

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								fails closed	potential trapped volume	safe	Low probability of a quality Circle Seal relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
SV	144	N2	SHT-1	3-	G	GN2 supply to Pc4	solenoid valve	fails open	no hazard	safe	operational problem	no
								fails closed	no hazard	safe	operational problem - no GN2 supply	no
PI	145	N2	SHT-1	4-	G	N2 gas from vaporizer to regen gas header / outdoor section	local pressure indicator	incorrect reading	no hazard	safe	operational problem	no
TE	146	N2	SHT-1	4-	G	N2 gas from vaporizer to regen gas header / outdoor section	temperature element	incorrect reading	no hazard	safe	operational problem	no
MV	148	N2	SHT-1	5-	G	liq. N2 from N2 trailer to phase sep. blow down / outdoor section	manual valve	fails open	LN2 dumps on ground outside	safe	operational problem - nitrogen vents outside, potential loss of refrigeration in PC4	no
								fails closed	no hazard	safe	operational problem - can't blow down nitrogen piping	no
PI	149	N2	SHT-1	4-	G	liq. N2 from N2 trailer to phase sep. outdoor section	local pressure indicator	incorrect reading	no hazard	safe	operational problem	no
PSV	150	N2	SHT-1	4-	G	liq. N2 from N2 trailer to phase sep. outdoor section	relief valve trapped volume	fails open	LN2 dumps on ground	safe	operational problem - nitrogen vents outside, potential loss of refrigeration in PC4	no
								fails closed	potential trapped volume	safe	Low probability of a quality Circle Seal relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
CV	151	N2	SHT-1	3-	F	N2 gas from vaporizer to regen gas header / indoor section	check valve	fails open	no hazard	safe	operational problem - argon or argon/hydrogen could flow into nitrogen piping	no
								fails closed	no hazard	safe	operational problem - no GN2 supply for filter regeneration	no
MV	152	N2	SHT-1	3-	G	N2 gas from vaporizer to regen gas header / indoor section	manual valve	fails open	no hazard	safe	operational problem - can't isolate nitrogen supply from filter regeneration	no
								fails closed	no hazard	safe	operational problem - no GN2 supply for filter regeneration	no
CV	153	HAr	SHT-1	3-	F	Ar/H2 from trailer to LAPD filtration indoor section	check valve	fails open	no hazard	safe	operational problem - argon or nitrogen could flow into argon/hydrogen piping	no
								fails closed	no hazard	safe	operational problem - no argon/hydrogen supply for filter regeneration	no
MV	154	HAr	SHT-1	3-	F	Ar/H2 from trailer to LAPD filtration indoor section	manual valve	fails open	no hazard	safe	operational problem - can't isolate argon/hydrogen supply from filter regeneration	no
								fails closed	no hazard	safe	operational problem - no hydrogen/argon supply for filter regeneration	no
MV	156	Ar	SHT-1	3-	C	HP Ar supply to LAPD tank	inside manual valve	fails open	no hazard	safe	operational problem	no
								fails closed	no hazard	safe	operational problem - no argon supply for various services	no
FCV	157	Ar	SHT-1	3-	D	Ar purge header to purge #101	rotameter	incorrect reading	no hazard	safe	operational problem - potential contamination from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive argon gas usage	no
								fails closed	no hazard	safe	operational problem - potential contamination from lack of purge	no
FCV	158	Ar	SHT-1	3-	D	Ar purge header to purge #102	rotameter	incorrect reading	no hazard	safe	operational problem - potential contamination from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive argon gas usage	no
								fails closed	no hazard	safe	operational problem - potential contamination from lack of purge	no
FCV	159	Ar	SHT-1	3-	D	Ar purge header to purge #103	rotameter	incorrect reading	no hazard	safe	operational problem - potential contamination from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive argon gas usage	no
								fails closed	no hazard	safe	operational problem - potential contamination from lack of purge	no
FCV	160	Ar	SHT-1	3-	D	Ar purge header to purge #104	rotameter	incorrect reading	no hazard	safe	operational problem - potential contamination from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive argon gas usage	no
								fails closed	no hazard	safe	operational problem - potential contamination from lack of purge	no
FCV	161	Ar	SHT-1	3-	D	Ar purge header spare	rotameter	incorrect reading	no hazard	safe	operational problem - potential contamination from inadequate purge	no

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								fails open	no hazard	safe	operational problem - excessive argon gas usage	no
								fails closed	no hazard	safe	operational problem - potential contamination from lack of purge	no
FCV	162	Ar	SHT-1	2-	D	Ar purge header spare	rotameter	incorrect reading	no hazard	safe	operational problem - potential contamination from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive argon gas usage	no
								fails closed	no hazard	safe	operational problem - potential contamination from lack of purge	no
FCV	163	Ar	SHT-1	2-	D	Ar purge header to purge #107	rotameter	incorrect reading	no hazard	safe	operational problem - potential contamination from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive argon gas usage	no
								fails closed	no hazard	safe	operational problem - potential contamination from lack of purge	no
FCV	164	Ar	SHT-1	2-	D	Ar purge header spare	rotameter	incorrect reading	no hazard	safe	operational problem - potential contamination from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive argon gas usage	no
								fails closed	no hazard	safe	operational problem - potential contamination from lack of purge	no
FCV	165	Ar	SHT-1	2-	D	Ar purge header spare	rotameter	incorrect reading	no hazard	safe	operational problem - potential contamination from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive argon gas usage	no
								fails closed	no hazard	safe	operational problem - potential contamination from lack of purge	no
FCV	166	Ar	SHT-1	2-	D	Ar purge header spare	rotameter	incorrect reading	no hazard	safe	operational problem - potential contamination from inadequate purge	no
								fails open	no hazard	s	operational problem - excessive argon gas usage	no
								fails closed	no hazard	safe	operational problem - potential contamination from lack of purge	no
MV	167	Ar	SHT-1	3-	D	Ar bottle gas to Ar purge header	manual valve	fails open	no hazard	safe	operational problem	no
								fails closed	no hazard	safe	operational problem - potential contamination from lack of purge	no
PSV	168	N2	SHT-1	3-	G	LN2 supply	relief valve trapped volume	fails open	LN2 vents inside pc4	safe	ODH analysis takes this into account	no
								fails closed	potential trapped volume	safe	Low probability of a quality Circle Seal relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
MV	170	HAr	SHT-1	6-	F	Ar/H2 from trailer blow down	manual valve	fails open	no hazard	safe	operational problem - hydrogen/argon mixture vents outside	no
								fails closed	no hazard	safe	operational problem - can't blow down hydrogen argon tube trailer supply	no
MV	171	HAr	SHT-1	7-	F	Ar/H2 from trailer	manual valve	fails open	no hazard	safe	operational problem	no
								fails closed	no hazard	safe	operational problem - filter regeneration gas supply isolated	no
PI	174	Ar	SHT-1	3-	D	Ar bottle gas to Ar purge header	pressure indicator	incorrect reading	no hazard	safe	operational problem	no
PI	175	Ar	SHT-1	7-	E	header from HP Ar dewars	pressure indicator on regulator	incorrect reading	no hazard	safe	operational problem	no
PI	176	Ar	SHT-1	7-	E	header from HP Ar dewars	pressure indicator on regulator	incorrect reading	no hazard	safe	operational problem	no
PI	178	HAr	SHT-1	7-	F	Ar/H2 from trailer	pressure indicator on regulator	incorrect reading	no hazard	safe	operational problem	no
PI	179	HAr	SHT-1	7-	F	Ar/H2 from trailer	pressure indicator on regulator	incorrect reading	no hazard	safe	operational problem	no
PI	180	Ar	SHT-1	5-	D	Ar bottle header	pressure indicator on regulator	incorrect reading	no hazard	safe	operational problem	no
PI	181	Ar	SHT-1	5-	D	Ar bottle header	pressure indicator on regulator	incorrect reading	no hazard	safe	operational problem	no
PI	182	Ar	SHT-1	5-	E	Ar bottle header	pressure indicator on regulator	incorrect reading	no hazard	safe	operational problem	no
PI	183	Ar	SHT-1	5-	E	Ar bottle header	pressure indicator on regulator	incorrect reading	no hazard	safe	operational problem	no

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CV	186	Ar	SHT-1	3-	C	HP Ar supply to LAPD tank	check valve	fails open	no hazard	safe	operational problem - bottle gas could flow towards argon supply dewars	no
								fails closed	no hazard	safe	operational problem - argon dewars can't provide gas	no
CV	187	Ar	SHT-1	4-	C	Ar bottle gas to PC4	check valve	fails open	no hazard	safe	operational problem - dewar gas could flow towards argon supply bottles	no
								fails closed	no hazard	safe	operational problem - argon source #2 can't provide gas	no
FCV	189	Ar	SHT-1	3-	D	Ar purge header to purge #111	rotameter	incorrect reading	no hazard	safe	operational problem - potential contamination from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive argon gas usage	no
								fails closed	no hazard	safe	operational problem - potential contamination from lack of purge	no
FCV	190	Ar	SHT-1	3-	D	Ar purge header spare	rotameter	incorrect reading	no hazard	safe	operational problem - potential contamination from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive argon gas usage	no
								fails closed	no hazard	safe	operational problem - potential contamination from lack of purge	no
FCV	191	Ar	SHT-1	3-	D	Ar purge header to purge #113	rotameter	incorrect reading	no hazard	safe	operational problem - potential contamination from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive argon gas usage	no
								fails closed	no hazard	safe	operational problem - potential contamination from lack of purge	no
FCV	192	Ar	SHT-1	3-	D	Ar purge header to purge #114	rotameter	incorrect reading	no hazard	safe	operational problem - potential contamination from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive argon gas usage	no
								fails closed	no hazard	safe	operational problem - potential contamination from lack of purge	no
FCV	193	Ar	SHT-1	3-	D	Ar purge header to purge #115	rotameter	incorrect reading	no hazard	safe	operational problem - potential contamination from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive argon gas usage	no
								fails closed	no hazard	safe	operational problem - potential contamination from lack of purge	no
FCV	194	Ar	SHT-1	2-	D	Ar purge header to purge #116	rotameter	incorrect reading	no hazard	safe	operational problem - potential contamination from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive argon gas usage	no
								fails closed	no hazard	safe	operational problem - potential contamination from lack of purge	no
FCV	195	Ar	SHT-1	2-	D	Ar purge header spare	rotameter	incorrect reading	no hazard	safe	operational problem - potential contamination from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive argon gas usage	no
								fails closed	no hazard	safe	operational problem - potential contamination from lack of purge	no
FCV	196	Ar	SHT-1	2-	D	Ar purge header to purge #118	rotameter	incorrect reading	no hazard	safe	operational problem - potential contamination from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive argon gas usage	no
								fails closed	no hazard	safe	operational problem - potential contamination from lack of purge	no
FCV	197	Ar	SHT-1	2-	C	Ar purge header spare	rotameter	incorrect reading	no hazard	safe	operational problem - potential contamination from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive argon gas usage	no
								fails closed	no hazard	safe	operational problem - potential contamination from lack of purge	no
FCV	198	Ar	SHT-1	2-	C	Ar purge header to purge #120	rotameter	incorrect reading	no hazard	safe	operational problem - potential contamination from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive argon gas usage	no
								fails closed	no hazard	safe	operational problem - potential contamination from lack of purge	no
FCV	199	Ar	SHT-1	2-	C	Ar purge header to purge #121	rotameter	incorrect reading	no hazard	safe	operational problem - potential contamination from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive argon gas usage	no

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								fails closed	no hazard	safe	operational problem - potential contamination from lack of purge	no
FCV	200	Ar	SHT-1	2-	C	Ar purge header spare	rotameter	incorrect reading	no hazard	safe	operational problem - potential contamination from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive argon gas usage	no
								fails closed	no hazard	safe	operational problem - potential contamination from lack of purge	no
FCV	201	Ar	SHT-1	2-	C	Ar purge header to purge #123	rotameter	incorrect reading	no hazard	safe	operational problem - potential contamination from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive argon gas usage	no
								fails closed	no hazard	safe	operational problem - potential contamination from lack of purge	no
FCV	202	Ar	SHT-1	2-	C	Ar purge header to purge #124	rotameter	incorrect reading	no hazard	safe	operational problem - potential contamination from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive argon gas usage	no
								fails closed	no hazard	safe	operational problem - potential contamination from lack of purge	no
PI	206	Ar	SHT-1	3-	D	low pressure ar purge line pressure	local pressure indicator	incorrect reading	no hazard	safe	operational problem	no
PRV	207	Ar	SHT-1	3-	D	low pressure ar purge line pressure regulator	pressure regulator	fails open	no hazard	safe	operational problem - potential excessive argon gas consumption due to elevated flowmeter inlet pressure	no
								fails closed	no hazard	safe	operational problem - potential contamination from lack of purge	no
CV	208	Ar	SHT-1	4-	D	argon supply	check valve	fails open	no hazard	safe	operational problem - dewar gas could flow towards argon supply bottles	no
								fails closed	no hazard	safe	operational problem - argon source #3 can't provide gas	no
PSV	209	N2	SHT-1	3-	G	trapped volume relief inside PC4	relief valve	fails open	GN2 vents inside PC4	safe	operational problem - venting inside considered in ODH analysis	no
								fails closed	potential trapped volume	safe	Low probability of a quality Circle Seal relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
PT	210	Air	SHT-1	6-	C	air bottle manifold	pressure transmitter	incorrect reading	no hazard	safe	operational problem	no
PT	211	Air	SHT-1	5	C	air bottle manifold	pressure transmitter	incorrect reading	no hazard	safe	operational problem	no
MV	212	Air	SHT-1	5	C	air bottle manifold	manual valve	fails open	no hazard	safe	air vents in gas shed - operational problem	no
								fails closed	no hazard	safe	4 Air bottles isolated - operational problem	no
MV	213	Air	SHT-1	5-	C	air bottle manifold	manual valve	fails open	no hazard	safe	can't designate primary/secondary bottle manifold - operational problem	no
								fails closed	no hazard	safe	air not available - operational problem	no
PRV	214	Air	SHT-1	5-	C	air bottle manifold	pressure regulator	fails open	high discharge pressure	safe	PSV-218-Air relieves protects downstream piping	no

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								fails closed	no hazard	safe	operational problem	no
PRV	215	Air	SHT-1	5-	C	air bottle manifold	pressure regulator	fails open	high discharge pressure	safe	PSV-218-Air relieves protects downstream piping	no
								fails closed	no hazard	safe	operational problem	no
PRV	216	Air	SHT-1	5-	C	air bottle manifold	pressure regulator	fails open	high discharge pressure	safe	PSV-218-Air relieves protects downstream piping	no
								fails closed	no hazard	safe	operational problem	no
PI	217	Air	SHT-1	5-	C	air bottle manifold	pressure indicator	incorrect reading	no hazard	safe	operational problem	no
PSV	218	Air	SHT-1	5	C	air bottle manifold	relief valve	fails open	no hazard	safe	operational problem - air vents in the gas shed	no
								fails closed	unprotected downstream piping	safe	Low probability of a quality Circle Seal relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
MV	219	Ar	SHT-2	4	D	Tank purge gas analyzers	manual valve	fails open	no hazard	safe	operational problem - tank could be isolated with FCV-221-Ar	no
								fails closed	no hazard	safe	operational problem - AE-298-Ar can't monitor Ar piston purge	no
MV	220	Ar	SHT-2	4-	D	Tank purge gas analyzers	manual valve	fails open	no hazard	safe	operational problem - tank could be isolated with FCV-222-Ar	no
								fails closed	no hazard	safe	operational problem - AE-299-Ar can't monitor Ar piston purge	no
FCV	221	Ar	SHT-2	4-	D	Tank purge gas analyzers	rotameter	incorrect reading	no hazard	safe	operational problem - incorrect flow could lead to poor purge data from AE-298-Ar	no
								fails open	no hazard	safe	operational problem - can't regulate gas to AE-298-Ar - could lead to poor purge data	no
								fails closed	no hazard	safe	operational problem - can't supply gas to AE-298-Ar - could lead to poor purge data	no

Instr Code	Tag #	Serv. Code	PID	GRID	LOC	Service Description	Instrument Type	Failure or Error Mode	Hazard or Effect	Hazard Class	Remarks	Operator intervention required*
FCV	222	Ar	SHT-2	4-	D	Tank purge gas analyzers	rotameter	incorrect reading	no hazard	safe	operational problem - incorrect flow could lead to poor purge data from AE-299-Ar	no
								fails open	no hazard	safe	operational problem - can't regulate gas to AE-299-Ar - could lead to poor purge data	no
								fails closed	no hazard	safe	operational problem - can't supply gas to AE-299-Ar - could lead to poor purge data	no
AV	225	N2	SHT-1	6-	G	LN2 supply	automatic valve	fails open	no hazard	safe	operational problem - no automatic shut off of LN2 in case of run away refrigeration or ODH (ODH analysis does not rely on actuation of this valve) - solenoid valves inside PC4 shut in the event of ODH	no
								fails closed	no hazard	safe	operational problem - no refrigeration or GN2 supply	no
MV	226	Ar	SHT-1	7-	B	connection to HP Ar dewar #3	manual valve	fails closed	can't connect dewar	safe	operational problem	no
								fails open	can't isolate dewar	safe	operational problem	no
MV	227	Har	SHT-1	6-	E	H2/Ar pressure instrumentation	manual valve	fails open	no hazard	safe	operational problem	no
								fails closed	no hazard	safe	operational problem - pressure instrumentation isolated	no
MV	228	Har	SHT-1	6-	B	Ar supply pressure instrumentation	manual valve	fails open	no hazard	safe	operational problem	no
								fails closed	no hazard	safe	operational problem - pressure instrumentation isolated	no
PI	229	Har	SHT-1	6-	B	Regeneration gas tube trailer pressure instrumentation	pressure indicator	incorrect reading	no hazard	safe	operational problem	no
MV	230	Har	SHT-1	4-	F	regeneration gas isolation	manual valve	fails open	no hazard	safe	operational problem	no
								fails closed	no hazard	safe	operational problem - filter regeneration gas supply isolated	no
PI	231	N2	SHT-1	3-	G	nitrogen gas supply	pressure indicator	incorrect reading	no hazard	safe	operational problem	no
MV	232	N2	SHT-1	3-	F	nitrogen gas supply	manual valve	fails open	no hazard	safe	operational problem	no
								fails closed	no hazard	safe	operational problem - no nitrogen gas supply to analyzers	no
MV	233	V	SHT-1	2-	F	regeneration gas header	manual valve	fails open	no hazard	safe	capped for future use	no
								fails closed	no hazard	safe	capped for future use	no
MV	234	V	SHT-1	2-	F	regeneration gas header	manual valve	fails open	no hazard	safe	capped for future use	no
								fails closed	no hazard	safe	capped for future use	no
CV	236	Ar	SHT-1	3-	F	argon gas supply @ regen header	check valve	fails open	no hazard	safe	operational problem - hydrogen/argon or nitrogen could flow into argon piping	no
								fails closed	no hazard	safe	operational problem - no argon supply for filter regeneration	no
MV	237	Ar	SHT-1	3-	F	argon gas supply @ regen header	manual valve	fails open	no hazard	safe	operational problem - can't isolate argon supply from filter regeneration	no
								fails closed	no hazard	safe	operational problem - no argon supply for filter regeneration	no
MV	238	Ar	SHT-1	4-	E	argon supply isolation	manual valve	fails open	no hazard	safe	operational problem	no
								fails closed	no hazard	safe	operational problem - no argon gas supply	no
SP	239	N2	SHT-1	3-	F	nitrogen gas supply	particulate filter	plugs	no hazard	safe	operational problem - no nitrogen gas supply to analyzers	no
SP	240	N2	SHT-1	3-	F	nitrogen gas supply	Y-strainer (particulate filter)	plugs	no hazard	safe	operational problem - no nitrogen gas supply filter regeneration	no
SP	241	Har	SHT-1	3-	F	hydrogen argon gas supply	Y-strainer (particulate filter)	plugs	no hazard	safe	operational problem - no hydrogen/argon gas supply filter regeneration	no
SP	242	Ar	SHT-1	3-	F	argon gas supply @ regen header	Y-strainer (particulate filter)	plugs	no hazard	safe	operational problem - no argon gas supply filter regeneration	no

Instr Code	Tag #	Serv. Code	PID	GRID	LOC	Service Description	Instrument Type	Failure or Error Mode	Hazard or Effect	Hazard Class	Remarks	Operator intervention required*
SP	243	N2	SHT-1	2-	F	nitrogen gas supply	particulate filter	plugs	no hazard	safe	operational problem - no nitrogen gas available for vacuum space bleed up	no
PI	244	N2	SHT-1	2-	F	nitrogen gas supply	pressure indicator	incorrect reading	no hazard	safe	operational problem	no
MV	245	N2	SHT-1	2-	F	nitrogen gas supply	manual valve	fails open	no hazard	safe	operational problem	no
								fails closed	no hazard	safe	operational problem - no nitrogen gas supply for vacuum space bleed up	no
SP	246	Ar	SHT-1	1-	E	argon supply	particulate filter	plugs	no hazard	safe	operational problem - no argon gas available for vacuum space bleed up	no
PI	247	Ar	SHT-1	3-	E	argon supply	pressure indicator	incorrect reading	no hazard	safe	operational problem	no
MV	248	Ar	SHT-1	3-	E	argon supply	manual valve	fails open	no hazard	safe	operational problem	no
								fails closed	no hazard	safe	operational problem - no argon gas supply for vacuum space bleed up	no
MV	249	Ar	SHT-1	3-	E	pneumatic valve actuation	manual valve	fails open	no hazard	safe	operational problem	no
								fails closed	no hazard	safe	operational problem - no argon for any valve actuation	no
PI	250	Ar	SHT-1	2-	E	pneumatic valve actuation	pressure indicator	incorrect reading	no hazard	safe	operational problem	no
MV	251	Ar	SHT-1	2-	E	pneumatic valve actuation	manual valve	fails open	no hazard	safe	operational problem	no
								fails closed	no hazard	safe	operational problem - no argon for valve actuation	no
MV	252	Ar	SHT-1	2-	E	pneumatic valve actuation	manual valve	fails open	no hazard	safe	operational problem	no
								fails closed	no hazard	safe	operational problem - no argon for valve actuation	no
MV	253	Ar	SHT-1	2-	E	pneumatic valve actuation	manual valve	fails open	no hazard	safe	operational problem	no
								fails closed	no hazard	safe	operational problem - no argon for valve actuation	no
MV	254	Ar	SHT-1	2-	E	pneumatic valve actuation	manual valve	fails open	no hazard	safe	operational problem	no
								fails closed	no hazard	safe	operational problem - no argon for valve actuation	no
MV	255	Ar	SHT-1	2-	E	pneumatic valve actuation	manual valve	fails open	no hazard	safe	operational problem	no
								fails closed	no hazard	safe	operational problem - no argon for valve actuation	no
MV	256	Ar	SHT-1	2-	E	TPC signal purge	manual valve	fails open	no hazard	safe	operational problem - can't isolate tank vapor space at source	no
								fails closed	no hazard	safe	operational problem - can't send gas to analyzers	no
SP	258	Ar	SHT-1	3-	C	argon supply	particulate filter	plugs	no hazard	safe	operational problem - no argon supply for various services	no
SP	259	Ar	SHT-1	3-	D	argon supply	particulate filter	plugs	no hazard	safe	operational problem - no argon supply for various services	no
MV	260	Ar	SHT-1	2-	D	argon purges	manual valve	fails open	no hazard	safe	operational problem	no
								fails closed	no hazard	safe	operational problem - potential contamination from lack of purge	no
MV	261	N2	SHT-1	7-	H	LN2 trailer control valve	manual valve	fails open	no hazard	safe	operational problem - can't isolate FCV-225-N2 I/P for service	no
								fails closed	no hazard	safe	operational problem - can't provide LN2 cooling to PC4	no
PRV	262	N2	SHT-1	6-	G	LN2 trailer control valve	pressure regulator	fails open	no hazard	safe	operational problem - excess actuator pressure could lead to excess cooling - other valves available to restrict flow	no
								fails closed	no hazard	safe	operational problem - can't provide LN2 cooling to PC4	no
PI	263	N2	SHT-1	6-	G	LN2 trailer automatic shut off valve	pressure indicator	incorrect reading	no hazard	safe	operational problem	no
PSV	264	N2	SHT-1	2-	G	trapped volume relief inside PC4	relief valve	fails open	LN2 vents inside pc4	safe	ODH analysis takes this into account	no
								fails closed	potential trapped volume	safe	Low probability of a quality Circle Seal relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no

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PI	265	Ar	SHT-1	3-	C	argon utility gas	pressure indicator	incorrect reading	no hazard	safe	operational problem	no
PT	266	Ar	SHT-1	2-	E	argon utility gas	pressure transmitter	incorrect reading	no hazard	safe	operational problem	no
PT	267	B	SHT-2	2-	C	barometric pressure	pressure transmitter	incorrect reading	no hazard	safe	operational problem	no
SP	268	Har	SHT-1	3-	F	H2/Ar dilution	particulate filter	plugs	no hazard	safe	operational problem - no regeneration gas	no
CV	269	Har	SHT-1	3-	F	H2/Ar dilution	check valve	fails open	no hazard	safe	operational problem - contamination backstream possible	no
								fails closed	no hazard	safe	operational problem - filter regeneration not possible	no
MV	270	Har	SHT-1	3-	F	H2/Ar dilution	manual valve	fails open	no hazard	safe	upstream isolation available	no
								fails closed	no hazard	safe	operational problem - oxygen filter regeneration might not be possible	no
SP	271	N2	SHT-1	3-	G	nitrogen purge supply	particulate filter	plugs	no hazard	safe	operational problem - no insulation purges, potential increased heat load	no
MV	272	N2	SHT-1	3-	G	nitrogen purge supply	manual valve	fails open	no hazard	safe	upstream isolation available	no
								fails closed	no hazard	safe	operational problem - no insulation purges, potential increased heat load	no
CV	273	Ar	SHT-1	5-	E	Argon Source #3	check valve	fails open	no hazard	safe	air contamination potentially introduced into pigtail during bottle change	no
								fails closed	no hazard	safe	operational problem - connected argon bottle cannot be used	no
CV	274	Ar	SHT-1	5-	E	Argon Source #3	check valve	fails open	no hazard	safe	air contamination potentially introduced into pigtail during bottle change	no
								fails closed	no hazard	safe	operational problem - connected argon bottle cannot be used	no
CV	275	Ar	SHT-1	5-	E	Argon Source #3	check valve	fails open	no hazard	safe	air contamination potentially introduced into pigtail during bottle change	no
								fails closed	no hazard	safe	operational problem - connected argon bottle cannot be used	no
CV	276	Ar	SHT-1	5-	E	Argon Source #3	check valve	fails open	no hazard	safe	air contamination potentially introduced into pigtail during bottle change	no
								fails closed	no hazard	safe	operational problem - connected argon bottle cannot be used	no
CV	277	Ar	SHT-1	5-	E	Argon Source #2	check valve	fails open	no hazard	safe	air contamination potentially introduced into pigtail during bottle change	no
								fails closed	no hazard	safe	operational problem - connected argon bottle cannot be used	no
CV	278	Ar	SHT-1	5-	E	Argon Source #2	check valve	fails open	no hazard	safe	air contamination potentially introduced into pigtail during bottle change	no
								fails closed	no hazard	safe	operational problem - connected argon bottle cannot be used	no
CV	279	Ar	SHT-1	5-	E	Argon Source #2	check valve	fails open	no hazard	safe	air contamination potentially introduced into pigtail during bottle change	no
								fails closed	no hazard	safe	operational problem - connected argon bottle cannot be used	no
CV	280	Ar	SHT-1	5-	E	Argon Source #2	check valve	fails open	no hazard	safe	air contamination potentially introduced into pigtail during bottle change	no

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								fails closed	no hazard	safe	operational problem - connected argon bottle cannot be used	no
CV	281	Ar	SHT-1	8-	E	Argon Source #1	check valve	fails open	no hazard	safe	air contamination potentially introduced into pigtail during bottle change	no
								fails closed	no hazard	safe	operational problem - connected argon bottle cannot be used	no
CV	282	Ar	SHT-1	8-	D	Argon Source #1	check valve	fails open	no hazard	safe	air contamination potentially introduced into pigtail during bottle change	no
								fails closed	no hazard	safe	operational problem - connected argon bottle cannot be used	no
CV	283	Ar	SHT-1	8-	C	Argon Source #1	check valve	fails open	no hazard	safe	air contamination potentially introduced into pigtail during bottle change	no
								fails closed	no hazard	safe	operational problem - connected argon bottle cannot be used	no
CV	284	Ar	SHT-1	8-	E	Argon Source #1	check valve	fails open	no hazard	safe	air contamination potentially introduced into pigtail during bottle change	no
								fails closed	no hazard	safe	operational problem - connected argon bottle cannot be used	no
MV	285	N2	SHT-1	2-	G	N2 liquid to LAPD	manual valve	fails open	no hazard	safe	operational problem - other points of isolation available	no
								fails closed	no hazard	safe	operational problem - no refrigeration	no
MV	286	AIR	SHT-1	3-	A	breathable air	manual valve	fails open	no hazard	safe	operational problem - other points of isolation available	no
								fails closed	no hazard	safe	operational problem -access point not available	no
SP	287	AIR	SHT-1	3-	A	breathable air	particulate filter	plugs	no hazard	safe	operational problem -no air available at MV-289-AIR	no
PI	288	AIR	SHT-1	3-	A	breathable air	pressure gauge	incorrect reading	no hazard	safe	operational problem	no
MV	289	AIR	SHT-1	3-	A	breathable air	manual valve	fails open	no hazard	safe	operational problem - other points of isolation available	no
								fails closed	no hazard	safe	operational problem - no refrigeration	no
SP	290	AIR	SHT-1	3-	A	breathable air	particulate filter	plugs	no hazard	safe	operational problem -no air available at MV-292-AIR	no
PI	291	AIR	SHT-1	3-	A	breathable air	pressure gauge	incorrect reading	no hazard	safe	operational problem	no
MV	292	AIR	SHT-1	3-	A	breathable air	manual valve	fails open	no hazard	safe	operational problem - other points of isolation available	no
								fails closed	no hazard	safe	operational problem - no refrigeration	no
CV	293	AIR	SHT-1	6-	C	breathable air	check valve	fails open	no hazard	safe	operational problem - potential back flow into air bottles	no
								fails closed	no hazard	safe	operational problem - connected air bottles cannot be used	no

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PI	294	AIR	SHT-1	6-	C	breathable air	pressure indicator	incorrect reading	no hazard	safe	operational problem	no
MV	295	AIR	SHT-1	5-	C	breathable air	manual valve	fails open	no hazard	safe	air vents in gas shed - operational problem	no
								fails closed	no hazard	safe	4 Air bottles isolated - operational problem	no
PI	296	AIR	SHT-1	5-	C	breathable air	pressure indicator	incorrect reading	no hazard	safe	operational problem	no
CV	297	AIR	SHT-1	5-	C	breathable air	check valve	fails open	no hazard	safe	operational problem - potential back flow into air bottles	no
								fails closed	no hazard	safe	operational problem - connected air bottles cannot be used	no
AE	298	Ar	SHT-2	4-	D	piston purge	oxygen sensor 1/3 elevation	incorrect reading	no hazard	safe	operational problem	no
AE	299	Ar	SHT-2	4-	D	piston purge	oxygen sensor 1/3 elevation	incorrect reading	no hazard	safe	operational problem	no
FCVE	300	Ar	SHT-2	7-	B	argon purge gas from HP Ar	gas mass flow control valve	incorrect reading	no hazard	safe	operational problem - purge could be faster or slower than anticipated	
								fails closed	no hazard	safe	operational problem - can't purge air from tank	
								fails open	no hazard	safe	operational problem - can't atop argon purge, possible contamination problem	
SP	301	N2	SHT-2	7-	G	liq. N2 from N2 trailer to phase sep. indoor section	Y-strainer	plugs	loss of pressure control	safe	operational problem - loss of refrigeration	no
MV	302	N2	SHT-2	8-	G	liq. N2 from N2 trailer to phase sep. indoor section	manual shutoff valve	fails open	no hazard	safe	operational problem - other points of isolation available	no
								fails closed	no hazard	safe	operational problem - no refrigeration	no
PI	303	N2	SHT-2	7-	G	liq. N2 from N2 trailer to phase sep. indoor section	local pressure indicator	incorrect reading	no hazard	safe	operational problem	no
PT	304	N2	SHT-2	7-	G	liq. N2 from N2 trailer to phase sep. indoor section	pressure transmitter	incorrect reading	no hazard	safe	operational problem	no
FCV	305	N2	SHT-2	7-	G	liq. N2 from N2 trailer to phase sep. indoor section	flow control valve	fails open	no hazard	safe	operational problem - other points of isolation available	no
								fails closed	no hazard	safe	operational problem - no refrigeration	no
PSV	306	N2	SHT-2	7-	G	vicinity of phase sep	relief valve trapped volume	fails open	LN2 vents inside PC4	safe	operational problem - potential loss of refrigeration, ODH analysis includes this venting probability, AV-225-N2 will close in the event of ODH alarm	no
								fails closed	potential trapped volume	safe	Low probability of a quality Circle Seal relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
PT	307	N2	SHT-2	6-	G	phase sep vent to vent header	pressure transmitter	incorrect reading	no hazard	safe	operational problem	no
PI	309	N2	SHT-2	6-	G	phase sep vent to vent header	pressure indicator	incorrect reading	no hazard	safe	operational problem	no
PRV	310	N2	SHT-2	7-	H	phase sep vent to vent header	back pressure regulator	fails open	no hazard	safe	operational problem - phase separator depressurizes leading to loss of refrigeration	no
								fails closed	no hazard	safe	operational problem - no refrigeration	no
PSV	311	N2	SHT-2	7-	G	phase separator vessel	vessel overpressure relief valve	fails open	LN2 vents inside PC4	safe	operational problem - potential loss of refrigeration, ODH analysis includes this venting probability, AV-225-N2 will close in the event of ODH alarm	no
								fails closed	potential trapped volume	safe	Low probability of a quality ASME code certified relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no

Instr Code	Tag #	Serv. Code	PID	GRID	LOC	Service Description	Instrument Type	Failure or Error Mode	Hazard or Effect	Hazard Class	Remarks	Operator intervention required*
FCV	312	N2	SHT-2	6-	F	liq N2 from phase separator condenser	flow control valve	fails open	no hazard	safe	operational problem - other points of isolation available	no
								fails closed	no hazard	safe	operational problem - no refrigeration	no
MV	313	N2	SHT-2	6-	G	phase separator vessel	manual valve	fails open	no hazard	safe	operational problem for instrument service	no
								fails closed	no hazard	safe	operational problem - potential instrumentation problem	no
MV	314	N2	SHT-2	7-	G	phase separator vessel	manual valve	fails open	no hazard	safe	operational problem for instrument service	no
								fails closed	no hazard	safe	operational problem - potential instrumentation problem	no
MV	315	N2	SHT-2	6-	G	phase separator vessel	manual valve	fails open	no hazard	safe	operational problem for instrument service	no
								fails closed	no hazard	safe	operational problem - potential instrumentation problem	no
LT	316	N2	SHT-2	6-	G	phase separator vessel	level transmitter (pressure differential)	incorrect reading	no hazard	safe	operational problem - may cause refrigeration issues	no
PSV	317	N2	SHT-2	6-	F	liq N2 from phase separator condenser	relief valve trapped volume	fails open	LN2 vents inside PC4	safe	operational problem - potential loss of refrigeration, ODH analysis includes this venting probability	no
								fails closed	potential trapped volume	safe	Low probability of a quality Circle Seal relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
MV	318	Ar	SHT-2	4-	D	LAPD nozzle air impurity purge vent	manual valve	fails open	no hazard	safe	operational problem - can't isolate tank vapor space at source	no
								fails closed	no hazard	safe	operational problem - can't send gas to analyzers	no
SV	319	N2	SHT-2	6-	G	liq N2 from phase separator condenser coil #3	solenoid valve	fails open	no hazard	safe	operational problem - potential refrigeration issues, isolation available at other points	no
								fails closed	no hazard	safe	operational problem - potential refrigeration issues	no
SV	320	N2	SHT-2	6-	F	liq N2 from phase separator condenser coil #2	solenoid valve	fails open	no hazard	safe	operational problem - potential refrigeration issues, isolation available at other points	no
								fails closed	no hazard	safe	operational problem - potential refrigeration issues	no
SV	321	N2	SHT-2	6-	F	liq N2 from phase separator condenser coil #1	solenoid valve	fails open	no hazard	safe	operational problem - potential refrigeration issues, isolation available at other points	no
								fails closed	no hazard	safe	operational problem - potential refrigeration issues	no
MV	322	Ar	SHT-2	7-	C	LAPD tank level	manual valve	fails open	no hazard	safe	operational problem - instrument can't be isolated	no
								fails closed	no hazard	safe	operational problem - instrument error, tank has redundant level instrumentation	no
LIT	323	Ar	SHT-2	7-	C	LAPD tank level	differential pressure indicator	incorrect reading	no hazard	safe	operational problem - tank has redundant level instrumentation	no
MV	324	Ar	SHT-2	7-	C	LAPD tank level	manual valve	fails open	no hazard	safe	operational problem - instrument can't be isolated	no
								fails closed	no hazard	safe	operational problem - instrument error, tank has redundant level instrumentation	no
MV	325	Ar	SHT-2	6-	C	LAPD tank level	manual valve	fails open	no hazard	safe	operational problem - instrument can't be isolated	no
								fails closed	no hazard	safe	operational problem - instrument error, tank has redundant level instrumentation	no
LT	326	Ar	SHT-2	6-	C	LAPD tank liquid level	differential pressure transmitter	incorrect reading	no hazard	safe	operational problem - tank has redundant level instrumentation	no
MV	327	Ar	SHT-2	6-	C	LAPD tank level	manual valve	fails open	no hazard	safe	operational problem - instrument can't be isolated	no
								fails closed	no hazard	safe	operational problem - instrument error, tank has redundant level instrumentation	no
MV	328	Ar	SHT-2	6-	C	LAPD tank level	manual valve	fails open	no hazard	safe	operational problem - dP instruments won't ready correctly	no
								fails closed	no hazard	safe	operational problem - instrument can't be properly equalized	no
PSV	329	Ar	SHT-2	4-	F	Pump cool down trapped volume	relief valve	fails open	LAr vents inside PC4	safe	operational problem - ODH analysis includes this venting probability, pump will shut off in the event of an odh event isolating the liquid source	no

Instr Code	Tag #	Serv. Code	PID	GRID	LOC	Service Description	Instrument Type	Failure or Error Mode	Hazard or Effect	Hazard Class	Remarks	Operator intervention required*
								fails closed	potential trapped volume	safe	Low probability of a quality ASME code certified relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
MV	330	Ar	SHT-2	5-	B	argon purge gas from HP Ar to LAPD tank	manual valve	fails open	no hazard	safe	operational problem - tank can't be isolated, other isolation available	no
								fails closed	no hazard	safe	operational problem - instrument errors, tank can't be purged	no
PT	332	N2	SHT-2	5-	G	N2 vent from condenser	pressure transmitter	incorrect reading	no hazard	safe	operational problem	no
MV	333	N2	SHT-2	5-	G	N2 vent from condenser	manual valve	fails open	no hazard	safe	operational problem - can't close valve for pressure testing	no
								fails closed	no hazard	safe	operational problem -loss of refrigeration	no
PSV	334	Ar	SHT-2	4-	G	condenser	vessel overpressure relief valve	fails open	Ar vents into PC4	safe	operational problem - Loss of tank pressure control. ODH analysis tanks this venting probability into account	no
								fails closed	potential trapped volume	safe	Low probability of a quality ASME code certified relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
PSV	335	N2	SHT-2	5-	G	condenser	relief valve	fails open	LN2 vents into PC4	safe	operational problem - ODH analysis tanks this venting probability into account	no
								fails closed	potential trapped volume	safe	Low probability of a quality ASME code certified relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
CV	338	Ar	SHT-2	7-	B	argon purge gas from HP Ar	check valve	fails open	no hazard	safe	operational problem - other points of isolation available	no
								fails closed	no hazard	safe	operational problem - can't purge tank	no
MV	339	Ar	SHT-2	6-	B	argon purge gas from HP Ar	manual valve	fails open	no hazard	safe	operational problem - CV-338-Ar provides back flow isolation, other valves provide isolation for repair	no
								fails closed	no hazard	safe	operational problem - can't purge air from tank	no
MV	340	Ar	SHT-2	6-	B	argon purge gas from HP Ar blow down	manual valve	fails open	no hazard	safe	operational problem - CV-338-Ar provides back flow isolation, other valves provide isolation for repair	no
								fails closed	no hazard	safe	operational problem - can't purge air from tank	no
MV	341	Ar	SHT-2	4-	E	LAPD nozzle air impurity purge vent	manual valve	fails open	no hazard	safe	operational problem - can't isolate source for contamination studies	no
								fails closed	no hazard	safe	operational problem - can't remove contamination from nozzle A	no
FCV	342	N2	SHT-2	7-	E	insulation purges	rotameter	incorrect reading	no hazard	safe	operational problem - potential insulation damage from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive nitrogen gas usage	no
								fails closed	insulation damage	safe	operational damage - foam insulation would eventually be compromised by water without a dry nitrogen purge	no
MV	343	Ar	SHT-2	4-	E	LAPD nozzle air impurity purge vent	manual valve	fails open	no hazard	safe	operational problem - can't isolate source for contamination studies	no
								fails closed	no hazard	safe	operational problem - can't remove contamination from nozzle B	no
FCV	344	N2	SHT-2	7-	E	insulation purges	rotameter	incorrect reading	no hazard	safe	operational problem - potential insulation damage from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive nitrogen gas usage	no
								fails closed	insulation damage	safe	operational damage - foam insulation would eventually be compromised by water without a dry nitrogen purge	no
FCV	345	N2	SHT-2	7-	E	insulation purges	rotameter	incorrect reading	no hazard	safe	operational problem - potential insulation damage from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive nitrogen gas usage	no

Instr Code	Tag #	Serv. Code	PID	GRID	LOC	Service Description	Instrument Type	Failure or Error Mode	Hazard or Effect	Hazard Class	Remarks	Operator intervention required*
								fails closed	insulation damage	safe	operational damage - foam insulation would eventually be compromised by water without a dry nitrogen purge	no
MV	346	Ar	SHT-2	4-	D	LAPD nozzle ar impurity purge vent	manual valve	fails open	no hazard	safe	operational problem - can't isolate source for contamination studies	no
								fails closed	no hazard	safe	operational problem - can't remove contamination from nozzle C riser	no
MV	347	Ar	SHT-2	3-	E	LAPD nozzle ar impurity purge vent	manual valve	fails open	no hazard	safe	operational problem - can't isolate source for contamination studies	no
								fails closed	no hazard	safe	operational problem - can't remove contamination from nozzle E riser	no
FCV	348	N2	SHT-2	7-	E	insulation purges	rotameter	incorrect reading	no hazard	safe	operational problem - potential insulation damage from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive nitrogen gas usage	no
								fails closed	insulation damage	safe	operational damage - foam insulation would eventually be compromised by water without a dry nitrogen purge	no
FCV	349	N2	SHT-2	7-	E	insulation purges	rotameter	incorrect reading	no hazard	safe	operational problem - potential insulation damage from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive nitrogen gas usage	no
								fails closed	insulation damage	safe	operational damage - foam insulation would eventually be compromised by water without a dry nitrogen purge	no
MV	350	Ar	SHT-2	4-	E	tank vent	manual valve	fails open	no hazard	safe	operational problem - can't isolate PCV-351-Ar from tank	no
								fails closed	no hazard	safe	operational problem - can't vent thru PCV-351-Ar, PSV-377-Ar can handle any venting scenario	no
PCV	351	Ar	SHT-2	4-	E	LAPD pressure control vent	pressure control valve	fails open	no hazard	safe	operational problem - tank may depressurize	no
								fails closed	no hazard	safe	operational problem - can't vent excess pressure, PSV-377-Ar can handle any venting scenario	no
SV	351	Ar	SHT-2	4-	E	PCV-351-Ar	solenoid valve	fails open	no hazard	safe	operational problem - tank may depressurize	no
								fails closed	no hazard	safe	operational problem - can't vent excess pressure, PSV-377-Ar can handle any venting scenario	no
MV	353	Ar	SHT-2	4-	E	LAPD pressure control vent	manual valve	fails open	no hazard	safe	operational problem - can't isolate source for contamination studies	no
								fails closed	no hazard	safe	operational problem - can't remove contamination from nozzle L riser	no
MV	354	Ar	SHT-2	4-	E	LAPD pressure control vent	manual valve	fails open	no hazard	safe	operational problem - tank may depressurize	no
								fails closed	no hazard	safe	operational problem - can't manually vent tank, PSV-377-Ar can handle any venting scenario	no
FO	355-X	Ar	SHT-2	3-	E	tank riser diffusion purge	orifice	plugs	no hazard	safe	operational problem - potential contamination	no
PI	358	Ar	SHT-2	3-	E	suction line to vent purge bellows pump	local pressure indicator	incorrect reading	no hazard	safe	operational problem - pump flow may be misunderstood	no
PT	359	Ar	SHT-2	3-	E	suction line to vent purge bellows pump	pressure transmitter	incorrect reading	no hazard	safe	operational problem - pump flow may be misunderstood	no
FCV	360	N2	SHT-2	7-	E	insulation purges	rotameter	incorrect reading	no hazard	safe	operational problem - potential insulation damage from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive nitrogen gas usage	no
								fails closed	insulation damage	safe	operational damage - foam insulation would eventually be compromised by water without a dry nitrogen purge	no
PSV	361	Ar	SHT-2	3-	E	vent purge bellows pump outlet	relief valve	fails open	no hazard	safe	operational problem - argon gas vents into PC4, ODH analysis takes this into account	no
								fails closed	bellows pump fails due to high discharge pressure	safe	operational problem - argon gas vents into PC4, ODH analysis takes this into account	no
PI	362	Ar	SHT-2	2-	E	vent purge bellows pump outlet	local pressure indicator	incorrect reading	no hazard	safe	operational problem - pump flow may be misunderstood	no

LAPD - FMEA

Instr Code	Tag #	Serv. Code	PID	GRID	LOC	Service Description	Instrument Type	Failure or Error Mode	Hazard or Effect	Hazard Class	Remarks	Operator intervention required*
PT	363	Ar	SHT-2	2-	E	vent purge bellows pump outlet	pressure transmitter	incorrect reading	no hazard	safe	operational problem - pump flow may be misunderstood	no
MV	364	Ar	SHT-2	2-	E	vent purge bellows pump discharge to vent header	manual valve	fails open	no hazard	safe	operational problem - other valves can provide isolation for repair	no
								fails closed	no hazard	safe	operational problem - can't send bellows pumped Gar to condenser	no
AE	365	V	SHT-2	3-	C	LAPD tank insulation	moisture analyzer and temperature sensor	incorrect reading	no hazard	safe	operational problem - tank insulation may be compromised	no
FCV	366	N2	SHT-2	7-	E	insulation purges	rotameter	incorrect reading	no hazard	safe	operational problem - potential insulation damage from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive nitrogen gas usage	no
								fails closed	insulation damage	safe	operational damage - foam insulation would eventually be compromised by water without a dry nitrogen purge	no
MV	367	Ar	SHT-2	2-	C	argon liquid return from filtration to tank	manual valve	fails open	no hazard	safe	operational problem - can't isolate pumped loop return at tank	no
								fails closed	no hazard	safe	operational problem - can't return purified liquid to tank	no
MV	368	Ar	SHT-2	3-	B	LAPD tank liquid to filtration pump	manual valve	fails open	no hazard	safe	operational problem - can't isolate pumped loop supply at tank	no
								fails closed	no hazard	safe	operational problem - can't supply liquid argon to pump	no
PT	369	Ar	SHT-2	4-	D	LAPD tank vapor pressure transmitter #1	pressure transmitter	incorrect reading	no hazard	safe	operational problem - may cause loss of tank pressure control, PSV-377-Ar provides both pressure and vacuum relief	no
PT	370	Ar	SHT-2	4-	D	LAPD tank vapor pressure transmitter #2	pressure transmitter	incorrect reading	no hazard	safe	operational problem - may cause loss of tank pressure control, PSV-377-Ar provides both pressure and vacuum relief	no
FCV	371	N2	SHT-2	7-	E	insulation purges	rotameter	incorrect reading	no hazard	safe	operational problem - potential insulation damage from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive nitrogen gas usage	no
								fails closed	insulation damage	safe	operational damage - foam insulation would eventually be compromised by water without a dry nitrogen purge	no
MV	372	Ar	SHT-2	5-	F	condenser liq overflow to LAPD tank	manual valve	fails open	no hazard	safe	operational problem - can't send condensed liquid argon to pumped purification loop	no
								fails closed	no hazard	safe	operational problem - can't send condensed liquid argon to tank without passing thru purification loop	no
FCV	373	N2	SHT-2	7-	E	insulation purges	rotameter	incorrect reading	no hazard	safe	operational problem - potential insulation damage from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive nitrogen gas usage	no
								fails closed	insulation damage	safe	operational damage - foam insulation would eventually be compromised by water without a dry nitrogen purge	no
FCV	374	N2	SHT-2	7-	E	insulation purges	rotameter	incorrect reading	no hazard	safe	operational problem - potential insulation damage from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive nitrogen gas usage	no
								fails closed	insulation damage	safe	operational damage - foam insulation would eventually be compromised by water without a dry nitrogen purge	no
MV	375	Ar	SHT-2	4-	D	LAPD nozzle air impurity purge vent	manual valve	fails open	no hazard	safe	operational problem - can't isolate source for contamination studies	no
								fails closed	no hazard	safe	operational problem - can't remove contamination from nozzle C riser	no
FO	376	Ar	SHT-2	4-	E	tank riser diffusion purge	orifice	plugs	no hazard	safe	operational problem - potential contamination	no
PSV	377	Ar	SHT-2	3-	D	LAPD tank relief vent	relief valve	fails open	no hazard	safe	operational problem - argon vapor vents outside and tank de-pressurizes	no
								fails closed	tank over pressurized	safe	Low probability of a quality relief valve failing shut.	no
PRV	378	N2	SHT-2	7-	F	nitrogen to tank insulation	pressure regulator	fails open	no hazard	safe	operational problem - potential excessive nitrogen gas consumption due to elevated flowmeter inlet pressure	no
								fails closed	no hazard	safe	operational problem - potential insulation damage from lack of purge	no
PI	379	N2	SHT-2	7-	F	nitrogen to tank insulation	pressure indicator on regulator	incorrect reading	no hazard	safe	operational problem	no

Instr Code	Tag #	Serv. Code	PID	GRID	LOC	Service Description	Instrument Type	Failure or Error Mode	Hazard or Effect	Hazard Class	Remarks	Operator intervention required*
PI	380	N2	SHT-2	7-	F	nitrogen to tank insulation	pressure indicator on regulator	incorrect reading	no hazard	safe	operational problem	no
FO	381	Ar	SHT-2	4-	E	tank riser diffusion purge	orifice	plugs	no hazard	safe	operational problem - potential contamination	no
FCV	382	N2	SHT-2	7-	F	nitrogen to tank insulation	rotameter	incorrect reading	no hazard	safe	operational problem - potential insulation damage from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive nitrogen gas usage	no
								fails closed	insulation damage	safe	operational damage - foam insulation would eventually be compromised by water without a dry nitrogen purge	no
FO	383	Ar	SHT-2	3-	D	tank riser diffusion purge	orifice	plugs	no hazard	safe	operational problem - potential contamination	no
MV	384	Ar	SHT-2	5-	C	LAPD tank vapor isolation	manual valve	fails open	no hazard	safe	operational problem - other valves can provide isolation	no
								fails closed	no hazard	safe	operational problem - dP tank level instrumentation will stop working	no
HTR	385	Ar	SHT-2	5-	B	LAPD tank	tank heater #1	OFF	no hazard	safe	operational problem - can't heat tank shell during gas purge and gas recirculation	no
								ON	heater and insulation damage	safe	Heater will eventually fail when on indefinitely at full power and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
HTR	386	Ar	SHT-2	5-	B	LAPD tank	tank heater #2	OFF	no hazard	safe	operational problem - can't heat tank shell during gas purge and gas recirculation	no
								ON	heater and insulation damage	safe	Heater will eventually fail when on indefinitely at full power and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
HTR	387	Ar	SHT-2	4-	B	LAPD tank	tank heater #3	OFF	no hazard	safe	operational problem - can't heat tank shell during gas purge and gas recirculation	no
								ON	heater and insulation damage	safe	Heater will eventually fail when on indefinitely at full power and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
HTR	388	Ar	SHT-2	4-	B	LAPD tank	tank heater #4	OFF	no hazard	safe	operational problem - can't heat tank shell during gas purge and gas recirculation	no
								ON	heater and insulation damage	safe	Heater will eventually fail when on indefinitely at full power and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
HTR	389	Ar	SHT-2	4-	B	LAPD tank	tank heater #5	OFF	no hazard	safe	operational problem - can't heat tank shell during gas purge and gas recirculation	no
								ON	heater and insulation damage	safe	Heater will eventually fail when on indefinitely at full power and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
HTR	390	Ar	SHT-2	4-	B	LAPD tank	tank heater #6	OFF	no hazard	safe	operational problem - can't heat tank shell during gas purge and gas recirculation	no
								ON	heater and insulation damage	safe	Heater will eventually fail when on indefinitely at full power and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
HTR	391	Ar	SHT-2	4-	B	LAPD tank	tank heater #7	OFF	no hazard	safe	operational problem - can't heat tank shell during gas purge and gas recirculation	no
								ON	heater and insulation damage	safe	Heater will eventually fail when on indefinitely at full power and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
HTR	392	Ar	SHT-2	4-	B	LAPD tank	tank heater #8	OFF	no hazard	safe	operational problem - can't heat tank shell during gas purge and gas recirculation	no
								ON	heater and insulation damage	safe	Heater will eventually fail when on indefinitely at full power and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
HTR	393	Ar	SHT-2	4-	B	LAPD tank	tank heater #9	OFF	no hazard	safe	operational problem - can't heat tank shell during gas purge and gas recirculation	no
								ON	heater and insulation damage	safe	Heater will eventually fail when on indefinitely at full power and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
HTR	394	Ar	SHT-2	4-	B	LAPD tank	tank heater #10	OFF	no hazard	safe	operational problem - can't heat tank shell during gas purge and gas recirculation	no
								ON	heater and insulation damage	safe	Heater will eventually fail when on indefinitely at full power and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
HTR	395	Ar	SHT-2	4-	B	LAPD tank	tank heater #11	OFF	no hazard	safe	operational problem - can't heat tank shell during gas purge and gas recirculation	no
								ON	heater and insulation damage	safe	Heater will eventually fail when on indefinitely at full power and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no

Instr Code	Tag #	Serv. Code	PID	GRID	LOC	Service Description	Instrument Type	Failure or Error Mode	Hazard or Effect	Hazard Class	Remarks	Operator intervention required*
HTR	396	Ar	SHT-2	5-	B	LAPD tank	tank heater #12	OFF	no hazard	safe	operational problem - can't heat tank shell during gas purge and gas recirculation	no
								ON	heater and insulation damage	safe	Heater will eventually fail when on indefinitely at full power and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
HTR	397	Ar	SHT-2	5-	B	LAPD tank	tank heater #13	OFF	no hazard	safe	operational problem - can't heat tank shell during gas purge and gas recirculation	no
								ON	heater and insulation damage	safe	Heater will eventually fail when on indefinitely at full power and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
HTR	398	Ar	SHT-2	5-	B	LAPD tank	tank heater #14	OFF	no hazard	safe	operational problem - can't heat tank shell during gas purge and gas recirculation	no
								ON	heater and insulation damage	safe	Heater will eventually fail when on indefinitely at full power and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
HTR	399	Ar	SHT-2	3-	B	LAPD tank	tank heater #15	OFF	no hazard	safe	operational problem - can't heat tank shell during gas purge and gas recirculation	no
								ON	heater and insulation damage	safe	Heater will eventually fail when on indefinitely at full power and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
HTR	400	Ar	SHT-2	4-	B	LAPD tank	tank heater #16	OFF	no hazard	safe	operational problem - can't heat tank shell during gas purge and gas recirculation	no
								ON	heater and insulation damage	safe	Heater will eventually fail when on indefinitely at full power and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
HTR	401	Ar	SHT-2	4-	B	LAPD tank	tank heater #17	OFF	no hazard	safe	operational problem - can't heat tank shell during gas purge and gas recirculation	no
								ON	heater and insulation damage	safe	Heater will eventually fail when on indefinitely at full power and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
HTR	402	Ar	SHT-2	4-	B	LAPD tank	tank heater #18	OFF	no hazard	safe	operational problem - can't heat tank shell during gas purge and gas recirculation	no
								ON	heater and insulation damage	safe	Heater will eventually fail when on indefinitely at full power and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
HTR	403	Ar	SHT-2	4-	B	LAPD tank	tank heater #19	OFF	no hazard	safe	operational problem - can't heat tank shell during gas purge and gas recirculation	no
								ON	heater and insulation damage	safe	Heater will eventually fail when on indefinitely at full power and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
HTR	404	Ar	SHT-2	4-	B	LAPD tank	tank heater #20	OFF	no hazard	safe	operational problem - can't heat tank shell during gas purge and gas recirculation	no
								ON	heater and insulation damage	safe	Heater will eventually fail when on indefinitely at full power and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
HTR	405	Ar	SHT-2	4-	B	LAPD tank	tank heater #21	OFF	no hazard	safe	operational problem - can't heat tank shell during gas purge and gas recirculation	no
								ON	heater and insulation damage	safe	Heater will eventually fail when on indefinitely at full power and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
HTR	406	Ar	SHT-2	4-	B	LAPD tank	tank heater #22	OFF	no hazard	safe	operational problem - can't heat tank shell during gas purge and gas recirculation	no
								ON	heater and insulation damage	safe	Heater will eventually fail when on indefinitely at full power and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
HTR	407	Ar	SHT-2	3-	B	LAPD tank	tank heater #23	OFF	no hazard	safe	operational problem - can't heat tank shell during gas purge and gas recirculation	no
								ON	heater and insulation damage	safe	Heater will eventually fail when on indefinitely at full power and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
HTR	408	Ar	SHT-2	3-	B	LAPD tank	tank heater #24	OFF	no hazard	safe	operational problem - can't heat tank shell during gas purge and gas recirculation	no
								ON	heater and insulation damage	safe	Heater will eventually fail when on indefinitely at full power and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
TE	409	Ar	SHT-2	5-	B	LAPD tank (base)	100 ohm platinum RTD	incorrect reading	heater damage	safe	Heater will eventually fail when on indefinitely at full power due to TE failure and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
TE	410	Ar	SHT-2	5-	B	LAPD tank (base)	100 ohm platinum RTD	incorrect reading	heater damage	safe	Heater will eventually fail when on indefinitely at full power due to TE failure and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
TE	411	Ar	SHT-2	5-	B	LAPD tank (base)	100 ohm platinum RTD	incorrect reading	heater damage	safe	Heater will eventually fail when on indefinitely at full power due to TE failure and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no

Instr Code	Tag #	Serv. Code	PID	GRID	LOC	Service Description	Instrument Type	Failure or Error Mode	Hazard or Effect	Hazard Class	Remarks	Operator intervention required*
TE	412	Ar	SHT-2	4-	C	LAPD tank (midpoint)	100 ohm platinum RTD	incorrect reading	heater damage	safe	Heater will eventually fail when on indefinitely at full power due to TE failure and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
TE	413	Ar	SHT-2	4-	B	LAPD tank (base)	100 ohm platinum RTD	incorrect reading	heater damage	safe	Heater will eventually fail when on indefinitely at full power due to TE failure and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
TE	414	Ar	SHT-2	4-	B	LAPD tank (base)	100 ohm platinum RTD	incorrect reading	heater damage	safe	Heater will eventually fail when on indefinitely at full power due to TE failure and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
MV	415	N2	SHT-2	7-	F	nitrogen to tank insulation	manual valve	fails open	no hazard	safe	operational problem - refrigeration would have to be suspended to provide isolation	no
								fails closed	insulation damage	safe	operational damage - Foam insulation would eventually be compromised by water without a dry nitrogen purge	no
FCV	417	N2	SHT-2	7-	F	nitrogen to tank insulation	rotameter	incorrect reading	no hazard	safe	operational problem - potential insulation damage from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive nitrogen gas usage	no
								fails closed	insulation damage	safe	operational damage - foam insulation would eventually be compromised by water without a dry nitrogen purge	no
TE	418	Ar	SHT-2	4-	B	LAPD tank (base)	100 ohm platinum RTD	incorrect reading	heater damage	safe	Heater will eventually fail when on indefinitely at full power due to TE failure and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
TE	419	Ar	SHT-2	4-	C	LAPD tank (midpoint)	100 ohm platinum RTD	incorrect reading	heater damage	safe	Heater will eventually fail when on indefinitely at full power due to TE failure and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
TE	420	Ar	SHT-2	4-	B	LAPD tank (base)	100 ohm platinum RTD	incorrect reading	heater damage	safe	Heater will eventually fail when on indefinitely at full power due to TE failure and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
TE	421	Ar	SHT-2	4-	B	LAPD tank (base)	100 ohm platinum RTD	incorrect reading	heater damage	safe	Heater will eventually fail when on indefinitely at full power due to TE failure and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
TE	422	Ar	SHT-2	4-	B	LAPD tank (base)	100 ohm platinum RTD	incorrect reading	heater damage	safe	Heater will eventually fail when on indefinitely at full power due to TE failure and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
TE	423	Ar	SHT-2	3-	C	LAPD tank (midpoint)	100 ohm platinum RTD	incorrect reading	heater damage	safe	Heater will eventually fail when on indefinitely at full power due to TE failure and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
MV	427	Ar	SHT-2	6-	C	LAPD tank level	manual valve	fails open	no hazard	safe	outlet is capped for future use	no
								fails closed	no hazard	safe	outlet is capped for future use	no
MV	428	Ar	SHT-2	4-	D	LAPD tank sample line	manual valve	fails open	no hazard	safe	operational problem - can't isolate tank vapor space at source	no
								fails closed	no hazard	safe	operational problem - can't send gas to analyzers	no
FO	429	Ar	SHT-2	3-	D	tank riser diffusion purge	orifice	plugs	no hazard	safe	operational problem - potential contamination	no
FO	430	Ar	SHT-2	3-	D	tank riser diffusion purge	orifice	plugs	no hazard	safe	operational problem - potential contamination	no
PI	431	Ar	SHT-2	6-	E	tank pressure makeup	pressure indicator	incorrect reading	no hazard	safe	operational problem	no
AV	432	Ar	SHT-2	6-	E	tank pressure makeup	automatic valve	fails open	contamination & excess tank pressure	safe	operational problem - large quantities of unfiltered argon gas will contaminate tank, any excess pressure will be vented by PSV-377-Ar and PCV-351-Ar	no
								fails closed	contamination	safe	operational problem - without argon make up gas tank relief is more likely to pull in air	no
SV	432	Ar	SHT-2	6-	E	AV-432-Ar	solenoid valve	fails open	contamination & excess tank pressure	safe	operational problem - large quantities of unfiltered argon gas will contaminate tank, any excess pressure will be vented by PSV-377-Ar and PCV-351-Ar	no
								fails closed	contamination	safe	operational problem - without argon make up gas tank relief is more likely to pull in air	no
MV	433	Ar	SHT-2	5-	E	tank pressure makeup	manual valve	fails open	no hazard	safe	operational problem	no
								fails closed	contamination	safe	operational problem - without argon make up gas tank relief is more likely to pull in air	no
MV	434	Ar	SHT-2	4-	F	LAPD tank vent to condenser	manual valve	fails open	no hazard	safe	operational problem - other valves provide isolation	no
								fails closed	no hazard	safe	operational problem - can't send pump vapor to condenser	no
PI	435	Ar	SHT-2	4-	F	LAPD tank vent to condenser	manual valve	incorrect reading	no hazard	safe	operational problem	no
MV	436	Ar	SHT-2	3-	E	bellows pump isolation	manual valve	fails open	no hazard	safe	operational problem - other valves provide isolation	no

Instr Code	Tag #	Serv. Code	PID	GRID	LOC	Service Description	Instrument Type	Failure or Error Mode	Hazard or Effect	Hazard Class	Remarks	Operator intervention required*
								fails closed	no hazard	safe	operational problem - can't pump vapor	no
MV	437	Ar	SHT-2	2-	E	vent purge bellows pump sample	manual valve	fails open	no hazard	safe	capped for future use	no
								fails closed	no hazard	safe	capped for future use	no
MV	438	Ar	SHT-2	2-	E	vent purge bellows pump discharge	manual valve	fails open	no hazard	safe	operational problem - vents argon gas into room	no
								fails closed	no hazard	safe	operational problem	no
TE	439	Ar	SHT-2	3-	B	LAPD tank (base)	100 ohm platinum RTD	incorrect reading	heater damage	safe	Heater will eventually fail when on indefinitely at full power due to TE failure and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
TE	440	Ar	SHT-2	3-	B	LAPD tank (base)	100 ohm platinum RTD	incorrect reading	heater damage	safe	Heater will eventually fail when on indefinitely at full power due to TE failure and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
TE	441	Ar	SHT-2	3-	C	LAPD tank (midpoint)	100 ohm platinum RTD	incorrect reading	heater damage	safe	Heater will eventually fail when on indefinitely at full power due to TE failure and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
TE	442	Ar	SHT-2	3-	B	LAPD tank (base)	100 ohm platinum RTD	incorrect reading	heater damage	safe	Heater will eventually fail when on indefinitely at full power due to TE failure and may locally damage the fiberglass insulation. Both the heater and insulation are non-flammable.	no
TE	443	Ar	SHT-2	3-	C	LAPD tank (top - L)	100 ohm platinum RTD	incorrect reading	no hazard	safe	operational problem - poor data for tank model	no
TE	444	Ar	SHT-2	4-	C	LAPD tank (top - E)	100 ohm platinum RTD	incorrect reading	no hazard	safe	operational problem - poor data for tank model	no
TE	445	Ar	SHT-2	4-	C	LAPD tank (top -C)	100 ohm platinum RTD	incorrect reading	no hazard	safe	operational problem - poor data for tank model	no
TE	446	Ar	SHT-2	5-	C	LAPD tank (top - A)	100 ohm platinum RTD	incorrect reading	no hazard	safe	operational problem - poor data for tank model	no
TE	447	Ar	SHT-2	5-	C	LAPD tank (top - B)	100 ohm platinum RTD	incorrect reading	no hazard	safe	operational problem - poor data for tank model	no
TE	448	Ar	SHT-2	3-	C	LAPD tank (top - D)	100 ohm platinum RTD	incorrect reading	no hazard	safe	operational problem - poor data for tank model	no
FCV	449	N2	SHT-2	7-	F	phase separator insulation purge	rotameter	incorrect reading	no hazard	safe	operational problem - potential insulation damage from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive nitrogen gas usage	no
								fails closed	insulation damage	safe	operational damage - foam insulation would eventually be compromised by water without a dry nitrogen purge	no
SV	450	N2	SHT-2	6-	F	liq N2 from phase separator condenser coil #1	solenoid valve	fails open	no hazard	safe	operational problem - potential refrigeration issues, isolation available at other points	no
								fails closed	no hazard	safe	operational problem - potential refrigeration issues	no
FCV	451	N2	SHT-2	7-	F	nitrogen to tank insulation	rotameter	incorrect reading	no hazard	safe	operational problem - potential insulation damage from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive nitrogen gas usage	no
								fails closed	insulation damage	safe	operational damage - foam insulation would eventually be compromised by water without a dry nitrogen purge	no
FCV	452	N2	SHT-2	7-	F	nitrogen to tank insulation	rotameter	incorrect reading	no hazard	safe	operational problem - potential insulation damage from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive nitrogen gas usage	no
								fails closed	insulation damage	safe	operational damage - foam insulation would eventually be compromised by water without a dry nitrogen purge	no
FCV	453	N2	SHT-2	7-	E	nitrogen to tank insulation	rotameter	incorrect reading	no hazard	safe	operational problem - potential insulation damage from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive nitrogen gas usage	no
								fails closed	insulation damage	safe	operational damage - foam insulation would eventually be compromised by water without a dry nitrogen purge	no
FCV	454	N2	SHT-2	7-	E	nitrogen to tank insulation	rotameter	incorrect reading	no hazard	safe	operational problem - potential insulation damage from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive nitrogen gas usage	no
								fails closed	insulation damage	safe	operational damage - foam insulation would eventually be compromised by water without a dry nitrogen purge	no
MV	455	Ar	SHT-2	4-	D	LAPD nozzle ar impurity purge vent	manual valve	fails open	no hazard	safe	operational problem - can't isolate source for contamination studies	no
								fails closed	no hazard	safe	operational problem - can't remove contamination from nozzle C riser	no

Instr Code	Tag #	Serv. Code	PID	GRID	LOC	Service Description	Instrument Type	Failure or Error Mode	Hazard or Effect	Hazard Class	Remarks	Operator intervention required*
MV	456	Ar	SHT-2	4-	D	LAPD nozzle ar impurity purge vent	manual valve	fails open	no hazard	safe	operational problem - can't isolate source for contamination studies	no
								fails closed	no hazard	safe	operational problem - can't remove contamination from nozzle C riser	no
MV	457	Ar	SHT-2	3-	E	LAPD nozzle ar impurity purge vent	manual valve	fails open	no hazard	safe	operational problem - can't isolate source for contamination studies	no
								fails closed	no hazard	safe	operational problem - can't remove contamination from nozzle C riser	no
MV	458	Ar	SHT-2	4-	D	LAPD nozzle ar impurity purge vent	manual valve	fails open	no hazard	safe	operational problem - tank will vent argon gas	no
								fails closed	no hazard	safe	operational problem - can't vent purge	no
MV	459	Ar	SHT-2	3-	E	LAPD nozzle ar impurity purge vent	manual valve	fails open	no hazard	safe	capped for future use	no
								fails closed	no hazard	safe	capped for future use	no
PI	460	Ar	SHT-2	3-	E	bellows pump suction	local pressure indicator	incorrect reading	no hazard	safe	operational problem	no
MV	461	Ar	SHT-2	3-	E	bellows pump suction	manual valve	fails open	no hazard	safe	operational problem - other valves provide isolation	no
								fails closed	no hazard	safe	operational problem - can't pump vapor	no
MV	462	Ar	SHT-2	3-	E	bellows pump suction	manual valve	fails open	no hazard	safe	operational problem - can't isolate restricted vapor path	no
								fails closed	no hazard	safe	operational problem - can't pump thru restricted vapor path	no
PI	463	Ar	SHT-2	3-	E	bellows pump suction	local pressure indicator	incorrect reading	no hazard	safe	operational problem	no
MV	464	Ar	SHT-2	2-	E	bellows pump discharge	manual valve	fails open	no hazard	safe	operational problem - other valves can provide isolation	no
								fails closed	no hazard	safe	operational problem - can't re-circulate gas	no
MV	465	Ar	SHT-2	5-	F	condenser liquid to pump suction	manual valve	fails open	no hazard	safe	operational problem - other valves provide isolation	no
								fails closed	no hazard	safe	operational problem - unfiltered condensed liquid can't be sent to pumped loop for purification	no
MV	466	Ar	SHT-2	4-	F	vapor from tank to condenser	manual valve	fails open	no hazard	safe	operational problem	no
								fails closed	no hazard	safe	operational problem - poor LAr condenser operation	no
FCV	467	N2	SHT-2	7-	E	nitrogen to condenser insulation	rotameter	incorrect reading	no hazard	safe	operational problem - potential insulation damage from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive nitrogen gas usage	no
								fails closed	insulation damage	safe	operational damage - foam insulation would eventually be compromised by water without a dry nitrogen purge	no
PI	468	N2	SHT-2	5-	H	nitrogen to condenser	pressure indicator	incorrect reading	no hazard	safe	operational problem	no
MV	469	N2	SHT-2	7-	G	nitrogen vent	manual valve	fails open	no hazard	safe	operational problem - no instrumentation isolation	no
								fails closed	no hazard	safe	operational problem - vent pressure instrumentation isolated	no
MV	470	N2	SHT-2	6-	G	phase separator vent pressure	manual valve	fails open	no hazard	safe	operational problem - no instrumentation isolation	no
								fails closed	no hazard	safe	operational problem - phase separator instrumentation isolated	no
SP	471	Ar	SHT-2	6-	E	tank make up gas	particulate filter	plugs	no hazard	safe	operational problem - restriction of tank make up gas flow	no
MV	472	Ar	SHT-2	5-	E	tank make up gas vent	manual valve	fails open	no hazard	safe	capped for future use	no
								fails closed	no hazard	safe	capped for future use	no
SP	473	Har	SHT-3	7-	H	regeneration gas	particulate filter	plugs	no hazard	safe	operational problem - regeneration gas flow restricted	no
SP	474	Ar	SHT-3	2-	F	liquid argon fill	particulate filter	plugs	no hazard	safe	operational problem - liquid fill restricted	no
SP	475	Ar	SHT-3	5-	B	liquid argon pump suction	particulate filter	plugs	pump cavitation	safe	Pump suction restriction could create pump cavitation	no
SP	476	Ar	SHT-3	7-	F	liquid return to tank	particulate filter	plugs	no hazard	safe	operational problem - pumped liquid loop restricted	no
MV	477	N2	SHT-2	7-	F	nitrogen purges	manual valve	fails open	no hazard	safe	operational problem	no

Instr Code	Tag #	Serv. Code	PID	GRID	LOC	Service Description	Instrument Type	Failure or Error Mode	Hazard or Effect	Hazard Class	Remarks	Operator intervention required*
								fails closed	insulation damage	safe	potential insulation damage due to moisture from lack of dry nitrogen purge	no
CV	478	Ar	SHT-2	6-	B	argon for tank purge	check valve	fails open	no hazard	safe	operational problem - other valves can provide isolation	no
								fails closed	no hazard	safe	operational problem - pumped gas can't return to the tank	no
SP	479	N2	SHT-2	6-	F	LN2 for condenser	Y-strainer (particulate filter)	plugs	loss of pressure control	safe	operational problem - restriction of tank refrigeration	no
MV	480	Ar	SHT-2	6-	B	tank dp valving vent	manual valve	fails open	no hazard	safe	operational problem - can't take separate tank liquid head and vapor space pressure readings on PI-487-Ar	no
								fails closed	no hazard	safe	operational problem - can't take separate tank liquid head and vapor space pressure readings on PI-487-Ar	no
MV	481	Ar	SHT-2	3-	E	purity monitor diffusion purge	manual valve	fails open	no hazard	safe	operational problem - other valves can provide isolation	no
								fails closed	contamination	safe	operational problem - lack of purity monitor purge may cause contamination	no
MV	482	N2	SHT-2	7-	G	LN2 for condenser	manual valve	fails open	no hazard	safe	operational problem - no isolation for pressure instrumentation	no
								fails closed	contamination	safe	operational problem - loss of nitrogen supply pressure instrumentation	no
SP	484	Ar	SHT-2	4-	D	tank atmospheric breather	particulate filter - sintered metal filter	plugs	no hazard	safe	operational problem	no
MV	485	Ar	SHT-2	6-	D	tank pressure instrumentation valving	manual valve	fails open	no hazard	safe	operational problem - upstream isolation available	no
								fails closed	no hazard	safe	operational problem - tank vapor pressure gage not operational	no
MV	486	Ar	SHT-2	6-	D	tank pressure instrumentation valving	manual valve	fails open	no hazard	safe	operational problem - upstream isolation available	no
								fails closed	no hazard	safe	operational problem - can't purge line	no
PI	487	Ar	SHT-2	6-	D	tank vapor pressure	pressure indicator	incorrect reading	no hazard	safe	operational problem	no
MV	489	Ar	SHT-2	4-	F	condenser Argon side	manual valve	fails open	argon vents into pc4	safe	operational problem - other valves can provide isolation	no
								is	no hazard	safe	operational problem - can't purge line	no
PSV	491	Ar	SHT-2	6-	D	tank pressure instrumentation	relief valve	fails open	Ar vents into PC4	safe	operational problem - tank could dpressurize	no
								fails closed	potential trapped volume	safe	Low probability of a quality ASME code certified relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
AE	492	V	SHT-2	2-	C	ambient	dewpoint transmitter	incorrect reading	no hazard	safe	operational problem	no
TE	493	N2	SHT-2	5-	G	N2 coil vent	100 ohm platinum RTD	incorrect reading	no hazard	safe	operational problem	no
CV	494	N2	SHT-2	8-	F	N2 insulation purges	check valve	fails open	no hazard	safe	operational problem	no
								fails closed	no hazard	safe	operational problem	no
MV	495	N2	SHT-2	8-	F	N2 to FCV isolation	manual valve	fails open	no hazard	safe	operational problem	no
								fails closed	no hazard	safe	operational problem - no N2 to control valves, no tank refrigeration	no
PI	496	Ar	SHT-2	4-	F	Pump cool down	pressure indicator	incorrect reading	no hazard	safe	operational problem	no
PSV	497	Ar	SHT-2	4-	F	Pump cool down trapped volume	relief valve	fails open	Ar vents into PC4	safe	operational problem - tank could dpressurize	no
								fails closed	potential trapped volume	safe	Low probability of a quality ASME code certified relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
MV	498	Ar	SHT-2	4-	F	Pump cool down	manual valve	fails open	Ar vents into PC4	safe	operational problem - tank could dpressurize	no
								fails closed	no hazard	safe	operational problem - can't pump out line, contamination potential	no
MV	499	Ar	SHT-2	4-	F	Pump cool down	manual valve	fails open	no hazard	safe	operational problem - other valves can provide isolation	no

Instr Code	Tag #	Serv. Code	PID	GRID	LOC	Service Description	Instrument Type	Failure or Error Mode	Hazard or Effect	Hazard Class	Remarks	Operator intervention required*
								fails closed	no hazard	safe	operational problem - can't vent vapor from liquid pump	no
PSV	500	Ar	SHT-3	7-	C	from LAPD tank to LAPD particulate filter before pump	relief valve	fails open	liquid argon dumps on floor	safe	ODH analysis takes this leakage into account	no
								fails closed	potential trapped volume	safe	Low probability of a quality Circle Seal relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
AV	501	Ar	SHT-3	6-	B	from LAPD tank to LAPD particulate filter before pump (normally closed)	automatic valve (act'd by SV-641-N2)	fails open	no automatic isolation of pumped loop	safe	ODH analysis does not depend upon this valve isolating the pumped loop in the event of an ODH event	no
								fails closed	pumped loop isolated	safe	operational problem - can't supply liquid to pump	no
SV	501	Ar	SHT-3	6-	B	AV-501-Ar	solenoid valve	fails open	no automatic isolation of pumped loop	safe	ODH analysis does not depend upon this valve isolating the pumped loop in the event of an ODH event	no
								fails closed	pumped loop isolated	safe	operational problem - can't supply liquid to argon pump	no
MV	502	Ar	SHT-3	6-	B	LAPD condenser to LAPD particulate filter before pump	manual valve	fails open	no hazard	safe	operational problem - isolation available at other valves	no
								fails closed	can't purify condensed liquid argon	safe	operational problem - unfiltered condensed liquid argon may contaminate the system	no
SC	504	Ar	SHT-3	5-	B	argon pump	motor speed control	ON	pump cavitates	safe	If pump runs under the wrong conditions it may cavitate and be damaged.	no
								OFF	no pumping	safe	operational problem - can't purify liquid	no
PT	505	Ar	SHT-3	5-	B	argon pump vacuum jacket	pressure transmitter	incorrect reading	no hazard	safe	operational problem	no
MV	506	Ar	SHT-3	5-	C	pressure differential line on pump	manual valve	fails open	no hazard	safe	operational problem - can't isolate pressure instrumentation	no
								fails closed	no hazard	safe	operational problem - can't use pressure instrumentation	no
DPT	507	Ar	SHT-3	5-	C	pressure differential across pump	pressure differential transmitter	incorrect reading	no hazard	safe	operational problem	no
MV	508	Ar	SHT-3	5-	B	pressure differential line on pump	manual valve	fails open	no hazard	safe	operational problem - can't isolate pressure instrumentation	no
								fails closed	no hazard	safe	operational problem - can't use pressure instrumentation	no
PI	509	Ar	SHT-3	5-	C	pressure differential line on pump	local pressure indicator	incorrect reading	no hazard	safe	operational problem	no
PT	510	Ar	SHT-3	5-	C	pressure differential line on pump	pressure transmitter	incorrect reading	no hazard	safe	operational problem	no
MV	511	Ar	SHT-3	4-	B	pressure differential line on pump	manual valve	fails open	no hazard	safe	operational problem - can't isolate pressure instrumentation	no
								fails closed	no hazard	safe	operational problem - can't use pressure instrumentation	no
MV	512	Ar	SHT-3	4-	B	pump discharge	manual valve	fails open	no hazard	safe	operational problem - other points of isolation available on line	no
								fails closed	no hazard	safe	operational problem - can't send gas to analyzers	no
MV	513	Ar	SHT-3	4-	F	regen gas to O2 filter	manual valve	fails open	no hazard	safe	operational problem - other points of isolation available on line	no
								fails closed	can't regenerate O2 filter	safe	operational problem	no
MV	514	Ar	SHT-3	4-	B	from argon pump to flow transmitter, pump isolation	manual valve	fails open	no hazard	safe	operational problem - can't isolate pumped loop supply at tank	no
								fails closed	no hazard	safe	operational problem - can't supply liquid argon to pump	no
MV	516	Ar	SHT-3	3-	C	from argon pump to LAPD tank / filter bypass	manual valve	fails open	no hazard	safe	operational problem - can't filter liquid	no
								fails closed	no hazard	safe	operational problem - can't bypass filters	no
PSV	517	Ar	SHT-3	6-	C	liquid argon from tank and condenser to particulate filter before pump	relief valve	fails open	liquid argon dumps on floor	safe	ODH analysis takes this leakage into account	no
								fails closed	potential trapped volume	safe	Low probability of a quality Circle Seal relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
MV	527	Ar	SHT-3	3-	D	argon filtration	manual valve	fails open	no hazard	safe	capped for future use	no
								fails closed	no hazard	safe	capped for future use	no

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PSV	531	Ar	SHT-3	3-	E	from argon pump to first filter	relief valve	fails open	liquid argon dumps on floor	safe	ODH analysis takes this leakage into account	no
								fails closed	potential trapped volume	safe	Low probability of a quality Circle Seal relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
CV	532	Ar	SHT-3	3-	D	vapor recirculation	check valve	fails open	no hazard	safe	operational problem - other valves can provide isolation	no
								fails closed	no hazard	safe	operational problem - pumped gas can't enter filter loop	no
PI	533	Har	SHT-3	7-	H	regen gas from heater to filters	local pressure indicator	incorrect reading	no hazard	safe	operational problem	no
PT	534	Har	SHT-3	7-	H	regen gas from heater to filters	pressure transmitter	incorrect reading	no hazard	safe	operational problem	no
MV	535	Har	SHT-3	7-	H	regen gas from heater to filters	manual valve	fails open	no hazard	safe	operational problem - other valves can provide isolation	no
								fails closed	can't regenerate O2 filter	safe	operational problem	no
MV	539	Har	SHT-3	6-	H	regen gas to filter one	manual valve	fails open	no hazard	safe	capped for future use	no
								fails closed	no hazard	safe	capped for future use	no
MV	540	Ar	SHT-3	4-	F	regen gas to filter one	manual valve	fails open	no hazard	safe	operational problem - other valves can provide isolation	no
								fails closed	can't regenerate mole sieve filter	safe	operational problem	no
MV	541	Ar	SHT-3	3-	F	filter one sample connection	manual valve	fails open	no hazard	safe	operational problem - other points of isolation available on line	no
								fails closed	no hazard	safe	operational problem - can't send gas to analyzers	no
TE	542	Ar	SHT-3	4-	G	regen gas to molecular sieve	Type K T/C	incorrect reading	no hazard	safe	operational problem - not a temperature control point	no
PSV	543	Ar	SHT-3	1-	F	bulk liquid argon supply line	relief valve	fails open	liquid argon dumps outside PC4	safe	operational problem	no
								fails closed	potential trapped volume	safe	Low probability of a quality Circle Seal relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
MV	544	Ar	SHT-3	1-	F	bulk liquid argon supply line	manual valve	fails open	no hazard	safe	operational problem - other points of isolation available on line	no
								fails closed	no hazard	safe	operational problem - can't fill tank	no
PI	545	Ar	SHT-3	1-	F	bulk liquid argon supply line	local pressure indicator	incorrect reading	no hazard	safe	operational problem	no
MV	547	Ar	SHT-3	2-	F	bulk liquid argon supply line	manual valve	fails open	LAr dumps on ground	safe	operational problem	no
								fails closed	can't blow down Lar supply line	safe	operational problem - can't fill tank	no
PSV	548	Ar	SHT-3	2-	F	bulk liquid argon supply line	relief valve	fails open	liquid argon dumps outside PC4	safe	operational problem	no
								fails closed	potential trapped volume	safe	Low probability of a quality Circle Seal relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
MV	549	Ar	SHT-3	2-	F	bulk liquid argon supply line	manual valve	fails open	no hazard	safe	operational problem - other valves can provide isolation	no
								fails closed	no hazard	safe	operational problem - can't fill tank	no
MV	550	Ar	SHT-3	3-	D	liquid recirculation mole sieve input	manual valve	fails open	no hazard	safe	operational problem - can't isolate pressure instrumentation	no
								fails closed	no hazard	safe	operational problem - can't use pressure instrumentation	no
PT	551	Ar	SHT-3	3-	D	liquid recirculation mole sieve input	pressure transmitter	incorrect reading	no hazard	safe	operational problem	no
PI	552	Ar	SHT-3	3-	D	liquid recirculation mole sieve input	local pressure indicator	incorrect reading	no hazard	safe	operational problem	no
MV	553	Ar	SHT-3	2-	F	line from pump and bulk argon supply to first filter	manual valve	fails open	no hazard	safe	operational problem - other points of isolation available	no
								fails closed	no hazard	safe	operational problem - liquid filtration not possible	no

Instr Code	Tag #	Serv. Code	PID	GRID	LOC	Service Description	Instrument Type	Failure or Error Mode	Hazard or Effect	Hazard Class	Remarks	Operator intervention required*
SV	553	Ar	SHT-3	2-	F	AV-533-Ar	solenoid valve	fails open	no hazard	safe	operational problem - other points of isolation available	no
								fails closed	no hazard	safe	operational problem - liquid filtration not possible	no
MV	554	Ar	SHT-3	4-	F	filter one to filter two	manual valve	fails open	no hazard	safe	operational problem - can't isolate individual filters	no
								fails closed	no hazard	safe	operational problem - liquid filtration not possible	no
MV	555	Ar	SHT-3	5-	F	filter two to filter three - future expansion	manual valve	fails open	no hazard	safe	capped for future use	no
								fails closed	no hazard	safe	capped for future use	no
MV	556	Ar	SHT-3	6-	F	filter three to purity monitor - future expansion	manual valve	fails open	no hazard	safe	capped for future use	no
								fails closed	no hazard	safe	capped for future use	no
AV	557	Ar	SHT-3	6-	F	filter three to purity monitor	automatic valve (act'd by SV-557-Ar)	fails open	no hazard	safe	operational problem - can't automatically isolate the inline purity monitor	no
								fails closed	no hazard	safe	operational problem - can't flow thru the inline purity monitor	no
SV	557	Ar	SHT-3	6-	F	AV-557-Ar	solenoid valve	fails open	no hazard	safe	operational problem - can't automatically isolate the inline purity monitor	no
								fails closed	no hazard	safe	operational problem - can't flow thru the inline purity monitor	no
MV	559	Ar	SHT-3	6-	E	filter loop vent to argon vaporizer and atmosphere	manual valve	fails open	LAr dumps on floor in PC4 if outlet cap is removed and no hose is attached	safe	Valve will be locked shut except for special procedures initiated by an engineer	Yes
								fails closed	no hazard	safe	operational problem - can't send liquid to vaporizer from this point	no
MV	560	Ar	SHT-3	7-	G	purity monitor vent to vent compressor	manual valve	fails open	no hazard	safe	operational problem - other points of isolation available	no
								fails closed	no hazard	safe	operational problem - potential contamination issues if vapor can't be with drawing from the purity monitor	no
FCV	562	Ar	SHT-3	7-	G	purity monitor vent	automatic valve (act'd by SV562-Ar)	fails open	inline purity monitor vents to outside	safe	operational problem - other valves can provide isolation for repair	no
								fails closed	no hazard	safe	operational problem - PSV-587-Ar can provide relief if the purity monitor vessel is isolated	no
SV	562	Ar	SHT-3	7-	G	FCV-552-Ar	solenoid valve	fails open	no hazard	safe	operational problem - other valves can provide isolation for repair	no
								fails closed	no hazard	safe	operational problem - PSV-587-Ar can provide relief if the purity monitor vessel is isolated	no
MV	563	Ar	SHT-3	6-	C	liquid argon from tank and condenser to particulate filter before pump	manual valve	fails open	no hazard	safe	capped for future use	no
								fails closed	no hazard	safe	capped for future use	no
PSV	564	Ar	SHT-3	3-	B	from argon pump to first filter	relief valve	fails open	liquid argon dumps on floor	safe	ODH analysis takes this leakage into account	no
								fails closed	potential trapped volume	safe	Low probability of a quality Circle Seal relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
MV	565	Ar	SHT-3	4-	G	O2 filter regen vent to water analyzer	manual valve	fails open	filter can't be isolated from vent	safe	operational problem - other valves can provide system isolation for repair	no
								fails closed	filter can't be regenerated	safe	operational problem	no
AE	566	Har	SHT-3	2-	G	O2 filter regeneration vent	Dew point meter	incorrect reading	no hazard	safe	operational problem - filter regeneration may be incomplete	no
PSV	568	Ar	SHT-3	4-	G	filter two	relief valve	fails open	liquid argon dumps on floor	safe	ODH analysis takes this leakage into account	no
								fails closed	potential trapped volume	safe	Low probability of a quality ASME relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
MV	569	Ar	SHT-3	4-	G	filter two	manual valve	fails open	no hazard	safe	operational problem - can't isolate pressure instrumentation	no
								fails closed	no hazard	safe	operational problem - can't use pressure instrumentation	no
PT	570	Ar	SHT-3	4-	G	oxygen filter	pressure transmitter	incorrect reading	no hazard	safe	operational problem	no
PI	571	Ar	SHT-3	4-	G	filter two	local pressure indicator	incorrect reading	no hazard	safe	operational problem	no

Instr Code	Tag #	Serv. Code	PID	GRID	LOC	Service Description	Instrument Type	Failure or Error Mode	Hazard or Effect	Hazard Class	Remarks	Operator intervention required*
MV	572	Ar	SHT-3	4-	F	filter two sample connection		fails open	no hazard	safe	operational problem - other points of isolation available on line	no
								fails closed	no hazard	safe	operational problem - can't send gas to analyzers	no
MV	573	Har	SHT-3	3-	G	filter one to analyzer	manual valve	fails open	filter can't be isolated from vent	safe	operational problem - other valves can provide system isolation for repair	no
								fails closed	filter can't be regenerated	safe	operational problem	no
TE	574	Har	SHT-3	5-	G	regen gas to oxygen filter	Type K TC	incorrect reading	no hazard	safe	operational problem - not a temperature control point	no
AE	576	Har	SHT-3	2-	G	molecular sieve regeneration vent	Dew point meter	incorrect reading	no hazard	safe	operational problem - filter regeneration may be incomplete	no
LT	586	Ar	SHT-3	6-	G	purity monitor liquid level	capacitance probe	incorrect reading	no hazard	safe	operational problem - HV may trip if detector is not submerged in liquid	no
PSV	587	Ar	SHT-3	6-	G	purity monitor	relief valve	fails open	liquid argon dumps on floor	safe	ODH analysis takes this leakage into account	no
								fails closed	potential trapped volume	safe	Low probability of a quality ASME relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
PI	589	Ar	SHT-3	6-	H	purity monitor	local pressure indicator	incorrect reading	no hazard	safe	operational problem	no
PT	590	Ar	SHT-3	6-	H	purity monitor	pressure transmitter	incorrect reading	no hazard	safe	operational problem	no
FCV	592	Har	SHT-3	7-	H	regen gas from heater to filters	Variable Area Flowmeter	incorrect reading	no hazard	safe	operational problem - filter may be regenerated incorrectly	no
								fails open	no hazard	safe	operational problem - excessive regeneration gas usage	no
								fails closed	insulation damage	safe	operational damage - can't regenerate filter	no
MV	593	Ar	SHT-3	6-	G	purity monitor to LAPD tank	manual valve	fails open	no hazard	safe	operational problem - other valves can provide system isolation for repair	no
								fails closed	no hazard	safe	operational problem - can't use inline purity monitor	no
MV	594	Ar	SHT-3	3-	B	from argon pump to first filter, flowmeter isolation	manual valve	fails open	no hazard	safe	operational problem - other valves can provide system isolation for repair	no
								fails closed	no hazard	safe	operational problem - can't use liquid flowmeter	no
FT	595	Ar	SHT-3	3-	B	from argon pump to first filter	coriolis flow transmitter	incorrect reading	no hazard	safe	operational problem	no
MV	596	Ar	SHT-3	3-	B	from argon pump to first filter	manual valve	fails open	no hazard	safe	operational problem - other valves can provide system isolation for repair	no
								fails closed	no hazard	safe	operational problem - can't use liquid flowmeter	no
MV	597	Ar	SHT-3	3-	B	from argon pump to first filter, blow down	manual valve	fails open	no hazard	safe	capped for future use	no
								fails closed	no hazard	safe	capped for future use	no
PSV	598	Ar	SHT-3	4-	B	from argon pump to first filter (trapped volume relief)	relief valve	fails open	liquid argon dumps on floor	safe	ODH analysis takes this leakage into account	no
								fails closed	potential trapped volume	safe	Low probability of a quality Circle Seal relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
MV	599	Ar	SHT-3	3-	B	from argon pump to first filter, flowmeter bypass	manual valve	fails open	no hazard	safe	operational problem - can't use liquid argon flowmeter	no
								fails closed	no hazard	safe	operational problem - can't isolate liquid argon flowmeter, other valves can provide isolation for repair	no
PSV	601	Ar	SHT-3	3-	F	filter one	relief valve	fails open	liquid argon dumps on floor	safe	ODH analysis takes this leakage into account	no
								fails closed	potential trapped volume	safe	Low probability of a quality ASME relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
MV	602	Ar	SHT-3	3-	F	filter one	manual valve	fails open	no hazard	safe	operational problem - can't isolate pressure instrumentation	no
								fails closed	no hazard	safe	operational problem - can't use pressure instrumentation	no
PT	603	Ar	SHT-3	3-	G	molecular sieve	pressure transmitter	incorrect reading	no hazard	safe	operational problem	no

Instr Code	Tag #	Serv. Code	PID	GRID	LOC	Service Description	Instrument Type	Failure or Error Mode	Hazard or Effect	Hazard Class	Remarks	Operator intervention required*
PI	604	Ar	SHT-3	3-	G	filter one	local pressure indicator	incorrect reading	no hazard	safe	operational problem	no
FCVE	606	Ar	SHT-3	4-	D	makeup argon gas to pump loop	flow control valve	incorrect reading	no hazard	safe	operational problem	no
								fails open	no hazard	safe	operational problem - excessive argon gas injection	no
								fails closed	insulation damage	safe	operational damage - can't introduce make up gas	no
CV	607	Ar	SHT-3	3-	D	makeup argon gas to pump loop	check valve	fails open	no hazard	safe	operational problem	no
								fails closed	no hazard	safe	operational problem - can't introduce makeup gas	no
MV	608	Ar	SHT-3	3-	D	makeup argon gas to pump loop	manual valve	fails open	no hazard	safe	operational problem - other valves can provide system isolation	no
								fails closed	no hazard	safe	operational problem - can't introduce makeup gas	no
MV	609	Ar	SHT-3	3-	D	makeup argon gas to pump loop	manual valve	fails open	no hazard	safe	capped for future use	no
								fails closed	no hazard	safe	capped for future use	no
MV	610	Ar	SHT-3	3-	D	from vent compressor to pump loop	manual valve	fails open	no hazard	safe	operational problem - other valves can provide system isolation	no
								fails closed	no hazard	safe	operational problem - can't re-circulate gas thru filters	no
TE	611	Ar	SHT-3	8-	E	filter loop vent to argon vaporizer and atmosphere	100 ohm platinum RTD	incorrect reading	no hazard	safe	operational problem	no
HTR	612	Har	SHT-3	6-	H	regen gas from heater to filters	Circulation heater	ON	filter over heats	safe	Heater is protected by hardwired interlocks and PLC interlocks. An on failure is unlikely.	no
								OFF	no hazard	safe	operational problem - can't regenerate filter	no
PSV	615	Ar	SHT-3	8-	F	liquid return to tank	relief valve	fails open	liquid argon dumps on floor.	safe	ODH analysis takes this leakage into account	no
								fails closed	potential trapped volume	safe	Low probability of a quality Circle Seal relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
SP	620	Ar	SHT-3	1-	F	bulk liquid argon supply line	y-strainer	plugs	no hazard	safe	operational problem - restricted flow of liquid argon	no
TE	621	Ar	SHT-3	3-	F	molecular sieve	100 ohm platinum RTD	incorrect reading	filter overheats	safe	PLC heater control loop monitors all five temperature sensors per filter and two temperature sensors per heater such that one sensor failure will not endanger the process. Hardwired interlocks protect the process independent of the PLC	no
TE	622	Ar	SHT-3	3-	F	molecular sieve	100 ohm platinum RTD	incorrect reading	filter overheats	safe	PLC heater control loop monitors all five temperature sensors per filter and two temperature sensors per heater such that one sensor failure will not endanger the process. Hardwired interlocks protect the process independent of the PLC	no
TE	623	Ar	SHT-3	3-	F	molecular sieve	100 ohm platinum RTD	incorrect reading	filter overheats	safe	PLC heater control loop monitors all five temperature sensors per filter and two temperature sensors per heater such that one sensor failure will not endanger the process. Hardwired interlocks protect the process independent of the PLC	no
TE	624	Ar	SHT-3	3-	F	molecular sieve	100 ohm platinum RTD	incorrect reading	filter overheats	safe	PLC heater control loop monitors all five temperature sensors per filter and two temperature sensors per heater such that one sensor failure will not endanger the process. Hardwired interlocks protect the process independent of the PLC	no
TE	625	Ar	SHT-3	3-	F	molecular sieve	100 ohm platinum RTD	incorrect reading	filter overheats	safe	PLC heater control loop monitors all five temperature sensors per filter and two temperature sensors per heater such that one sensor failure will not endanger the process. Hardwired interlocks protect the process independent of the PLC	no
TE	626	Ar	SHT-3	4-	F	oxygen filter	100 ohm platinum RTD	incorrect reading	filter overheats	safe	PLC heater control loop monitors all five temperature sensors per filter and two temperature sensors per heater such that one sensor failure will not endanger the process. Hardwired interlocks protect the process independent of the PLC	no
TE	627	Ar	SHT-3	4-	F	oxygen filter	100 ohm platinum RTD	incorrect reading	filter overheats	safe	PLC heater control loop monitors all five temperature sensors per filter and two temperature sensors per heater such that one sensor failure will not endanger the process. Hardwired interlocks protect the process independent of the PLC	no

Instr Code	Tag #	Serv. Code	PID	GRID	LOC	Service Description	Instrument Type	Failure or Error Mode	Hazard or Effect	Hazard Class	Remarks	Operator intervention required*
TE	628	Ar	SHT-3	4-	F	oxygen filter	100 ohm platinum RTD	incorrect reading	filter overheats	safe	PLC heater control loop monitors all five temperature sensors per filter and two temperature sensors per heater such that one sensor failure will not endanger the process. Hardwired interlocks protect the process independent of the PLC	no
TE	629	Ar	SHT-3	4-	F	oxygen filter	100 ohm platinum RTD	incorrect reading	filter overheats	safe	PLC heater control loop monitors all five temperature sensors per filter and two temperature sensors per heater such that one sensor failure will not endanger the process. Hardwired interlocks protect the process independent of the PLC	no
TE	630	Ar	SHT-3	4-	F	oxygen filter	100 ohm platinum RTD	incorrect reading	filter overheats	safe	PLC heater control loop monitors all five temperature sensors per filter and two temperature sensors per heater such that one sensor failure will not endanger the process. Hardwired interlocks protect the process independent of the PLC	no
MV	633	Ar	SHT-3	6-	B	LAPD TANK To Argon vaporizer	manual valve	fails open	LAr dumps on floor in PC4 if outlet cap is removed and no hose is attached	safe	Valve will be locked shut except for special procedures initiated by an engineer	Yes
								fails closed	no hazard	safe	operational problem - can't send liquid to vaporizer from this point	no
HTR	634	Har	SHT-3	6-	H	regen gas from heater to filters	Circulation heater	ON	filter over heats	safe	Heater is protected by hardwired interlocks and PLC interlocks. An on failure is unlikely.	no
								OFF	no hazard	safe	operational problem - can't regenerate filter	no
TE	635	Har	SHT-3	6-	H	regen gas heater (gas flow)	Type K TC	incorrect reading	overheating	safe	PLC heater control loop monitors all five temperature sensors per filter such that one sensor failure will not endanger the process. Hardwired interlocks protect the process independent of the PLC	no
TE	636	Har	SHT-3	6-	H	regen gas heater (heater surface)	Type K TC	incorrect reading	overheating	safe	PLC heater control loop monitors all five temperature sensors per filter and two temperature sensors per heater such that one sensor failure will not endanger the process. Hardwired interlocks protect the process independent of the PLC	no
TE	637	Har	SHT-3	6-	H	regen gas heater (gas flow)	Type K TC	incorrect reading	overheating	safe	PLC heater control loop monitors all five temperature sensors per filter and two temperature sensors per heater such that one sensor failure will not endanger the process. Hardwired interlocks protect the process independent of the PLC	no
TE	638	Har	SHT-3	6-	H	regen gas heater (gas flow)	Type K TC	incorrect reading	overheating	safe	PLC heater control loop monitors all five temperature sensors per filter and two temperature sensors per heater such that one sensor failure will not endanger the process. Hardwired interlocks protect the process independent of the PLC	no
TE	639	Har	SHT-3	6-	H	regen gas heater (heater surface)	Type K TC	incorrect reading	overheating	safe	PLC heater control loop monitors all five temperature sensors per filter and two temperature sensors per heater such that one sensor failure will not endanger the process. Hardwired interlocks protect the process independent of the PLC	no
TE	640	Har	SHT-3	6-	H	regen gas heater (gas flow)	Type K TC	incorrect reading	overheating	safe	PLC heater control loop monitors all five temperature sensors per filter and two temperature sensors per heater such that one sensor failure will not endanger the process. Hardwired interlocks protect the process independent of the PLC	no
PSV	650	Ar	SHT-3	7-	B	liquid line to pump	relief valve	fails open	liquid argon dumps on floor	safe	ODH analysis takes this leakage into account	no
								fails closed	potential trapped volume	safe	Low probability of a quality Circle Seal relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
PI	651	Ar	SHT-3	7-	B	liquid line to pump	pressure gauge	incorrect reading	no hazard	safe	operational problem	no
MV	652	Ar	SHT-3	7-	B	liquid line to pump	manual valve	fails open	no hazard	safe	capped for future use	no
								fails closed	no hazard	safe	capped for future use	no
PI	653	Ar	SHT-3	7-	C	condenser to pump suction	pressure gauge	incorrect reading	no hazard	safe	operational problem	no
MV	654	Ar	SHT-3	7-	C	condenser to pump suction	manual valve	fails open	no hazard	safe	capped for future use	no
								fails closed	no hazard	safe	capped for future use	no
PI	655	Ar	SHT-3	6-	C	liquid line to pump	pressure gauge	incorrect reading	no hazard	safe	operational problem	no
DPT	656	Ar	SHT-3	5-	C	liquid line to pump across filter	differential pressure transmitter	incorrect reading	no hazard	safe	operational problem	no

Instr Code	Tag #	Serv. Code	PID	GRID	LOC	Service Description	Instrument Type	Failure or Error Mode	Hazard or Effect	Hazard Class	Remarks	Operator intervention required*
PI	657	Ar	SHT-3	5-	C	liquid line to pump	pressure gauge	incorrect reading	no hazard	safe	operational problem	no
MV	658	Ar	SHT-3	5-	C	liquid line to pump	manual valve	fails open	no hazard	safe	operational problem - can't isolate pressure instrumentation	no
								fails closed	no hazard	safe	operational problem - other valves can provide isolation for repair	no
MV	659	Ar	SHT-3	6-	B	liquid line to pump	manual valve	fails open	no hazard	safe	operational problem - can't isolate pressure instrumentation	no
								fails closed	no hazard	safe	operational problem - other valves can provide isolation for repair	no
MV	660	Ar	SHT-3	5-	B	liquid line to pump	manual valve	fails open	no hazard	safe	operational problem - can't isolate pressure instrumentation	no
								fails closed	no hazard	safe	operational problem - other valves can provide isolation for repair	no
MV	661	Ar	SHT-3	4-	C	liquid line pump discharge	manual valve	fails open	no hazard	safe	capped for future use	Yes
								fails closed	no hazard	safe	capped for future use	no
TE	662	Ar	SHT-3	5-	B	liquid pump temperature	100 ohm platinum RTD	incorrect reading	no hazard	safe	operational problem	no
PSV	663	Ar	SHT-3	4-	C	pump discharge trapped volume relief	relief valve	fails open	liquid argon dumps on floor	safe	ODH analysis takes this leakage into account	no
								fails closed	potential trapped volume	safe	Low probability of a quality Circle Seal relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
FCV	664	N2	SHT-2	7-	E	nitrogen purge to liquid argon flowmeter foam insulation	rotameter	incorrect reading	no hazard	safe	operational problem - potential insulation damage from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive nitrogen gas usage	no
								fails closed	insulation damage	safe	operational damage - foam insulation would eventually be compromised by water without a dry nitrogen purge	no
PI	665	Ar	SHT-3	3-	B	liquid argon flowmeter inlet pressure	pressure gauge	incorrect reading	no hazard	safe	operational problem	no
PSV	666	V	SHT-3	5-	B	tank to pump vacuum jacket relief	relief valve (vacuum pumpout)	fails open	vacuum spoils	safe	Trapped volume reliefs can handle loss of insulating vacuum	no
								fails closed	vacuum jacket over pressurized	safe	Low probability of a CVI pump out with the spring removed (acting like a parallel plate relief) not opening	no
MV	667	Ar	SHT-3	5-	E	future filter bypass isolation	manual valve	fails open	no hazard	safe	operational problem - can't isolate oxygen filter	no
								fails closed	no hazard	safe	operational problem - can't filter liquid argon	no
PT	668	V	SHT-3	3-	F	molecular sieve vacuum	pressure transmitter	incorrect reading	no hazard	safe	operational problem - potential insulation damage from inadequate purge	no
PT	669	V	SHT-3	4-	F	Cu filter vacuum	pressure transmitter	incorrect reading	no hazard	safe	operational problem	no
PSV	670	V	SHT-3	3-	F	molecular sieve vacuum	parallel plate relief	fails open	vacuum spoils	safe	Filter vessel relief can handle loss of insulating vacuum	no
								fails closed	vacuum jacket over pressurized	safe	Low probability of a parallel plate relief not opening	no
PSV	671	V	SHT-3	4-	F	copper filter vacuum	parallel plate relief	fails open	vacuum spoils	safe	Filter vessel relief can handle loss of insulating vacuum	no
								fails closed	vacuum jacket over pressurized	safe	Low probability of a parallel plate relief not opening	no
PSV	672	V	SHT-3	6-	F	inline purity monitor vacuum	parallel plate relief	fails open	vacuum spoils	safe	Filter vessel relief can handle loss of insulating vacuum	no
								fails closed	vacuum jacket over pressurized	safe	Low probability of a parallel plate relief not opening	no
PI	673	Ar	SHT-3	8-	F	liquid return to tank	pressure gauge	incorrect reading	no hazard	safe	operational problem	no
MV	674	Ar	SHT-3	6-	F	inline purity monitor bypass	manual valve	fails open	no hazard	safe	operational problem - flow can't be balanced between the two flow paths	no
								fails closed	no hazard	safe	operational problem - inline purity monitor will restrict flow and reduce filtration rate	no
MV	675	Ar	SHT-3	7-	F	liquid return to tank	manual valve	fails open	no hazard	safe	operational problem - other valves can provide isolation	no

Instr Code	Tag #	Serv. Code	PID	GRID	LOC	Service Description	Instrument Type	Failure or Error Mode	Hazard or Effect	Hazard Class	Remarks	Operator intervention required*
								fails closed	no hazard	safe	operational problem - can't return filtered gas to the tank	no
MV	676	Ar	SHT-3	6-	E	filter bypass	manual valve	fails open	no hazard	safe	capped for future use	no
								fails closed	no hazard	safe	capped for future use	no
MV	677	Ar	SHT-3	6-	F	inline purity monitor bypass	manual valve	fails open	no hazard	safe	capped for future use	no
								fails closed	no hazard	safe	capped for future use	no
PI	678	Ar	SHT-3	6-	F	inline purity monitor bypass	pressure gauge	incorrect reading	no hazard	safe	operational problem	no
PI	680	Ar	SHT-3	2-	F	Lar supply	local pressure indicator	incorrect reading	no hazard	safe	operational problem	no
MV	681	Ar	SHT-3	2-	F	Lar supply	manual valve	fails closed	no hazard	safe	capped for future use	no
								fails open	no hazard	safe	capped for future use	no
FCV	682	N2	SHT-2	7-	E	nitrogen purge - spare	rotameter	incorrect reading	no hazard	safe	operational problem - potential insulation damage from inadequate purge	no
								fails open	no hazard	safe	operational problem - excessive nitrogen gas usage	no
								fails closed	insulation damage	safe	operational damage - foam insulation would eventually be compromised by water without a dry nitrogen purge	no
PSV	683	Ar	SHT-3	6-	F	liquid return to tank	relief valve	fails open	liquid argon dumps on floor	safe	ODH analysis takes this leakage into account	no
								fails closed	potential trapped volume	safe	Low probability of a quality Circle Seal relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
PI	684	Har	SHT-3	7-	H	regeneration gas heater inlet	pressure gauge	incorrect reading	no hazard	safe	operational problem	no
MV	685	Har	SHT-3	7-	H	regeneration gas heater inlet	manual valve	fails open	no hazard	safe	operational problem - other valves can provide isolation	no
								fails closed	can't regenerate O2 filter	safe	operational problem	no
MV	686	Har	SHT-3	3-	G	regeneration vent drain	manual valve	fails open	vent exhaust gases into room	safe	operational problem	no
								fails closed	no hazard	safe	operational problem - can't drain water from vent pipe	no
MV	687	Har	SHT-3	3-	G	regeneration vent drain	manual valve	fails open	vent exhaust gases into room	safe	operational problem	no
								fails closed	no hazard	safe	operational problem - can't drain water from vent pipe	no
MV	688	Ar	SHT-3	3-	B	post pump Lar trapped volume	manual valve	fails open	no hazard	safe	capped for future use	no
								fails closed	no hazard	safe	capped for future use	no
MV	689	Ar	SHT-3	3-	B	post pump Lar trapped volume	manual valve	fails open	no hazard	safe	capped for future use	no
								fails closed	no hazard	safe	capped for future use	no
PI	690	Ar	SHT-3	3-	B	post pump Lar trapped volume	pressure gauge	incorrect reading	no hazard	safe	operational problem	no
MV	691	Ar	SHT-3	7-	F	tank liquid return trapped volume	manual valve	fails open	no hazard	safe	capped for future use	no
								fails closed	no hazard	safe	capped for future use	no
MV	692	Ar	SHT-3	7-	F	tank liquid return trapped volume	manual valve	fails open	no hazard	safe	capped for future use	no
								fails closed	no hazard	safe	capped for future use	no
PSV	693	Ar	SHT-3	7-	E	trapped volume relief	relief valve	fails open	liquid argon dumps on floor	safe	ODH analysis takes this leakage into account	no
								fails closed	potential trapped volume	safe	Low probability of a quality relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
MV	694	Ar	SHT-3	7-	G	inline purity monitor	manual valve	fails open	liquid argon dumps on floor	safe	Valve will be locked shut except for special procedures initiated by an engineer	no
								fails closed	no hazard	safe	operational problem - can't evacuate inline purity monitor	no

Instr Code	Tag #	Serv. Code	PID	GRID	LOC	Service Description	Instrument Type	Failure or Error Mode	Hazard or Effect	Hazard Class	Remarks	Operator intervention required*
PI	698	Ar	SHT-3	7-	G	pump discharge	pressure gauge	incorrect reading	no hazard	safe	operational problem	no
AE	702	Har	SHT-3	3-	G	Regeneration gas vent	Hydrogen analyzer	incorrect reading	no hazard	safe	operational problem	no
PT	704	Ar	SHT-3	8-	F	Tank side of return particulate filter	pressure transmitter	incorrect reading	no hazard	safe	operational problem	no
SV	705	Har	SHT-3	7-	H	Regen gas to filters	solenoid valve	fails open	filter overheats	safe	operational problem - filter material could over heat which reduces its capacity, no danger to pressure containment	no
								fails closed	no hazard	safe	operational problem - can't regenerate filters	no
SV	706	Har	SHT-3	7-	H	H2/Ar dilution shutoff	solenoid valve	fails open	filter overheats	safe	operational problem - filter material could over heat which reduces its capacity, no danger to pressure containment	no
								fails closed	no hazard	safe	operational problem - can't regenerate filters	no
PI	707	Har	SHT-3	3-	H	O2 filter regeneration vent H2 analyzer	pressure gauge	incorrect reading	no hazard	safe	operational problem	no
MV	708	Har	SHT-3	3-	H	O2 filter regeneration vent H2 analyzer	manual valve	fails open	no hazard	safe	operational problem - other valves can provide isolation for repair	no
								fails closed	no hazard	safe	operational problem - can't monitor filter regeneraiton vent gas	no
FCV	709	Har	SHT-3	3-	H	O2 filter regeneration vent H2 analyzer	rotometer	incorrect reading	no hazard	safe	operational problem - potential incorrect reading at AE-702-Har	no
								fails open	no hazard	safe	operational problem - excessive flow to AE-702-Har	no
								fails closed	no hazard	safe	operational damage -AE-702-Har can't provide regeneration exhaust analysis	no
MV	710	Har	SHT-3	3-	H	H2 analyzer	manual valve	fails open	no hazard	safe	operational problem - other valves can provide isolation for repair	no
								fails closed	no hazard	safe	operational problem - can't check H2 concentration in premix	no
FCV	711	Har	SHT-3	3-	H	H2 analyzer	rotometer	incorrect reading	no hazard	safe	operational problem - potential incorrect reading at AE-702-Har	no
								fails open	no hazard	safe	operational problem - excessive flow to AE-702-Har	no
								fails closed	no hazard	safe	operational damage -AE-702-Har can't analyze H2 concentration in the premix	no
MV	712	Har	SHT-3	3-	H	H2 analyzer	manual valve	fails open	no hazard	safe	operational problem - other valves can provide isolation for repair	no
								fails closed	no hazard	safe	operational problem - can't analyze premix bottles	no
FCV	713	Har	SHT-3	3-	H	H2 analyzer	rotometer	incorrect reading	no hazard	safe	operational problem - potential incorrect reading at AE-702-Har	no
								fails open	no hazard	safe	operational problem - excessive flow to AE-702-Har	no
								fails closed	no hazard	safe	operational damage -AE-702-Har can't provide analysis	no
FCV	714	Har	SHT-3	7-	H	H2/Ar dilution	rotometer	incorrect reading	no hazard	safe	operational problem - filter regeneration could be compromised	no
								fails open	no hazard	safe	operational problem - filter regeneration could be compromised	no
								fails closed	no hazard	safe	operational problem - filter regeneration not possible	no
PI	715	Har	SHT-3	7-	H	H2/Ar dilution	pressure gauge	incorrect reading	no hazard	safe	operational problem	no
MV	716	Har	SHT-3	7-	H	H2/Ar dilution	manual valve	fails open	inert gas vents into pc4	safe	operational problem - ODH takes venting into account, other valves can provide isolation for repair	no
								fails closed	no hazard	safe	operational problem	no
MV	717	Ar	SHT-3	5-	B	pump strainer vent	manual valve	fails open	LAr vents into pc4	safe	operational problem - valve fed by 1/8" capillary such that leakage would be small	no
								fails closed	no hazard	safe	operational problem	no
MV	718	Ar	SHT-3	4-	C	pump discharge cooldown	manual valve	fails open	no hazard	safe	operational problem - other valves can provide isolation for repair	no
								fails closed	no hazard	safe	operational problem - can't vent vapor from liquid pump	no
MV	719	Ar	SHT-3	4-	C	pump discharge cooldown	manual valve	fails open	no hazard	safe	operational problem - other valves can provide isolation for repair	no
								fails closed	no hazard	safe	operational problem - can't remove air from attached hose	no

Instr Code	Tag #	Serv. Code	PID	GRID	LOC	Service Description	Instrument Type	Failure or Error Mode	Hazard or Effect	Hazard Class	Remarks	Operator intervention required*
PSV	720	Ar	SHT-3	3-	C	pump discharge trapped volume relief	relief valve	fails open	liquid argon dumps on floor	safe	ODH analysis takes this leakage into account	no
								fails closed	potential trapped volume	safe	Low probability of a quality relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
SP	721	Ar	SHT-3	5-	F	Post filter particulate	particulate filter	plugs	no hazard	safe	operational problem - restricted flow of liquid argon	no
FO	722	Ar	SHT-3	6-	F	inline purity monitor	orifice	plugs	no hazard	safe	operational problem - restricted flow of liquid argon	no
MV	5001	Ar	SHT-3	4-	A	LBNE 35T to filter (isolation)	manual valve	fails open	no hazard	safe	valve will be locked closed for LAPD Run 2 or until LBNE 35T is approved	YES
								fails closed	no hazard	safe	valve will be locked closed for LAPD Run 2	no
MV	5002	Ar	SHT-3	4-	A	LBNE 35T from filters (isolation)	manual valve	fails open	no hazard	safe	valve will be locked closed for LAPD Run 2 or until LBNE 35T is approved	YES
								fails closed	no hazard	safe	valve will be locked closed for LAPD Run 2	no
MV	803	N2	SHT-4	6-	G	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer zero gas filtration compromised	no
								fails closed	no hazard	safe	operational problem - gas analyzer zero gas filtration compromised	no
SP	804	N2	SHT-4	6-	G	gas analyzers	H2O filter	saturated	no hazard	safe	operational problem - gas analyzer zero gas filtration compromised	no
MV	805	N2	SHT-4	5-	G	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer zero gas filtration compromised	no
								fails closed	no hazard	safe	operational problem - gas analyzer zero gas filtration compromised	no
MV	806	N2	SHT-4	5-	G	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer zero gas filtration compromised	no
								fails closed	no hazard	safe	operational problem - gas analyzer zero gas filtration compromised	no
SP	807	N2	SHT-4	5-	G	gas analyzers	O2 filter	saturated	no hazard	safe	operational problem - gas analyzer zero gas filtration compromised	no
MV	808	N2	SHT-4	5-	G	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer zero gas filtration compromised	no
								fails closed	no hazard	safe	operational problem - gas analyzer zero gas filtration compromised	no
MV	809	N2	SHT-4	6-	G	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer zero gas filtration compromised	no
								fails closed	no hazard	safe	operational problem - gas analyzer zero gas filtration compromised	no
MV	810	N2	SHT-4	6-	F	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer zero gas filtration compromised	no
								fails closed	no hazard	safe	operational problem - gas analyzer zero gas filtration compromised	no
SP	811	N2	SHT-4	6-	F	gas analyzers	H2O filter	saturated	no hazard	safe	operational problem - gas analyzer zero gas filtration compromised	no
MV	812	N2	SHT-4	5-	F	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer zero gas filtration compromised	no
								fails closed	no hazard	safe	operational problem - gas analyzer zero gas filtration compromised	no
MV	813	N2	SHT-4	5-	F	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer zero gas filtration compromised	no
								fails closed	no hazard	safe	operational problem - gas analyzer zero gas filtration compromised	no
SP	814	N2	SHT-4	5-	F	contaminant gas to analyzers	O2 filter	saturated	no hazard	safe	operational problem - gas analyzer zero gas filtration compromised	no
MV	815	N2	SHT-4	5-	F	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer zero gas filtration compromised	no

Instr Code	Tag #	Serv. Code	PID	GRID	LOC	Service Description	Instrument Type	Failure or Error Mode	Hazard or Effect	Hazard Class	Remarks	Operator intervention required*
								fails closed	no hazard	safe	operational problem - gas analyzer zero gas filtration compromised	no
AE	819	V	SHT-4	2-	E	vicinity of LAPD tank	ODH O2 sensor	incorrect reading	ODH atmosphere not alarmed	safe	ODH analysis includes the probability of hardware failure	no
AE	820	V	SHT-4	2-	D	vicinity of LAPD tank	ODH O2 sensor	incorrect reading	ODH atmosphere not alarmed	safe	ODH analysis includes the probability of hardware failure	no
FS	821	V	SHT-4	1-	D	ODH blower inlet duct	pressure differential switch	incorrect reading	no hazard	safe	ODH system operates independent of the flow switch	no
MV	827	N2	SHT-4	5-	F	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer zero gas filtration compromised	no
								fails closed	no hazard	safe	operational problem - gas analyzer zero gas filtration compromised	no
MV	828	N2	SHT-4	5-	G	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer zero gas filtration compromised	no
								fails closed	no hazard	safe	operational problem - gas analyzer zero gas filtration compromised	no
PI	829	N2	SHT-4	5-	G	gas analyzers	pressure indicator	incorrect reading	no hazard	safe	operational problem	no
CV	830	N2	SHT-4	5-	F	gas analyzers	check valve	fails open	no hazard	safe	operational problem - gas analyzer zero gas filtration compromised	no
								fails closed	no hazard	safe	operational problem - gas analyzer zero gas filtration compromised	no
CV	831	Ar	SHT-4	6-	F	gas analyzers	check valve	fails open	no hazard	safe	operational problem - possible to back stream contamination into argon utility gas supply	no
								fails closed	no hazard	safe	operational problem - no argon utility gas available to maintain gas analyzers	no
MV	840	Ar	SHT-4	3-	F	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - other points of isolation available	no
								fails closed	no hazard	safe	operational problem - tank vapor space gas can't be sampled	no
MV	841	Ar	SHT-4	3-	F	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer zero gas delivery compromised	no
								fails closed	no hazard	safe	operational problem - gas analyzer zero gas delivery compromised	no
PI	842	Ar	SHT-4	4-	F	gas analyzers	pressure indicator	incorrect reading	no hazard	safe	operational problem	no
PT	843	Ar	SHT-4	4-	F	gas analyzers	pressure transmitter	incorrect reading	no hazard	safe	operational problem	no
PI	844	Ar	SHT-4	4-	F	gas analyzers	pressure indicator	incorrect reading	no hazard	safe	operational problem	no
PT	845	Ar	SHT-4	4-	F	gas analyzers	pressure transmitter	incorrect reading	no hazard	safe	operational problem	no
PSV	846	Ar	SHT-4	4-	F	gas analyzers	relief valve	fails open	argon gas vents into room	safe	ODH analysis takes this leakage into account	no
								fails closed	bellows pump over pressurized	safe	Low probability of a quality Circle Seal relief valve failing completely shut. As pressure in the pumped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
CV	847	Ar	SHT-4	4-	F	gas analyzers	check valve	fails open	no hazard	safe	operational problem - potential to back stream contamination to tank	no
								fails closed	no hazard	safe	operational problem - can't analyze tank gas	no
MV	848	Ar	SHT-4	3-	F	gas analyzers	manual valve	fails open	no hazard	safe	capped for future use	no
								fails closed	no hazard	safe	capped for future use	no
MV	849	Ar	SHT-4	4-	F	gas analyzers	manual valve	fails open	no hazard	safe	capped for future use	no
								fails closed	no hazard	safe	capped for future use	no
PI	850	Ar	SHT-4	3-	F	gas analyzers	pressure indicator	incorrect reading	no hazard	safe	operational problem	no
PCV	851	N2	SHT-4	3-	F	gas analyzers	pressure control valve	fails open	no hazard	safe	operational problem - down stream equipment can handle full N2 supply pressure	no
								fails closed	no hazard	safe	operational problem - gas analyzer zero gas delivery compromised	no
EV	852	Ar	SHT-4	3-	F	gas analyzers	actuated metering valve	fails open	venting of Ar gas	safe	operational problem - other points of isolation available, without the proper restriction pump may vent argon thru PSV-846-Ar, vent rate will be very slow	no

Instr Code	Tag #	Serv. Code	PID	GRID	LOC	Service Description	Instrument Type	Failure or Error Mode	Hazard or Effect	Hazard Class	Remarks	Operator intervention required*
								fails closed	no hazard	safe	operational problem - tank vapor space gas can't be sampled	no
MV	853	Ar	SHT-4	3-	F	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - other points of isolation available	no
								fails closed	no hazard	safe	operational problem - tank vapor space gas can't be sampled	no
AE	860	V	SHT-4	3-	D	gas analyzers	Dewpoint meter	incorrect reading	no hazard	safe	operational problem	no
AE	861	V	SHT-4	3-	D	gas analyzers	Dewpoint meter	incorrect reading	no hazard	safe	operational problem	no
MV	900	V	SHT-4	5-	E	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
MV	901	V	SHT-4	5-	E	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
MV	902	V	SHT-4	5-	E	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
MV	903	V	SHT-4	6-	E	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
MV	904	V	SHT-4	5-	D	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
MV	905	V	SHT-4	5-	D	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
MV	906	V	SHT-4	5-	D	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
MV	907	V	SHT-4	5-	D	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
MV	908	V	SHT-4	5-	D	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
MV	909	V	SHT-4	5-	D	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
MV	910	V	SHT-4	5-	D	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
MV	911	V	SHT-4	6-	D	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
MV	912	V	SHT-4	5-	D	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
MV	913	V	SHT-4	5-	C	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
MV	914	V	SHT-4	5-	C	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
MV	915	V	SHT-4	5-	C	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no

Instr Code	Tag #	Serv. Code	PID	GRID	LOC	Service Description	Instrument Type	Failure or Error Mode	Hazard or Effect	Hazard Class	Remarks	Operator intervention required*
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
MV	952	V	SHT-4	4-	C	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
MV	953	V	SHT-4	5-	B	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
MV	954	V	SHT-4	5-	B	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
MV	955	V	SHT-4	5-	B	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
MV	956	V	SHT-4	5-	B	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
MV	957	V	SHT-4	5-	B	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
MV	958	V	SHT-4	5-	B	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
MV	959	V	SHT-4	5-	A	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
MV	960	V	SHT-4	4-	B	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
MV	961	V	SHT-4	5-	A	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
MV	962	V	SHT-4	5-	A	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
MV	963	V	SHT-4	5-	A	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
MV	964	V	SHT-4	6-	E	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
MV	965	V	SHT-4	6-	E	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
PE	966	V	SHT-4	6-	E	gas analyzers	pressure element	incorrect reading	no hazard	safe	operational problem	no
CV	967	V	SHT-4	6-	E	gas analyzers	check valve	fails open	vacuum pump operation compromised	safe	operational problem	no
								fails closed	vacuum pump over pressurized	safe	Low probability of a quality Circle Seal check valve failing completely shut. As pressure in the pumped volume exceeded the relief valve set point, the probability of a check relief valve opening would increase.	no
CV	968	V	SHT-4	6-	D	gas analyzers	check valve	fails open	no hazard	safe	operational problem - check valve protects against vacuum pulling air contamination into analyzer from ambient	no
								fails closed	no hazard	safe	operational problem - gas analyzer cannot sample gas	no

Instr Code	Tag #	Serv. Code	PID	GRID	LOC	Service Description	Instrument Type	Failure or Error Mode	Hazard or Effect	Hazard Class	Remarks	Operator intervention required*
MV	969	V	SHT-4	6-	D	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - other points of isolation available	no
								fails closed	no hazard	safe	operational problem - gas analyzer cannot sample gas	no
CV	970	V	SHT-4	6-	C	gas analyzers	check valve	fails open	no hazard	safe	operational problem - check valve protects against vacuum pulling air contamination into analyzer from ambient	no
								fails closed	no hazard	safe	operational problem - gas analyzer cannot sample gas	no
PCV	971	V	SHT-4	6-	B	gas analyzers	pressure control valve	fails open	no hazard	safe	operational problem - down stream equipment can handle full supply pressure	no
								fails closed	no hazard	safe	operational problem - gas analyzer cannot sample gas	no
PI	972	V	SHT-4	6-	B	gas analyzers	pressure indicator	incorrect reading	no hazard	safe	operational problem	no
CV	973	V	SHT-4	6-	B	gas analyzers	check valve	fails open	no hazard	safe	operational problem - check valve protects against vacuum pulling air contamination into analyzer from ambient	no
								fails closed	no hazard	safe	operational problem - gas analyzer cannot sample gas	no
PCV	974	V	SHT-4	4-	D	gas analyzers	pressure control valve	fails open	no hazard	safe	operational problem - down stream equipment can handle full supply pressure	no
								fails closed	no hazard	safe	operational problem - gas analyzer cannot sample gas	no
PI	975	V	SHT-4	4-	D	gas analyzers	pressure indicator	incorrect reading	no hazard	safe	operational problem	no
CV	976	V	SHT-4	4-	D	gas analyzers	check valve	fails open	no hazard	safe	operational problem - check valve protects against vacuum pulling air contamination into analyzer from ambient	no
								fails closed	no hazard	safe	operational problem - gas analyzer cannot sample gas	no
CV	977	V	SHT-4	4-	C	gas analyzers	check valve	fails open	no hazard	safe	operational problem - check valve protects against vacuum pulling air contamination into analyzer from ambient	no
								fails closed	no hazard	safe	operational problem - gas analyzer cannot sample gas	no
MV	978	V	SHT-4	4-	C	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - other points of isolation available	no
								fails closed	no hazard	safe	operational problem - gas analyzer cannot sample gas	no
PCV	979	V	SHT-4	4-	C	gas analyzers	pressure control valve	fails open	no hazard	safe	operational problem - down stream equipment can handle full supply pressure	no
								fails closed	no hazard	safe	operational problem - gas analyzer cannot sample gas	no
PI	980	V	SHT-4	4-	C	gas analyzers	pressure indicator	incorrect reading	no hazard	safe	operational problem	no
CV	981	V	SHT-4	4-	C	gas analyzers	check valve	fails open	no hazard	safe	operational problem - check valve protects against vacuum pulling air contamination into analyzer from ambient	no
								fails closed	no hazard	safe	operational problem - gas analyzer cannot sample gas	no
PCV	982	V	SHT-4	4-	B	gas analyzers	pressure control valve	fails open	no hazard	safe	operational problem - down stream equipment can handle full supply pressure	no
								fails closed	no hazard	safe	operational problem - gas analyzer cannot sample gas	no
PI	983	V	SHT-4	4-	B	gas analyzers	pressure indicator	incorrect reading	no hazard	safe	operational problem	no
CV	984	V	SHT-4	4-	B	gas analyzers	check valve	fails open	no hazard	safe	operational problem - check valve protects against vacuum pulling air contamination into analyzer from ambient	no
								fails closed	no hazard	safe	operational problem - gas analyzer cannot sample gas	no
AE	990	V	SHT-4	7-	D	gas analyzers	oxygen analyzer	incorrect reading	no hazard	safe	operational problem	no
AE	991	V	SHT-4	7-	C	gas analyzers	water analyzer	incorrect reading	no hazard	safe	operational problem	no
AE	992	V	SHT-4	7-	B	gas analyzers	oxygen analyzer	incorrect reading	no hazard	safe	operational problem	no
AE	993	V	SHT-4	4-	D	gas analyzers	nitrogen analyzer	incorrect reading	no hazard	safe	operational problem	no
AE	994	V	SHT-4	4-	D	gas analyzers	water analyzer	incorrect reading	no hazard	safe	operational problem	no
AE	995	V	SHT-4	4-	B	gas analyzers	oxygen analyzer	incorrect reading	no hazard	safe	operational problem	no
AE	996	V	SHT-4	4-	A	gas analyzers	oxygen analyzer	incorrect reading	no hazard	safe	operational problem	no
MV	997	V	SHT-4	6-	E	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no

Instr Code	Tag #	Serv. Code	PID	GRID	LOC	Service Description	Instrument Type	Failure or Error Mode	Hazard or Effect	Hazard Class	Remarks	Operator intervention required*
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
PI	998	V	SHT-4	6-	E	gas analyzers	pressure indicator	incorrect reading	no hazard	safe	operational problem	no
MV	999	V	SHT-4	6-	D	gas analyzers	manual valve	fails open	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
								fails closed	no hazard	safe	operational problem - gas analyzer distribution panel functionality compromised.	no
SP	1001	N2	SHT-1	3-	G	N2 liquid to LBNE 35T	particulate filter	plugs	no hazard	safe	operational problem - reduced liquid liquid to future 35T cryostat	no
MV	1002	N2	SHT-1	3-	G	N2 liquid to LBNE 35T instrumentation	manual valve	fails open	LN2 vents inside PC4	safe	upstream isolation available	no
								fails closed	no hazard	safe	operational problem	no
MV	1003	N2	SHT-1	3-	G	N2 liquid to LBNE 35T instrumentation	manual valve	fails open	no hazard	safe	operational problem - can't isolate instrumentation	no
								fails closed	no hazard	safe	operational problem - can't use instrumentation	no
PI	1004	N2	SHT-1	3-	G	N2 liquid to LBNE 35T instrumentation	pressure indicator	incorrect reading	no hazard	safe	operational problem	no
MV	1005	N2	SHT-1	3-	G	N2 liquid to LBNE 35T	manual valve	fails open	LN2 vents inside PC4	safe	upstream isolation available - Valve will be locked closed until LBNE 35T operation is approved.	YES
								fails closed	no hazard	safe	operational problem	no
MV	1006	N2	SHT-1	3-	G	N2 liquid to LBNE 35T instrumentation	manual valve	fails open	LN2 vents inside PC4	safe	upstream isolation available	no
								fails closed	no hazard	safe	operational problem	no
MV	1007	N2	SHT-1	3-	G	N2 liquid to LBNE 35T instrumentation	manual valve	fails open	no hazard	safe	operational problem - can't isolate instrumentation	no
								fails closed	no hazard	safe	operational problem - can't use instrumentation	no
PSV	1008	N2	SHT-1	3-	G	N2 liquid to LBNE 35T	relief valve	fails open	LN2 vents inside pc4	safe	ODH analysis takes this into account	no
								fails closed	potential trapped volume	safe	Low probability of a quality Circle Seal relief valve failing completely shut. As pressure in the trapped volume exceeded the relief valve set point, the probability of a stuck relief valve opening would increase.	no
PI	1009	N2	SHT-1	3-	G	N2 liquid to LBNE 35T instrumentation	pressure gauge	incorrect reading	no hazard	safe	operational problem	no
PT	1010	N2		3-	G	N2 liquid to LBNE 35T instrumentation	pressure transmitter	incorrect reading	no hazard	safe	operational problem	no

*Operator intervention required to prevent potentially large amounts of cryogenes from spilling into PC4. These valves are tagged and administratively controlled.