

# USING TIME-AT-RISK TO SET MAXIMUM TIME THAT AN IPL CAN BE BYPASSED

## DEFINITIONS

Critical Component/Equipment	A component, loop, or subsystem that part of a possible initiating event (IE) or that is part of an independent protection layer (IPL)
Bypass	Temporary removal of an IPL from service for repair or for inspection, test, calibration, PM
Maximum Out-of-Service Time (MOST)	The maximum time that an IPL can be unavailable, with no alternative path / device available
PFD of an IPL	an order-of-magnitude estimate of the average likelihood of the IPL failing to perform its function on demand, with a large uncertainty

$$PFD_{IPL} = 10^{-x \pm 1}$$

## IPL PFD TOLERANCE

The IPL PFD exponent changes to the next order-of-magnitude once the PFD crosses the mid-point between orders of magnitude on log-log plot, since all risk matrices are actually log-log plots.

### EXAMPLE

PFD = 0.1 (for purposes of LOPA)

x	10 <sup>-x</sup>
0.5	0.316
1	0.100
1.5	0.032
2	0.010
2.5	0.003

Tolerable range: 0.032 to 0.32

	Category 1	Category 2	Category 3	Category 4	Category 5	Category 6
1E+1	Optional (Evaluate alternatives)	Optional (Evaluate alternatives)	Action at next opportunity (consult company EHS)	Immediate action (consult company EHS)	Immediate action (consult company EHS)	Immediate action (consult company EHS)
1E+0	Optional (Evaluate alternatives)	Optional (Evaluate alternatives)	Optional (Evaluate alternatives)	Action at next opportunity (consult company EHS)	Immediate action (consult company EHS)	Immediate action (consult company EHS)
1E-1	No further action	Optional (Evaluate alternatives)	Optional (Evaluate alternatives)	Action at next opportunity (consult company EHS)	Action at next opportunity (consult company EHS)	Immediate action (consult company EHS)
1E-2	No further action	No further action	Optional (Evaluate alternatives)	Optional (Evaluate alternatives)	Action at next opportunity (consult company EHS)	Action at next opportunity (consult company EHS)
1E-3	No further action	No further action	No further action	Optional (Evaluate alternatives)	Optional (Evaluate alternatives)	Action at next opportunity (consult company EHS)
1E-4	No further action	No further action	No further action	No further action	Optional (Evaluate alternatives)	Optional (Evaluate alternatives)
1E-5	No further action	No further action	No further action	No further action	No further action	Optional (Evaluate alternatives)
1E-6	No further action	No further action	No further action	No further action	No further action	No further action

## TIME AT RISK FRACTION OF THE MAXIMUM PFD ALLOWED

Assuming the demand rate on the PFD is once a year or less (which is true about more for more than 95% of the scenarios), then time at risk can be expressed as fractional parts of a year

Days bypassed	Year fraction
0.73	0.002
7.3	0.020
73	0.200

## MOST (MAXIMUM OUT-OF-SERVICE TIME DURING A BYPASS)

Nominal PFD Value	Maximum Value for PFD	Maximum Time at Risk Value (Maximum Value of PFD minus Nominal PFD Value)	MOST (days)
0.1	0.3	0.2	73
0.01	0.03	0.02	7.3
0.001	0.003	0.002	0.73

Note that a **SIL 3 SIF is degraded to a SIL 2** if the bypass of the SIF is more than 0.73 days but less than 7.3 days

