Appendix

Example Application of 1910.119(e)(3)(vii)

Below are excerpts from two different PHA methodologies [What-If Checklist (Figure 1) and HAZOP (Figure 2)]. Each PHA excerpt identifies one hazard/deviation as well as its corresponding engineering and administrative controls, safeguards, recommendation/actions and a quantitative description of consequence, likelihood and the risk priority for the identified hazard. An example (e.g. ❸) of the application of the specific OSHA 1910.119(e)(3) "consequence" requirements are identified on the example PHA worksheets. After the PHA worksheet examples, other examples are provided to illustrate how some employers utilize a risk matrix to comply with the "qualitative evaluation" requirement (1910.119(e)(3)(vii)). As noted earlier, PSM is performance standard, and that these examples may or may not be applicable to your specific situation.

The following is an example of the development and use of a risk matrix. First, a qualitative description of consequence and likelihood/frequency of the hazard based on a failure of engineering and/or administrative controls is established. Figure 3 is the Consequence Table. It is a qualitative description of the range of degrees of consequences related to the identified hazard and its associated failure of controls. These consequences range from 1 – 4, with 4 being the most severe Consequence Class. Figure 4 is the Likelihood Table, it is a qualitative description of the range of likelihood/frequency that an identified engineering or administrative control might fail. The likelihood ranges from 1 – 4, with 4 being the most likely to fail.

Using the Consequence and Likelihood Class numbers a Risk Priority Matrix (Figure 5) can be constructed. The Risk Priority Matrix is used to identify the Risk Class. Once the Risk Class (e.g. C) is determined from the Risk Priority Matrix, the Risk Class can be correlated to the Risk Priority Legend (Figure 6) which prioritizes the hazard as identified by the PHA team. In this case, the PHA team enters the evaluated Consequence Class, Likelihood Class, and Risk Class on the PHA worksheets, Figures 1 and 2.

In the following example PHA worksheets the abbreviations and symbols mean:

C = Consequences Class
L = Likelihood Class
R = Risk Priority Class

❶ - 1910.119(e)(3)(i): address the hazards of the process
❷ - 1910.119(e)(3)(iii): address engineering and administrative controls applicable to the hazards…
❸ - 1910.119(e)(3)(iv): address consequence of failure of engineering and administrative controls
❹ - 1910.119(e)(3)(vii): address a qualitative evaluation of a range of possible safety and health effects of failure of controls…

Figure 1 - Example Worksheet Excerpt from What If/Checklist PHA Methodology
C= Consequence Class, L= Likelihood Class, R = Risk Class

What If...	Consequences/ Hazard	Safeguards	C	L	R	Recommendations/ Action
Emergency Shutdown Valve 23 (ESD - 23) fails to close when needed? (This can occur due to extremely cold weather, reliability due to inspection/ testing/maintenance or design problems) ❶ ❸	Release of highly flammable materials in the operating area. Potential for fire/explosion with employee injuries/fatalities ❶ ❸	1. Specific Inspection/testing/ maintenance program for ESDs 2. Valve actuator sizing 3. ESD-23 is fail closed design ❷	4 ❹	2 ❹	B ❹	1. Due to cold weather modify MI procedures to increase ESD valve testing to 1/2wks. 2. Inspection records for ESD 23 not in file, follow-up to assure ESD-23 inspected as required by MI procedures 3. No equipment data sheet was found for actuator for ESD-23, follow-up with engineering to assure design is correct. 4. Consider over sizing valve actuator

Figure 2 - Example Excerpt from HAZOP PHA Methodology
C= Consequence Class, L= Likelihood Class, R = Risk Class

Deviation	Causes	Consequences	Safeguards	Recommendations/ Actions	C	L	R
Loss of Agitation ❶	Agitator motor fails Electrical utility lost Agitator mechanical linkage fails Operator fails to activate agitator ❶ ❷	Un-reacted HHC in the reactor carried over to Storage Tank 3 (ST-3) and is released to the enclosed work area. Probable injuries or fatalities to workers due to highly acute toxic material hazard ❸	HHC detector and alarm ❷	1. Consider adding alarm/shutdown of the system for loss of agitation to the reactor 2. Ensure adequate ventilation exists for enclosed work area and/or use an enclosed ST-3 3. Update PSI file and Op. Procedure HHC-39 to include consequence of deviation, engineering controls including safety system information, e.g. SIS and emergency ventilation	4 ❹	2 ❹	B ❹

Figure 3 - Consequence Table

Consequence Class	Qualitative Employee Safety Consequence Criteria
1	No employee injuries
2	One Loss Time Injury or Illness
3	Multiple Lost Time Injuries or Illnesses
4	Multiple Lost Time Injuries or Illnesses w/one or more fatalities

Figure 4 - Likelihood Table

Likelihood Class	Qualitative Likelihood Criteria
1	Not expected to occur during the lifetime of the process. Examples – Simultaneous failures of two or more independent instrument or mechanical systems
2	Expected to occur only a few times during the life of the process. Examples – Rupture of product piping, trained employees w/procedures injured during LOTO operation
3	Expected to occur several times during the life of the process. Examples – hose rupture, pipe leaks, pump seal failure
4	Expected to occur yearly. Examples - instrument component failures, valve failure, human error, hose leaks

Figure 5 - Example Risk Priority Matrix

Consequences →					
	4	**C**	**B**	**A**	**A**
	3	**C**	**B**	**B**	**A**
	2	**D**	**C**	**B**	**B**
	1	**D**	**D**	**C**	**C**
		1	**2**	**3**	**4**
Likelihood →					

Figure 6 - Example Risk Priority Legend

Priority →	Risk Class	Explanation of Risk
	A	Risk intolerable - needs to be mitigated within 2 weeks to at least a Class C, if that cannot be accomplished, process needs to be shutdown
	B	Risk undesirable - needs to be mitigated within 6 months to at least a Class C
	C	Risk tolerable with controls (engineering and administrative)
	D	Risk acceptable – no further action required