Robotic Safeguarding

- Establish, minimize and safeguard the restricted space

- Safeguard personnel outside of cell
  - Install perimeter guarding
  - Permit material flow

- Safeguard personnel entering cell
  - Interlocked access
  - Entry procedure
  - Personal control over restart
  - Control of hazardous energy
Robotic Safeguarding

- Safeguard personnel from point of operation/process hazards
  - Process hazards
    - Arc flash
    - Flumes
    - Radiation
    - Noise
    - Heat

Six Point Check List

1. Risk assessment
2. Safeguard personnel outside
   2.1 Perimeter guard with interlocked access
   2.2 Safeguard material flow in and out
   2.3 Safeguard operator stations
3. Provide energy isolation
4. Provide means to work within cell
5. Ensure safety functions achieve necessary integrity levels
6. Provide awareness, signs and safety instructions
Robotic Safeguarding

2. Safeguard personnel outside
   2.1 Perimeter guard with interlocked access
   2.2 Safeguard material flow in and out
   2.3 Safeguard operator stations
Industrial Robot Safety Training Program

Safety Essentials for the Robot Integrator

Locate perimeter fence outside of reach or contain robot

Robot control outside of safeguarded space

Provide required clearance and safe place to program

Safety Essentials for the Robot Integrator

Apply perimeter guarding

Safeguard material entry and exit

Provide interlocked gates
Industrial Robot Safety Training Program
Safety Essentials for the Robot Integrator

Locate emergency stop buttons

The robot can reach beyond the safeguarded space

Safeguarded Space

Maximum Space

Operating Space
A limiting device reduces the restricted reach. The perimeter fence is outside or contains the robot.

Robotic Safeguarding

- Material must flow in and out
- But personnel must not have access to internal hazards
Industrial Robot Safety Training Program

Safety Essentials for the Robot Integrator

Muted Light Curtains
Robotic Safeguarding – Point of Operation Hazards

- Safeguard hazards created by robot task and process
  - Arc weld flash, expulsions, sparks
  - Noise
  - Dust
  - Fumes
  - Excessive heat or cold
Safeguard the Load Station

Robotic Safeguarding – Safeguard personnel entering the cell.

- Provide personal control
  - Prevent re-initiation
    - Lockout
    - Alternative Protective Measures

- Teaching/jogging
  - Slow Speed
  - Enable Switch

- Provide clearance and a safe place to work.
Industrial Robot Safety Training Program

Safety Essentials for the Robot Integrator

Robotic Safeguarding – Safeguard personnel entering the cell.

- Original OSHA 1910.147 is still the regulation
- New ANSI/ASSE Z244.1: Highlights new Alternative Protective Methods – APM’s

Lockout Procedure and Placard
- Preparation for shutdown
- Machine or equipment shutdown
- Machine or equipment energy isolation
- Application of lockout device
- Control of stored energy
- Verification of isolation
### Typical Robot Energy Sources

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Isolation Device</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical Power</td>
<td>Electrical disconnect for controller</td>
</tr>
<tr>
<td>Compressed Air</td>
<td>Air to grippers</td>
</tr>
<tr>
<td>Gravity</td>
<td>Weight of arm held by brakes</td>
</tr>
<tr>
<td>Potential Energy</td>
<td>Balance springs and cylinders</td>
</tr>
</tbody>
</table>

### Typical Robot System Energy Isolation

- Safety Essentials for the Robot Integrator
When don’t I need to perform an energy isolation lockout?

Permitted per the OSHA exception rule
- Only routine and repetitive tasks integral to production
- Tasks must meet most of the criteria for routine and repetitive
- Provide an effective alternative means of protection (APM)
- The APM must be selected per a risk assessment

Criteria for Task Selection

Per Z244.1, the task must meet **most** of the following criteria

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short in duration</td>
<td>Predetermined cyclical activity</td>
</tr>
<tr>
<td>Relatively minor</td>
<td>Expected to occur regularly</td>
</tr>
<tr>
<td>Occurs frequently</td>
<td>Minimally interrupt production</td>
</tr>
<tr>
<td>Performed by operator or maintenance</td>
<td>Exist even under optimal levels</td>
</tr>
<tr>
<td>No extensive disassembly</td>
<td>Required task specific training</td>
</tr>
</tbody>
</table>
Safety Essentials for the Robot Integrator

Awareness Means

Use to identify residual risk after main safeguards are implemented

May be:
- Awareness barriers
- Lights
- Horns
- Safety signs

Questions?

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