CONVEYOR EQUIPMENT MANUFACTURERS ASSOCIATION

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2023 CEMA ENGINEERING CONFERENCE
CONVEYOR CONTROLS COMMITTEE MEETING
Naples Grande Beach Resort, Naples, FL
Monday, June 12, 2023 – 1:00 pm

AGENDA

1. Call to order.

2. Attendance and Introductions.

3. Approval of Minutes of November 8, 2022 (attached).

4. NFPA79 and ASME B20 – Updates
   NFPA79 is the Electrical Standard for Industrial Machinery that conveyor equipment designs must meet by law.

   ASME B20.1 Standard is the conveyor safety standard included in OSHA regulations by reference and applies to Bulk and Unit conveyors.

   These standards aim to be the main resource for engineering design.

5. Old business
   a) **CEMA Safety Best Practices SBP-002 "E-Stop Application Guide for Unit Handling and Bulk Material Handling Conveyor Systems" Discussion** – Updates
   Subcommittee: Troy Uahinui, Honeywell Intelligrated; Hans Rodgers, SEW-EURODRIVE, Inc.; Pat Knapke, PulseRoller; Mitch Burkert, Dematic Corp.; Richard Kosik, ITOH Denki USA, Inc.; Todd Swinderman, RToddS Engineering LLC.; Mark Corsmeier, Honeywell Intelligrated; Bjorn Kulsen-Hansen, Industrial Kinetics, Inc.

   The committee agreed to create a subcommittee to continue studying the SBP-002 and determine how the document can be improved for a more defined and refined application within the material handling industry.

   The CEMA's Unit Handling Safety Subcommittee requested that this committee develop a list of factors to be considered when creating a risk assessment. This subcommittee started virtual meetings in order to review in detail this document.

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b) **White papers or case studies**. Volunteers needed.

- CIP (Common Industrial Protocol) Safety
- Diagnostics/Condition monitoring
- Grounding/Shielding Practices
- Electrostatic Discharge Challenges
- Wireless Pendants
- Safety PLCs
- Intrinsic Safety Techniques
- Field Bus Communication Types
- Alternate Controls for Minor Servicing Exceptions

c) **White Papers** – Updates
- DC Power Rollers or Communication Standards – Pat Knapke, PulseRoller
- Redundant PLCs/Downstream Devices – Andrew Jennings, Conveyor Dynamics, Inc.
- STO (Safe Torque Off)– Adam Soder, Sumitomo Drive Technologies

d) Explosion-proof basics for general membership - Updates
Volunteer: Hans Rodgers, SEW-EURODRIVE, Inc.

e) Brainstorming **new ideas for discussion** within the Conveyor Controls Committee
- Safety PLC General Overview – Volunteer needed.
- Alternative Control Measures, where allowed, how applied – it was mentioned that other standards refer to safeguarding as administrative measures and offer certain procedures to follow.

f) **Condition Monitoring for Overall System Document** (From CEMA's Bulk Belt Systems and Emerging Technologies Committee)
Subcommittee: Hans Rodgers, SEW-Eurodrive, Inc. (Chair); Andrew Hustrulid, Shaw Almex Industries Ltd.; Andrew Jennings, Conveyor Dynamics, Inc.; David Jesse, Lassing Dibben Consulting Engineers Ltd.; Al Reicks, Overland Conveyor Co. Inc.; Chad Brown, Dodge Industrial, Inc.; Dan Miners, Cambelt International LLC; Adam Soder, Sumitomo Drive Technologies.

It was agreed that this discussion should be in this committee and no longer in the CEMA's Bulk Belt Systems and Emerging Technologies Committee. It was mentioned that there are different options for monitoring like wireless, fiber optic cable, etc., used in the conveyor industry.

The idea is to provide a document that would give end-users advice on the practical use and interpretation of the data.

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6. New Business.
    a) Election of a Vice Chair

7. Next Meeting – November 7, 2023, Virtual CEMA Fall Engineering Conference.

8. Adjourn.

Hans Rodgers, Chair

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2022 CEMA FALL ENGINEERING CONFERENCE
CONVEYOR CONTROLS COMMITTEE MEETING
Cisco Webex Meetings
Tuesday, November 8, 2022

MINUTES

1. Call to order
   Hans Rodgers, SEW-EURODRIVE; Chair, called the meeting to order at 3:35 pm.

2. Attendance and Introductions – Roll call attached.

3. Approval of Minutes of June 14, 2022 – Minutes were approved.

4. Old business
   a) **NFPA79 and ASME B20** – Updates.
   NFPA79 is the Electrical Standard for Industrial Machinery that conveyor equipment designs must meet by law.

   ASME B20.1 Standard is the conveyor safety standard included in OSHA regulations by reference and applies to Bulk and Unit conveyors.

   The current version of NFPA79 is the 2021 version. It provides safeguards for industrial machinery to protect operators, equipment, facilities, and work-in-progress from fire and electrical hazards.

   The current version of ASME B20.1 is the 2021 version. It applies to the design, construction, installation, maintenance, inspection, and operation of conveyors and systems concerning hazards.

   b) **CEMA Safety Best Practices SBP-002 "E-Stop Application Guide for Unit Handling and Bulk Material Handling Conveyor Systems" Discussion** – Updates
   Subcommittee: Troy Uahinui, Honeywell Intelligrated; Hans Rodgers, SEW-EURODRIVE, Inc.; Pat Knapke, PulseRoller; Mitch Burkert, Dematic Corp.; Greg Edwards, Schneider Electric; Richard Kosik, ITOH Denki USA, Inc.; Todd Swinderman, RToddS Engineering LLC.

   The committee agreed to create a subcommittee to continue studying the SBP-002 and determine how the document can be improved for a more defined and refined application within the material handling industry.

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No work has been done. It was requested send the last approved version to the subcommittee members for review.

The CEMA's Unit Handling Safety Subcommittee requested that this committee develop a list of factors to be considered when creating a risk assessment. Mitch Burkert, Dematic; volunteered for this subcommittee from the CEMA's Unit Handling Safety Subcommittee.

Mark Corsmeier, Honeywell Intelligrated; Bjorn Kulsen-Hansen, Industrial Kinetics, Inc. volunteer to the subcommittee.

c) Brainstorming for new **white papers or case studies**. Volunteers needed

- CIP (Common Industrial Protocol) Safety
- Diagnostics/Condition monitoring
- Grounding/Shielding Practices
- Electrostatic Discharge Challenges
- Wireless Pendants
- Safety PLCs
- Intrinsic Safety Techniques
- Field Bus Communication Types
- Alternate Controls for Minor Servicing Exceptions

No volunteers at this time.

d) **White Papers** – Updates
- DC Power Rollers or Communication Standards – Pat Knapke, PulseRoller
- Redundant PLCs/Downstream Devices – Andrew Jennings, Conveyor Dynamics, Inc.
- STO (Safe Torque Off)– Adam Soder, Sumitomo Drive Technologies

None of the volunteers were present to provide updates on their work. Tabled until the 2023 CEMA Engineering Conference.

e) Brainstorming **new ideas for discussion** within the Conveyor Controls Committee
- Safety PLC General Overview – No volunteers at this time.
- Explosion-proof basics for general membership – Hans Rodgers will develop a draft.
- Alternative Control Measures, where allowed, how applied – it was mentioned that other standards refer to safeguarding as administrative measures and offer certain procedures to follow.

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5. New Business
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   It was agreed that this discussion should be in this committee and no longer in the CEMA's Bulk Belt Systems and Emerging Technologies Committee.

   It was mentioned that there are different options for monitoring like wireless, fiber optic cable, etc., used in the conveyor industry.

   The idea is to provide a document that would give end-users advice on the practical use and interpretation of the data.

   b) **CEMA Conveyor Controls Committee involved in other CEMA Committees/Sections**
   Hans Rodgers suggested that this committee could attract more volunteers can offer a report during the CEMA's Bulk Handling Section, and Unit Handling Section Meetings regarding the projects under development by the committee.

   Additionally, if there is a need for a new publication related to controls that need to be discussed/developed/reviewed in this committee (controls) is an easy and faster way to address them.

6. Next Meeting – June 12, 2023, LaPlaya Beach & Golf Resort, Naples, FL.

7. Meeting was adjourned at 4:30 pm

Hans Rodgers, Chair

CONVEYOR EQUIPMENT
MANUFACTURERS ASSOCIATION

CEMA SBP-002 - 2022
Revision of CEMA SBP-002 - 2016
Approved: **XXXXX**

Safety Best Practices Recommendation
CEMA SBP-002 - **Draft 4**

E-Stop Application Guide for Unit and Bulk Material Handling Conveyor Systems

Conveyor Equipment Manufacturers Association, Inc.

DISCLAIMER

The information provided herein is advisory only.

These recommendations provided by CEMA are general in nature and are not intended as a substitute for professional advice. Users should seek the advice, supervision and/or consultation of qualified engineers, safety consultants, and other qualified professionals.

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FOREWORD

This document shall be used in conjunction with the applicable current standard of ASME B20.1 “Safety Standard for Conveyor and Related Equipment.”

TABLE OF CONTENTS

1. DEFINITIONS

The following definitions are both specific to this document and generic to the material handling industry where such definitions can be found.

Accessible, Readily (as applied to E-Stop actuators): The rapid visual contact and recognition of an Emergency Stop (E-Stop) actuator that is capable of being reached quickly for operation without a need to climb over or remove obstacles.

E-Stop Purpose: To disable or stop any motion hazardous to personnel, equipment or product as quickly as is safe and practical without creating additional hazards.

E-Stop Actuator: The mechanism which the operator interfaces with and, in turn, causes the E-Stop device to register an emergency stop state.

E-Stop Application Criteria: Required on equipment on which there is a reasonable potential for injury to personnel, moving components or conveyables. The potential for injury from falling conveyables must also be considered.

E-Stop Device: A push-button switch, cable-operated switch, active electronic sensing or other component that is manufactured with the specific intent to be used as an input, logic or output device as part of the E-Stop function.

E-Stop Interlocking: Where an E-Stop associated with one control cabinet will be required to initiate an E-Stop condition in another control cabinet/E-Stop zone, such as when two independent control areas have transportation conveyors running adjacent to each other en-route to a merging operation.

E-Stop Panel: This is an independently powered relay cabinet that will not shut down if one or more of the interlocked control cabinets are shut down.

E-Stop Zone: The physical area in which the conveyor equipment motion is stopped when an E-Stop device is actuated, in accordance with an agreed-upon risk assessment.

Functional Safety: The part of the overall safety of a system or piece of equipment that depends on the system or equipment operating correctly in response to its inputs, including the safe management of likely operator errors, hardware failures and environmental changes.

General Access Area: Designated passageways/walkways where trained operators will travel between work stations and other areas such as break rooms, offices, restrooms, supply rooms, or other areas employees are required to travel in the course of their normal duties. During the course of travel these operators may utilize stairs, ladders, crossovers, gates, etc. in order to access work stations and may pass under, over or adjacent to operating conveyor equipment.

Guarded by Location Area: Describes areas where moving parts are so protected by their remoteness from the floor, platform, walkway, or other working level or by their location with reference to frame, foundation, or structure as to reduce risk of accidental contact by persons or objects. Remoteness from regular or frequent presence of public or employed personnel may, in reasonable circumstances, constitute guarding by location. Unprotected danger points and areas that are inaccessible to the operating personnel in the normal performance of their duties shall be considered guarded by location.

Lock-Out Device: Any approved device that can be used to lock out or isolate any or all potential energy sources, such as electrical, air, or kinetic, that might cause unexpected movement of machine components. See current edition of ANSI Z244.1 “American National Safety Standards for Lock-out Tag-out of Energy Sources.

Minor Servicing: Activities, which take place during normal production operations and which are routine, repetitive, and integral to the use of machine/equipment for production. Based on the results of a risk assessment, minor servicing tasks may be determined to be at an acceptable risk level and do not require the use of a lock-out device to isolate power during the task. See OSHA 29 CFR 1910.147 (a)(2)(ii) and ASME B20.1-2015 (5.4).

Observable: Point from which an operator has an unobstructed view and can make a reasonably sound evaluation on the state/condition of a situation (maximum distance of 100 ft). [(1)]

Restricted Access Area: Areas of the material handling system that do not meet the above two defined areas (General Access and Guarded by Location) and do not have a normal presence of trained operators or allow operators to enter this area in the performance of their normal duties.

Work Station: A physical location where a person is normally positioned, which is located by design and supported with facilities necessary for a person to perform prescribed work duties. This position would not apply to maintenance location.

Note: For the purpose of this document, the term “conveyor” applies to all powered material handling equipment that transports a product.

[(1)] Distance based on several studies on effectiveness of eyewitnesses’ ability to recognize fine and gross details at various distances

2. OBJECTIVES

The following objectives form the basis toward which we must strive in E-Stop application. Occasionally, these objectives must be tempered with the realities of practical application such as equipment density, equipment interfaces, and customer operational preferences, which can be evaluated using established risk assessment methods.

- Stop the conveyor motion when a hazardous situation is observed in order to prevent or minimize accidents that may result in injury to personnel, damage to equipment or damage to conveyables.
- Stop the hazardous motion as quickly as possible, without generation of other hazards, in the event that an accident has occurred.

⚠ CAUTION Do not apply E-Stop equipment in a manner that might entice, encourage or otherwise facilitate unsafe practices.

⚠ WARNING Do not deviate from the established guidelines or standards without evaluating the safety of those changes in the specific situations using an established risk assessment method.

3. GUIDELINES COMMON TO ALL CONVEYORS

The following section contains guidelines which apply generally to all conveyor types.

3.1 Application Rules for E-Stop Hardware/Devices

- Only E-Stop devices that are designed and manufactured with the intent to function for that purpose shall be used.
- The use of an E-Stop, to prevent unintentional motion while clearing jams and other minor servicing, is permitted under the OSHA minor servicing exception, as long as the person servicing the equipment is in control of the E-Stop.
- E-Stop circuits must be analyzed and designed according to consensus standards NFPA 79, ISO 13849, or IEC 62061.
- E-Stop circuits, when activated and the stop cycle completes, shall ensure that no torque-generating energy can continue to act upon a motor and also prevent unintentional initiation of hazardous motion.
- E-Stop stopping cycle behavior is defined by NFPA 79. For most conveyors, a Category 0 Emergency Stop will immediately remove power to the conveyor actuators resulting in an uncontrolled stop. When an uncontrolled stop is more hazardous than a controlled stop, the E-Stop shall trigger a Category 1 Emergency Stop. This cycle is a controlled stop where power is not removed until the stop is complete.
- The suspension of a safety function must be replaced by another safety function with the equivalent performance level.
- E-Stop circuits shall stop air or hydraulic powered devices by interrupting the power source in such a manner that hazardous motion due to kinetic energy or other means does not occur.
- E-Stop electrical devices and systems must be designed such that they require manual reset at the point of electrical actuation before a restart sequence can begin.
- Resetting the activated E-Stop device must not automatically restart the equipment. Equipment restart must be initiated by start controls of the associated equipment only after the activated E-Stop device has been manually reset, and begin only after the normal startup sequence including delays and warnings has occurred. Equipment interlocked with the associated cabinet will also restart (or not) per the sequence of operation. No equipment will restart without appropriate warning and delay.
- Apply only those E-Stop devices and systems that meet accepted company, industry, engineering, and government standards for performance, appearance, and electrical design.
- E-Stop switches, and actuators must be recognizable and distinct from any other controls:
  - The actuator of a pushbutton-operated device shall be of the palm or mushroom head type.
  - E-Stop pushbutton actuators shall be colored red. The background immediately around an E-Stop pushbutton shall be colored yellow.
  - Pull cords for pull cord switches should be provided in a high visibility color which allows rapid identification.
  - Other E-Stop switches and actuators should be clearly labeled or be a high visibility color.
- E-Stop devices, and systems, regardless of type, will effectively stop all hazardous motion in the controlled E-Stop zone.
- Pull cords shall be tested, at actuation points, to ensure the manufacturer's recommended performance is within the limits for the maximum deflection and pull force. An anti-friction device may be used to reduce pull force to extend the distance when changing direction.

3.2 Placement Rules for E-Stops Affecting All Accessible Powered Equipment

- Apply an approved E-Stop device mounted to or available nearby to all control cabinets on which there are external controls that stop, start or monitor conveyor operation.
- Apply E-Stops so that they control all conveyors observable from where that E-Stop can be actuated, where practical.
- E-Stop devices are not required to be readily accessible to personnel for conveyors that are guarded

by location, provided such or additional guarding can reasonably prevent contact with the conveyor and injury to personnel from falling conveyables.

- An E-Stop must be provided at reasonable intervals consistent with equipment type and density, expected operational parameters, reasonable foreseeable misuse and training levels of personnel expected to be in the area.
- Apply an E-Stop at hazards that cannot otherwise be protected in a practical manner and are accessible by personnel.
- Extend E-Stop cords to accessible areas where practical, unless additional electrical devices would be needed.
- Maintain consistency when determining the functions, locations, arrangements, labeling, and appearance of emergency stop system cords and switches within the same installation wherever possible.
- For unit handling conveyor E-Stop placement rules refer to Section 4.2.
- For bulk handling conveyor E-Stop placement rules refer to Section 5.2.

3.3 E-Stop Interlocking

E-Stop interlocking applies to situations where an E-Stop device associated with one control cabinet will be required to initiate an E-Stop condition in another control cabinet/E-Stop zone. For example, this occurs when two independent control areas have conveyors located adjacent to each and are observable.

- Provide interlocks between independent control sections in an effort to maintain compliance with the criteria specified in first two bullet points of Section 2.
- Provide E-Stop interlock capability for third party equipment expected to be in the area.
- Interlocks should be provided between independent OEM equipment controls as specified in section 2, first two bullet points.

E-Stop electrical/electronic interlocking is typically accomplished via one of the methods listed below:

- One or more E-Stop relays in each cabinet with contacts wired to other cabinets for interlocking on a zone-to-zone basis.
- Single E-Stop device: A single E-Stop device being interlocked to another area can be equipped with multiple isolated contacts: one set for each control cabinet/E-Stop zone.
- Dedicated E-Stop panel: An E-Stop panel is an independently powered relay cabinet that will not shut down if one or the other interlocked control cabinets is shut down. The E-Stop devices are connected to the E-Stop panel which is then interlocked to the appropriate control cabinets on a zone-by-zone basis.
- Multiple E-Stop devices: When one or more independently powered E-Stop devices must be interlocked to one or more additional cabinets, an E-Stop panel may be employed to avoid an unnecessary shutdown of interlocked cabinets.
- Safety-rated communication between safety controllers.

Operation of interlocked E-Stop zones is as follows:

- The cabinet associated with the actuated E-Stop device will comply with all rules specified in Section 3.1.
- The interlocked cabinet E-Stopped zone works as follows:
  - When the remote E-Stop device is actuated, the interlocked cabinet/E-Stop zone immediately goes into an E-Stop shutdown cycle.
  - Recommend that the E-Stop indicator on the interlocked control cabinet will uniquely signal to user (light or sound), indicating that the E-Stop condition is remote from that controlled area.
  - When the E-Stop device is reset and the associated control cabinet is restarted, the interlocked cabinet/E-Stop zone may restart after a minimum of a five - second audible alarm. No physical reset in the interlocked cabinet is required.

3.4 Inspection and Testing

- E-Stops must be validated after installation and before delivery to the end user. The validation process must be documented and performed by qualified personnel.
- E-Stops must be inspected and tested at a frequency that complements the hazard being guarded. This frequency should be documented as a time period or system output in the documentation given to the customer.
- Testing shall be done with the conveyor operating. The safety system response and feedback must be verified to be consistent with the intended design.
- E-Stop switches, and actuators should be clearly labeled or be a high visibility color.

4. GUIDELINES SPECIFIC TO UNIT HANDLING CONVEYORS

The following section contains guidelines which apply to unit handling conveyors.

4.1 Application Rules for E-Stop Hardware/Devices

- An E-Stop must be provided at reasonable intervals consistent with equipment type and density, expected operational parameters, reasonable foreseeable misuse and training levels of personnel expected to be in the area.
- When E-Stops are configured to function as lockout devices, the performance must meet or exceed the performance of a dedicated supply disconnect means.
- Pull cord E-Stop switch systems shall be slack detection type to operate and activate an emergency stop condition should a cord break or come loose.
- An E-Stop must stop all hazardous motion within the defined E-Stop Zone.

4.2 Primary Placement Rules for E-Stops

- Apply an E-Stop actuator within reach (maximum of 1.5 m (5 ft) of any designated “Work Station” that directly interfaces with powered conveyors. (See Section 1 for definition of “Work Station”).
- Apply an E-Stop actuator such that “E-Stop Access” is provided within 7.5 m (25 ft) for any point along a conveyor in a “general access area”. (See Section 1 for definitions of “E-Stop access” and “general access area”).
- Apply an E-Stop actuator such that “E-Stop access” is provided within an unobstructed travel distance of 30 m (100 ft) of any point along a conveyor in a “restricted access area”. (See Section 1 for definitions of “E-Stop Access” and “Restricted Access Area”).
- The placement rules, listed in the Common Guidelines Section 3.2, are supplementary to the primary.

4.3 E-Stop Interlocking

There are no unique interlocking requirements. Refer to Section 3.3 for more information.

4.4 Typical Areas for E-Stop Application

The following are examples of typical areas and types of equipment where E-Stops would or could be applied on unit handling conveyors. This section is not intended to be a complete listing of where E-Stops are to be applied, nor does it mandate that E-Stops be applied in all the situations listed.

- Pick modules, picking conveyors
  - Conveyor: Cords along the entire accessible length.
  - Gates: None if non-powered or often fall under the low hazard exception determined by established risk assessment methods.
  - Accessible feed and take away conveyors unless they are within 7.5m (25 ft) of an E-Stop actuating device.

- General duty conveyors with operator access: Follow distance requirements in Section 4.2 for the following:
  - Belt conveyor
  - Live roller conveyor (including lineshaft driven and accumulation conveyors)
  - Transfers
  - Transportation corridors
- Merges:
  - Central (large): Pull cord protection where generally accessible
  - Remote (mini): Mushroom switch or pull cord within 7.5 m (25 ft)
  - Alligators (pivot belts): Mushroom switch or pull cord where readily accessible
- Induction: Cord along accessible length
- Sorters:
  - Slat: Cord along accessible length
  - Tube: Cord along accessible length
  - Pop-up wheel or roller: Cord along accessible length
  - Isolated diverters: Require individual evaluation based on access
- Trailer loaders and unloaders:
  - Control station mushroom switch at the end of a decline or incline
  - Interlock loader/unloader to feed/takeaway conveyor and other visible conveyors
- Pallet Conveyor:
  - Roller transport or accumulation conveyors. Cord protection or within 7.5 m (25 ft) if generally accessible
  - Chain: Cord protection on all generally accessible areas
- Transfers: Cord protected if generally accessible; button or cord protection within sight if not accessible
- Scale conveyor
- Miscellaneous equipment utilizing conveyor, “Third-party”, such as those components listed below, the denser coverage of: manufacturer’s recommendations or per these specifications if the supplier integrates the equipment. Individual installations are to be evaluated for additional needs.
- Stretch wrappers
- Depalletizers
- Palletizers
- Strappers/tapers
- Those conveyors where moving surfaces and general arrangements qualify under the low energy exception need not be provided with access to E-Stop devices as long as all residual hazards are assessed to be at an acceptable risk level.

5. GUIDELINES SPECIFIC TO BULK HANDLING CONVEYORS

The following section contains guidelines which apply to bulk handling conveyors.

5.1 Application Rules for E-Stop Hardware/Devices

- E-Stop circuits, when activated, shall stop the conveyor as fast as possible without damaging the equipment or creating new hazards. However, uncontrolled stops can create additional hazards on some conveyors, such as downhill regenerative conveyors.
- An E-Stop must stop all hazardous motion within the defined E-Stop Zone.

5.2 Placement Rules for E-Stops

- Refer to the placement rules, listed in the Common Guidelines Section 3.2.
- Apply pull cord E-Stops such that “E-Stop access” is provided along the full length of belt feeders and belt conveyors normally accessible from walkways, floors, or platforms.

- Apply an E-Stop actuator such that “E-Stop access” is provided within an unobstructed travel distance of 15 m (50 ft) of any point along a conveyor in a “general access area” where pull cord E-Stops cannot be practically applied.

5.3 E-Stop Interlocking

There are no unique interlocking requirements. Refer to section 3.3 for more information.

5.4 Typical Areas for E-Stop Application

The following are examples of typical areas and types of equipment where E-Stops would or could be applied. This section is not intended to be a complete listing of where E-Stops are to be applied, nor does it mandate that E-Stops be applied in all the situations listed.

- Bulk Conveyors: Along the carrying run of the conveyor terminating at the head and tail ends of the conveyor.
- Those conveyors where moving surfaces and general arrangements qualify under the low energy exception need not be provided with access to E-Stop devices as long as all residual hazards are assessed to be at an acceptable risk level.
- Bulk components and accessories such as sampling devices, magnetic separators, crushers, screens, de-lumpers and any similar equipment that is electrically controlled.
- Along the length of travel for tripper or stacking conveyors.
- Along the accessible side(s) of shuttle conveyors.
- Shall be provided at points where personnel could come in contact with cables, chains, belts, and runways of exposed bucket conveyors.
- Shall be provided on material encapsulating conveyors, unless guarded by location or position, at unguarded nip points.
- Accessible carry and return idlers at convex and horizontal curves.
- As determined by risk assessment.

6. SPECIAL APPLICATIONS OR AREAS

In areas and applications where the preceding rules do not appear to apply, such as the following, the situation should be analyzed and qualified using established risk assessment methods:

- Hazardous special equipment
- Unusual controls configurations
- Special operational factors
- Sub-standard training levels of personnel with access to the area
- Restricted Access Facility

7. REFERENCES

The following is an abbreviated list of related references, technical reports, and national and international standards. Referenced documents are for the current versions at the time of publishing this guide

- ASME B20.1 Safety Standard for Conveyors and Related Equipment
- ASME B30.13 Storage/Retrieval (SR) Machines and Associated Equipment
- CEMA – Technical Report 2015-01 Recommended CEMA Risk Assessment Process
- ISO 13849 – Safety of machinery - Safety-related parts of control systems
- ISO 12100 – General principles for design — Risk assessment and risk reduction
- IEC 62061 - Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems
- NFPA 79 - Electrical Standard for Industrial Machinery
- RIA R15.06 Industrial Robots and Robot Systems

- OSHA CPL 02-00-147 The Control of Hazardous Energy – Enforcement Policy and Inspection Procedures
  - Minor servicing exception -- §1910.147(a) (2) (ii)
- OSHA 29CFR 1910.147 Lock-out/Tag-out
- CEMA Belt Conveyors for Bulk Materials, 7th ed., 2014
- CEMA Application Guide for Unit Handling Conveyors, 2nd ed., 2016