



Stage Machinery Working Group
E1.64 - 202x, Stage Machinery Control Systems in the Entertainment Industry

PR2 comment resolutions

Reference document: E1.64 - 202x, *Design, Manufacturing, Inspection, Operation, and Maintenance of Stage Machinery Control Systems in the Entertainment Industry [DCN SL/2023-10002r2]*

ANSI Public review period: 11 August 2023 through 25 September 2023

Question: In your opinion, do you think the requirements of E1.64 - 202x, *Design, Manufacturing, Inspection, Operation, and Maintenance of Stage Machinery Control Systems in the Entertainment Industry*

Please answer the question using one of the options below. Select “Yes”, “Yes, but...” (provide comments to support your opinion), or “No, with reasons” (the document’s requirements are unacceptable or unreasonable).

Responses:

Bruce Darden, InterAmerica Stage	Yes
Steve Walker, Steve A Walker & Associates (SW)	No, with reasons
Craig Roberts, TAIT (CR)	No, with reasons

Individual Comments:

No.	Commenter	Ref. section	Comment	resolutions
1	SW	Overall	This draft is poorly organized and difficult to follow. Sections 15, 16, 17, and 18 give general requirements that would be better stated early in the document (After section 4). The use of multiple unnumbered paragraphs, many with different concepts and requirements, is difficult to follow or reference.	On the contrary – the organization is very deliberate. The sections in question follow the general mechanical and electrical requirements of a motion control system. The sections in question refer to use and operation and are strategically placed to follow suit with other ESTA standards.
2	CR	Foreword	This standard relies on the Hazard Analysis and Risk Assessment process but assumes the relative safety of machinery types (acoustic curtains vs wagons). Suggest removal of later part of sentence.	Agree – sentence edited to use ‘may’ and now reads; <i>“Performer flying, for instance, may have different requirements than variable speed chain hoists, stage lifts may need more sensors than powered hoist systems, and acoustic curtains may pose less risk of harm than turntables or wagons.”</i>
3	SW	Scope	Virtually all this document has requirements for control systems with a PES while ignoring systems without a PES. Either the scope needs to be limited to control	In principle the task group agreed to rephrase the scope but disagree that the document is focused only on systems with a PES. All sections with the exception of the ones that

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			<p>systems with a PES or needs to cover all control systems.</p> <p>In the second paragraph replace “associated ESTA published stage machinery standards” with “appropriate machinery and rigging standards.”</p> <p>The fifth paragraph referencing ESTA’s TSP web page gives general information with no requirements and would be better as an annex note.</p>	<p>specifically address PES can be used for simple push button systems.</p> <p>The section now reads;</p> <p><i>“This standard establishes minimum requirements for the design, manufacture, installation, commissioning, inspection, operation, and maintenance of machinery control equipment in the Entertainment Industry including equipment that is used in production, touring, and temporary or permanent installation.</i></p> <p><i>This standard offers guidance in the selection of sensors used to provide feedback of information gathered from the machinery and sent to the control system. It focuses on control equipment, user devices, enclosure assemblies, and directly with the action/reaction of signals sent to or from the control equipment and not the specific mechanical actuators and machinery that send and receive those signals.</i></p> <p><i>Machinery standards may have additional requirements for control equipment, control system safety requirements, and/or user interface(s) that are directly related to the application, use or mechanical systems covered by those standards. The reader should refer to the ESTA Technical Standards Documents web page at https://tsp.esta.org/tsp/documents/published_docs.php and combine the requirements and recommendations of this standard with the machinery standard that matches the application</i></p> <p><i>The assemblies covered by this standard are limited to voltages of not greater than 1000 volts.”</i></p>
4	CR	2.2 References	<p>ISO13849 should be ISO13849-1. Suggest including ISO13849-2 "Safety of machinery - Safety related parts of control systems - Part 2: Validation". Check for consistent capitalization of all publication names</p>	<p>Agreed – changes made as suggested.</p>
5	SW	3.1 Actuator	<p>As used in this draft, it refers to a machine and “machine” would be a better term.</p>	<p>Rejected – the focus of this standard is to control the actuator that is driving the machine. That being the motor, hydraulic ram, or other device.</p>
6	SW	3.17 encoder	<p>An encoder is one type of position sensor. Wherever used in this draft it referenced as “encoding and position sensing”. There is no need for a separate definition.</p>	<p>Agreed in principle – the discussion surrounding this comment took us to review section 7.17 where we removed the work “encoding” and retained “position sensing”. The definition of</p>

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				<p>encoder was not altered. Section 7.17 now reads;</p> <p><i>“7.17 Position sensing* Position sensing hardware shall be selected based on the following criteria:</i></p> <ul style="list-style-type: none"> <i>• the type of signal required by the receiving device</i> <i>• the mechanical attachment to the equipment being measured</i> <i>• the resolution required for measurement accuracy</i> <i>• the minimum and maximum data management capabilities of the receiving device</i> <p><i>There shall be a method to restore lost position information caused by power down or power loss to the position sensing equipment. (see annex note)</i></p> <p><i>Where machinery may be operated while encoder receiving equipment is powered off, the use of absolute encoders is recommended.”</i></p> <p>Further to the above the annex note has been updated to read</p> <p><i>“A7.17 Position sensing. Position sensors may include any input device that can be utilized for the purpose of scaling position.</i></p> <p><i>Restoration of lost positioning requires a procedure that ensures the user is able to confirm the restored position is accurate. Restoration of lost position data may be performed via homing sequence or by reloading position data stored or backed up to a secondary device or in non-volatile storage.</i></p> <p><i>The use of analog encoding systems on stage machinery is not recommended.</i></p> <p><i>When using single ended digital encoders, attention should be given to ensure consistency and quality of signal.”</i></p>
7	CR	3.19	<p>"Enabling Device" is not used in this document, and definition does not functionally differ from 3.24 Hold-to-Run device. Suggest removing "Enabling Device" from definitions.</p>	<p>Enabling device is used 2 times in the document in section 15.13 to describe remote usage. This section has been updated to clarify the differences between the HTR and the use of an enabling device and now reads;</p> <p><i>The architecture of the installation of a stage machinery</i></p>

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				<p><i>control system shall allow for the user to have first-person visual contact with all loads in motion.</i></p> <p><i>Manufacturers of stage machinery control equipment shall inform their users of the importance of first-person visual contact in their user guides and manuals.</i></p> <p><i>Where the user is unable to gain first-person visual contact with the loads in motion due to constraints of the installation, a risk assessment shall be performed to determine the specifics of a secondary system for visual contact.</i></p> <p><i>Acceptable means that may be used are:</i></p> <ul style="list-style-type: none"> <i>• the use of a second user operating an enabling device connected to the control system (e.g. enabling devices may include a pushbutton switch, pendant switch, lever/handle, pressure pad, or other suitable device)</i> <i>• cameras, lights, signals, or other visual means to ensure motion paths are clear</i> <i>• radio communications with an authorized person</i> <p><i>No matter the means employed when first person visual contact is not possible, there shall be a procedural document detailing the safe movement of the load(s) in question.</i></p>
8	CR	3.28	Suggest separating "Jogging" from "Bumping". The definition matches "Bumping" however "Jogging" is typically defining manual control of an axis whereby there is no programmed target.	<p>Agreed in principle – definition now reads;</p> <p><i>“3.28 Bumping (inching). The quickly repeated opening and closing of the motive power circuit to initiate small movements of the machine.”</i></p> <p>In the act of revising this definition the task group also moved to focus on Section 15.7 and rewrote it to read;</p> <p><i>“15.7 Machine bumping (inching)* Stage machinery control system components shall be selected and, if required, programmed to allow bumping, or inching of the machinery. Where bumping or inching is not possible, the user guide shall provide instruction on how to apply engineering or administrative controls to achieve small movements of the load.”</i></p> <p>For clarity the task group chose to add an annex note that</p>

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				reads; <i>"A15.7 Machine bumping (inching). For purposes of selecting electrical components this function may also be referred to as jogging in other standards or by some component manufacturers."</i>
9	SW	3.31 load path	A better term is "travel path" since it gives a clearer definition for the space occupied by moving equipment and avoids confusion with the structural use or "load path".	Agreed – load path changed to motion path to read; <i>"3.34 motion path. The physical space used by an element of stage equipment as it is moved from one place to another."</i>
10	CR	3.50, 3.51	SHALL and SHOULD are defined, however we note that MUST and MAY are also used within this document. Suggest removing uses of MUST or MAY and replacing with SHALL or SHOULD.	Agreed – Must has been changed in most circumstances with shall, but may could not be changed without altering context. In addition definitions of may and must have also been added as below; <i>"3.33 may. Indicates a feature, accessory or methodology is permissible."</i> <i>"3.35 must. Indicates a mandatory requirement."</i>
11	CR	3.52	"Stage Machinery" is not well defined. Suggest addition of "powered" machinery that utilizes electrical/fluid power systems.	Revised to read: <i>stage machinery. Any mechanical assembly that utilizes actuators to move stage equipment or performers.</i>
12/13	SW	3.57 user	There needs to be separate terms distinguishing users operating or controlling machinery compared users working with the machinery.	Reject – the standard is about controls and therefore the user is using stage machinery controls. Definition has been reworded to improve clarity. Definition now reads: <i>3.58 user. Any person or group of persons that operates the control system for the intended purpose.</i>
14	SW	4 Risk management	This is a non-standard term. ESTA's other standards use "risk assessment" or "risk assessment and risk reduction mitigation."	Agree. Changes made to remove reference to risk management and instead refer to risk assessment and risk reduction. Further note that Risk Management definition removed.
15	SW	4.3	This is non mandatory and not an inclusive list. It would be better moved to an annex note.	Reject – this list is relative and an important part of the document.
16	SW	5	In the first paragraph, replace "are designed and constructed to an appropriate standard" with :shall comply with an appropriate standard".	Accepted as noted
17	SW	7	The fourth paragraph about listing and labeling duplicates	Agreed, paragraph deleted.

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			the requirements of section 5.	
18	SW	7.1	Delete “local” before AHJ. It needs to comply with the requirements of all AHJs.	Agreed and accepted, “local” deleted. Also deleted from A9.3.
19	CR	7.4	Indicators, check and align table of industrial norms with IEC 60204-1. In the norms specific to stage machinery, a GO/RUN button that is a HTR, GREY, BLACK or WHITE should be used - see IEC60204-1 10.2.1	Reject – task group determined that the table does align.
20	CR	7.9 Phase Rotation Protection	this statement should not apply to touring or semi-permanent variable speed drive systems whereby phase rotation does not matter.	Agreed and accepted – paragraph title changed to read. <i>“7.9 Phase rotation protection – direct to line devices”</i> Annex notes added. <i>A7.8 Phase loss protection. A phase may be lost during a weather event or through aging or faulty wiring in the building that houses the stage machinery control system.</i> <i>Electronic variable speed drives may include inherent phase loss protection that triggers a fault upon detection of a lost phase.</i> <i>Loss of a phase can cause unpredictable and/or catastrophic results.</i> <i>A7.9 Phase rotation protection. A phase rotation error may occur during maintenance of the electrical infrastructure of the building that houses the stage machinery control system.</i> <i>A change of phase rotation can cause unpredictable and/or catastrophic results.</i>
21	SW	7.11	The last paragraph is very wordy and difficult to understand. Revise “Connectors used as a means to disconnect the machinery from the source power shall meet the requirements for which the connector is labeled.”	Agreed and accepted. Paragraph now reads. <i>“If the connector is to be used as a means to disconnect the actuator from motive power, the connector shall be labeled by the manufacturer for disconnect under load.”</i>
22	CR	7.11.1.1 Mating or rupture under load	suggest “shall be labeled ‘Do Not Disconnect Under Load’”. See IEC60417:6070.	Agreed – additional edits made, this section now reads. <i>7.11.1.1 Mating or disconnect under load Connectors shall be rated for interconnection and disconnection while energized.</i>

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				<p><i>When the connector is not rated for interrupting the load, it shall be labeled "Do Not Disconnect under Load".</i></p> <p><i>Connectors not suitable for hot connection or disconnection shall be equipped with an appropriately rated disconnect or circuit breaker upstream of the connector.</i></p>
23	SW	7.11.2	Change "control equipment manufacturer" to system designer". In the last paragraph change "rated output" to "maximum output".	Agreed – changes made as described
24	SW	7.12	This section seems to apply only to portable cables but there are no corresponding requirements for permanently installed wiring.	Agreed in principle – see new item 7.12.4
25	SW	7.12.3	The requirement for separate pins for the brake circuits precludes wiring the brake directly to the motor power.	<p>Agree in principle – section now reads.</p> <p><i>Motor cables shall be selected to meet with the demands of the specific type of motor and drive.</i></p>
26	CR	7.12.3 Motor cables	Brakes being released without a motor connected may be mitigated through other means. At present, this does not account for external brakes that are not integrated into the motor.	<p>Agreed – Paragraph added to 7.6 which reads.</p> <p><i>"Disconnection of the motor shall also disconnect the energy supply to all operating and/or holding brakes of the machine."</i></p>
27	SW	7.14	The requirement to alert the user is excessive for simple systems such as starters.	<p>Accept in principle – annex note added to read.</p> <p><i>"A7.14 Motor overloads. User alert notification can be as simple as a visual state indicator, such as the change of position of a tripped circuit breaker."</i></p>
28	CR	7.15 - Motor drives.	Suggest removal of wording about 4kHz switching frequency. This is not common or standard.	<p>Accept in principle – paragraph now reads.</p> <p><i>"The control equipment manufacturer shall ensure that conductors are appropriately sized and protected from overload and drive settings are appropriately configured for the motor nameplate values."</i></p>
29	CR	7.18	Suggest update to last paragraph: "The software controlling or reading the data from the signal amplifier shall have a means of scaling and offset. Scaling and Offset routines should be detailed in user guides or service manuals."	Good update – adopted.
30	SW	7.19	Replace "at the discretion of the stage machinery control equipment manufacturer" with "system designer".	Good update – adopted.
31	SW	7.20.6	Revise "Assembly designs shall adhere to the limitations of minimum bend radii for which the product/assembly is labeled."	Good update – adopted.

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32	SW	7.20.8	Revise "Separation practices and the use of barriers within assemblies shall meet the requirements for which the product/assembly is labeled.	Good update – adopted.
33	SW	7.20.9	Revise "Control equipment circuits shall be appropriately grounded or bonded.	Good update – adopted.
34	SW	8.1	Add "a" before common industrial standard.	Edited with thanks
35	SW	8.5	In the third paragraph, "Authorized" should not be capitalized.	Edited with thanks
36	SW	9	In the first paragraph, delete " using a PES". Control systems without a PES also need an E-Stop.	Edited with thanks
37	SW	9.3	The table for stop categories duplicates the definitions. The first paragraph after the table needs to be revised. Some machinery needs a Cat 1 stop and cannot use a cat 0 stop.	Accept in principle – paragraph deleted.
38	CR	9.3	last paragraph, suggest replace "releasing power safety contactors" with "opening power safety contactors". Also, a solid-state STO function of a drive may also be acceptable here, depending on the Category / Performance Level / SIL of the drives STO function.	Paragraph Deleted
39	CR	9.4	Self Monitored contacts, periodic test intervals may also mitigate this risk. Requirement for self monitored contacts is too prescriptive, preventative measures should be based on risk assessment and failure analysis report.	Agreed in principle – paragraph now reads <i>Contact blocks shall be securely connected to the switch operator. If the operator and the contact block become disconnected the contacts shall open leaving the system in a safe state.</i>
40	SW	9.5	This section repeats requirements from 9.4.1 and should be combined with that section.	Reject – 9.4.1 refers to type of E-Stop actuators and 9.5 addresses labeling. They are in separate sections with identified headers for clarity.
41	SW	9.6	Revise "After activation of an E-Stop device, the system shall come to a safe and complete stop as determined by risk assessment.	Reject – refer to 9.3 where determination of the choice of E-Stop category requires risk assessment.
42	SW	9.6.1	Delete "as described in section 9.3 E-stop categories". It adds no additional requirements.	Accepted
43	SW	9.6.2	Delete "as described in section 9.3 E-stop categories". ". It adds no additional requirements.	Accepted
44	SW	9.7	Delete the last paragraph, it is excessive for simple systems without a PES.	Agreed in principle – paragraph now reads <i>The system shall inform the user that it has been returned to a ready state.</i>

No.	Commenter	Ref. section	Comment	resolutions
45/ 46	SW	9.9	In the first paragraph change “shall” to “may” and delete “when necessary”. Not all systems will have a bypass.	Accepted
47	SW	9.10	In the first paragraph, change “control systems” to control system. In the last sentence of this paragraph change “both systems” to “all systems”. The last paragraph refers to an annex note, but the annex note does not address this requirement.	Edited with thanks
48	SW	10	Revise “An HTR provides a method of enabling the operation of stage machinery and triggers a controlled stop of the machinery if the user releases the HTR. This is clearer and more descriptive of its function.	Agreed – edit made
49	CR	10.1	please better define what a 'HTR event' is.	Good point – HTR event removed. It has also been removed from 10.5. Please see item 50 below.
50	SW	10.1	Delete the first paragraph. It is redundant. Combine the third and fourth paragraphs, they have similar requirements.	Agree in principle – edits made in conjunction with CR’s comments. Section now reads. <i>The HTR Function is a complementary protective measure applied to the overall stage machinery control system design that shall not be applied as a substitute, or impair the effectiveness, of other safeguarding measures or procedures.</i> <i>The HTR function shall be designed so that it does not impair other protective safety functions, such as egress of persons from confined spaces.</i> <i>Unlike the E-Stop Function, the HTR function shall be designed to stop motion and place the machine in a safe stopped state without isolating the motive power. Restoring operation of the machine shall not require additional action by the user beyond what is defined as the machinery control system's normal operation. This section is now 10.3</i>
51	SW	10.2	Delete this section.	Reject – Please see resolution to comment 49, 50, and 52 This section is now 10.4.
52	CR	10.2	"HTR is the ideal solution" - contradicts requirement to conduct a HARA	Agree this section needed a rewrite. Section now reads. <i>The architecture of the HTR system shall require the user to maintain constant pressure on the HTR operator to allow motion.</i> <i>When practicable, the HTR system shall provide the ability to program Category 0, 1, or 2 Stop functions as described in section 9.3 E-Stop categories as required by specific</i>

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				<i>machinery or applications under review of risk assessment and risk reduction strategies. This section is now 10.4r.</i>
53	CR	10.3	Paragraph 2 & 3 - suggest using "Diverse Contacts" instead of "disparity detection circuit". Although, the requirement for this functionality should be determined via Risk Assessment and failure analysis on a case-by-case basis.	Now section 10.5 Accepted – section now reads <i>Selection of the HTR operator shall be determined through the application of a risk assessment focused on determining the risks and consequences involved in deliberate activation or nuisance/erroneous activation of the HTR operator to the OFF position.</i> <i>HTR operators that employ more than one set of switch contacts can be diverse or complimentary and shall be monitored for disparity (disagreement of switch position).</i> Annex note added: <i>A 10.5 HTR Operators</i> <i>It is recommended that the use of complimentary contacts in the HTR actuator follow these circuit design parameters:</i> <ul style="list-style-type: none"> • <i>Both switch contacts closed – machine(s) can operate</i> • <i>Both switch contacts open – machine(s) is(are) disabled</i> • <i>One switch contact open + one switch contact closed - machine(s) remain idle and the circuit shall fault</i>
54	SW	10.5	Delete this section, it duplicates 10.1.	Accept – section deleted
55	CR	11.2	This is not clear and does not allow for diverse contacts for safety functions.	Accept – in principle, significant changes were made to this entire section. Too many to list here.
56	CR	11.3 & 11.4	the combination of these two sections states that Brake release circuits (Digital output signal, normal high sent 11.3) can not be fail-safe operation as prescribed in 11.4 Digital output signal, normal low signal sent	Accept – in principle, see above
57	SW	11.6	Revise “Loss of signal from any sensor shall be observed as a failure, cause a fault, and bring all affected machinery to a safe stop.”	Agreed – edit made.
58	SW	12.1.2	Change “actuator” to “machine motion”. This is more descriptive, and the actuator direction may not match the machine motion i.e. a hoist may be raising a load (moving out) while the actuator (motor) is rotating CCW.	Agreed in principle – Edits made to chart.
59	CR	12.1.2	Actuator direction Plus limits - FWD/CW/Extend -	Agreed – Section rewritten, too many edits to list here.

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		Definitions	Suggest FWD/CW/Extend/Open Actuator direction Minus limits - REV/CCW/Retract - Suggest REV/CCW/Retract/Close Vertical Motion Plus limits - Out/Above Stage - Suggest Out/Above Stage/Up Vertical Motion Minus limits - In/Below Stage - Suggest In/Below Stage/Down Horizontal Motion Plus limits - Off SR/Onstage - Suggest Off SR/Onstage/Up Stage Horizontal Motion Minus limits - Off SL/Offstage - Suggest Off SL/Offstage/Down Stage	
60	CR	12.2.8	Suggest using "override" in place of "bypass"	Agreed – edit made
61	SW	12.2.8	Change “protect the load” with “stop the load”. This more accurately describes its function.	Agreed – edit made
62	SW	12.3	This section also needs to describe sensors used as an interlock with other machines.	Agreed – edit made to add a new section <i>12.4 Interlock constraints and protection*</i> <i>In some cases, a machine may require additional sensors to prevent damage to machinery or equipment that is not moved by the subject machine. When these sensors are not the Initial or ultimate sensors these should be referred to as interlocks and further defined by their action. (see annex note)</i>
63	SW	13	Add “or guard” after “safety devices” in the second paragraph.	Agreed – edit made
64	SW	13.1	This paragraph is confusing and needs to be reworded.	Agreed – edit made. Paragraph now reads. <i>Doors and hatches used to prevent access to motion path areas shall be monitored by electronic locks and/or signal processes that immediately stops all motion upon activation.</i>
65	CR	14.3	Signal override (muting) - note that Muting is different to Override. Override is a user-initiated action, whereby muting is an automated action (e.g. you may ignore a light curtain as a machine passes through it).	Agreed – muting deleted. It was in place as a historic reference but your point is well taken. Item renumbered to 14.2.2.1
66	SW	15	This section describes the general system operation and should be before the detailed requirements in sections 7, 8, and 9.	Rejected – order of items is by design, renumbered to 14
67	SW	15.2.2 & 15.2.3	These sections add no requirements and should be deleted.	Agreed in principle. Previously numbered section 14 has been inserted into section 15 and the document sections have been renumbered forward from this point.
68	SW	15.2.4	How is the “Commissioning/Testing mode different from	Reject – the task group sees them as two separate modes.

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			the Service/Maintenance mode?	Commissioning is the first step in setup where constraints of the machinery or operation have yet to be confirmed or determined. Service/maintenance mode would include normal operation ready equipment. Item renumbered to 14.2.3
69	SW	15.3	Revise the first sentence "Prior to starting any machine, the control system shall check to ensure that the machine is ready for operation." All systems need to do this, not just systems with a PES.	Agreed in principle. Edit made to open the section with. Item renumbered to 14.3 <i>Prior to starting any machine, the control system shall check to ensure that the machine is ready for operation.</i>
70	SW	15.4	In the first sentence, change "will" to "may". These characteristics can be the same. In the second sentence delete "holding". A fixed speed motor will produce a starting torque, not a holding torque.	Agreed – edits made. Item renumbered to 14.4
71	SW	15.5	In the first sentence, change "will" to "may".	Agreed – edit made. Item renumbered to 14.5
72	SW	15.6	Change "stage machinery control equipment shall be designed to sequentially" to "control system shall sequentially."	Agreed – edits made. Item renumbered to 14.6
73	CR	15.7	See note on 3.28	See response to 3.28, comment 8. Item renumbered to 14.7
74	SW	15.9	Delete this section, it describes a designer error.	Accepted in principle – edits made. Item renumbered to 14.9
75	SW	15.10.1	The second paragraph is not appropriate for a simple control system.	Accepted in principle – edits made, paragraph deleted. Item renumbered to 14.10.1
76	SW	15.10.3	This is not appropriate for a simple control system.	Agreed in principle. Edit made to read. Item renumbered to 14.10.3 <i>Systems with the capability, shall produce fault logs with a timestamp for recall by the user for troubleshooting.</i>
77	SW	16	Not all systems have a PES.	Understood – but this section is about PES. Item renumbered to 15.
78	CR	16.2.5	Suggest adding "PES manufacturers shall consider the effects of color-blindness of users within their user interface. Offering alternative colors, pictograms, changing text or high-contrast colors are all acceptable ways to mitigate this issue. "	Agreed – added to the annex. Item renumbered to 15.2.5.
79	SW	16.3	This section duplicates 7.4	It does in some manner but it is relevant to this section and shall remain because it is not verbatim to 7.4 and deals directly with the PES requirements. Item renumbered to 15.3
80	CR	18.1	suggest replacing "Enclosures shall employ input power connectors that qualify as suitable for disconnect under load. Panels that are painted and mechanically fastened together shall be individually bonded to protective earth." with "Enclosures should	Agreed – edit made. Item renumbered to 17.1

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			employ input power connectors that qualify as suitable for disconnect under load. Panels that are painted and mechanically fastened together shall be individually bonded to protective earth." - This change to should is specifically in regards to single pole connectors used commonly in the industry (camlock & powerlock)	
81	SW	A3.17	This note refers to paragraph 3.16.	Edit made with thanks.