How Safety And Safety Requirements Are Evolving In The Elevator Industry

November 28, 2012

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Concerns Of Elevator Industry

General Public Transportation

Industrial Equipment

Developments In Industry

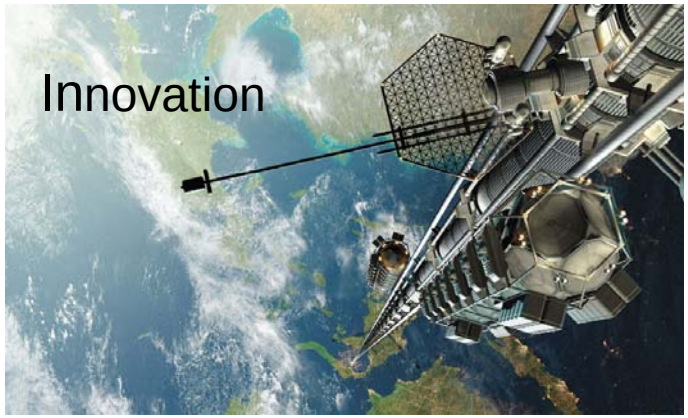
Elevator Industry

- Building markets still down
- Due to the down building markets, R&D Budgets also down
- Innovating and getting innovation to market quickly and efficiently is still critical

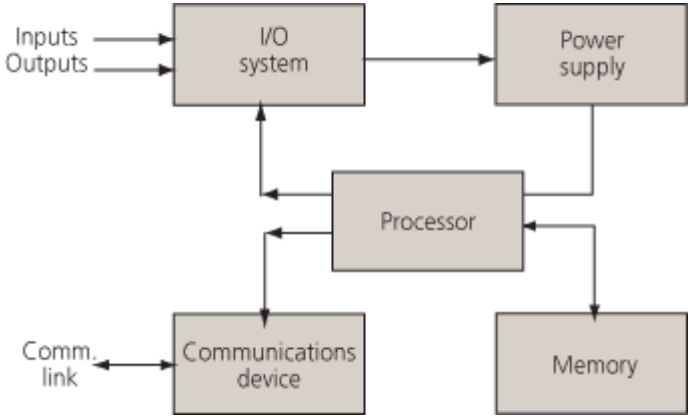
Industrial Automation

- Solid state programmable controls are increasingly prevalent
- Safety equipment is often integrated within a networked environment
- Safety controls incorporating solid state and programmable devices are more common, adding to the complexity

Industry Maintains A High Standard Of Safety



Electronics



How Requirements Can Accommodate Innovation

Electronic Protective Devices

- Safety Controls Specifically called out in Table 2.26.4.3.2 of ASME A17.1/CSA B44

- Requires that Electronic Protective Devices meet a specified Safety Integrity Level (SIL), as per IEC61508

Innovation

- ASME Performance Based Codes ASME A17.7/CSA B44.7

- Performance Based Code determines equivalent safety to requirements in ASME A17.1/B44

Electronic Controls

Table 2.26.4.3.2 allows use of Electronic Protective Devices in safety related control devices (Safety Integrity Level – SIL)

Either positively opened, mechanically

OR

Listed / Certified / Marked with an IEC 61508 SIL level as appropriate

Function - When an EPD is activated, it shall provide an electronic function, removing electric power from the driving machine, motor and brake

References

ASME A17.1/CSA B44, Paragraphs **2.26.2, 2.26.4.3, 2.26.4.3.1, 2.26.4.3.2**

Examples of safety related functions in ASME A17.1/CSA B44, Table 2.26.4.3.2

Function	ASME A17.1/CSA B44 Reference	SIL Rating
Unexpected Car Movement Device	2.26.2.34	3
Car Leveling or Truck Zoning Device	2.26.1.6	2
Firefighters stop switch	2.26.2.33	3

What is a SIL?

Safety Integrity Level (SIL) is defined as:

A relative level of risk-reduction provided by a safety function

In simple terms, SIL is a measurement of performance required for a Safety Instrumented Function (SIF).

Risk Reduction Level	SIL
LOWEST	1
↓	2
↓	3
HIGHEST	4

What if we have something that is specified in Table 2.26.4.3.2, how do we meet IEC 61508?

IEC 61508 – *Functional Safety of Electrical / Electronic / Programmable Electronic Safety-related Systems* (E/E/PE, or E/E/PES).

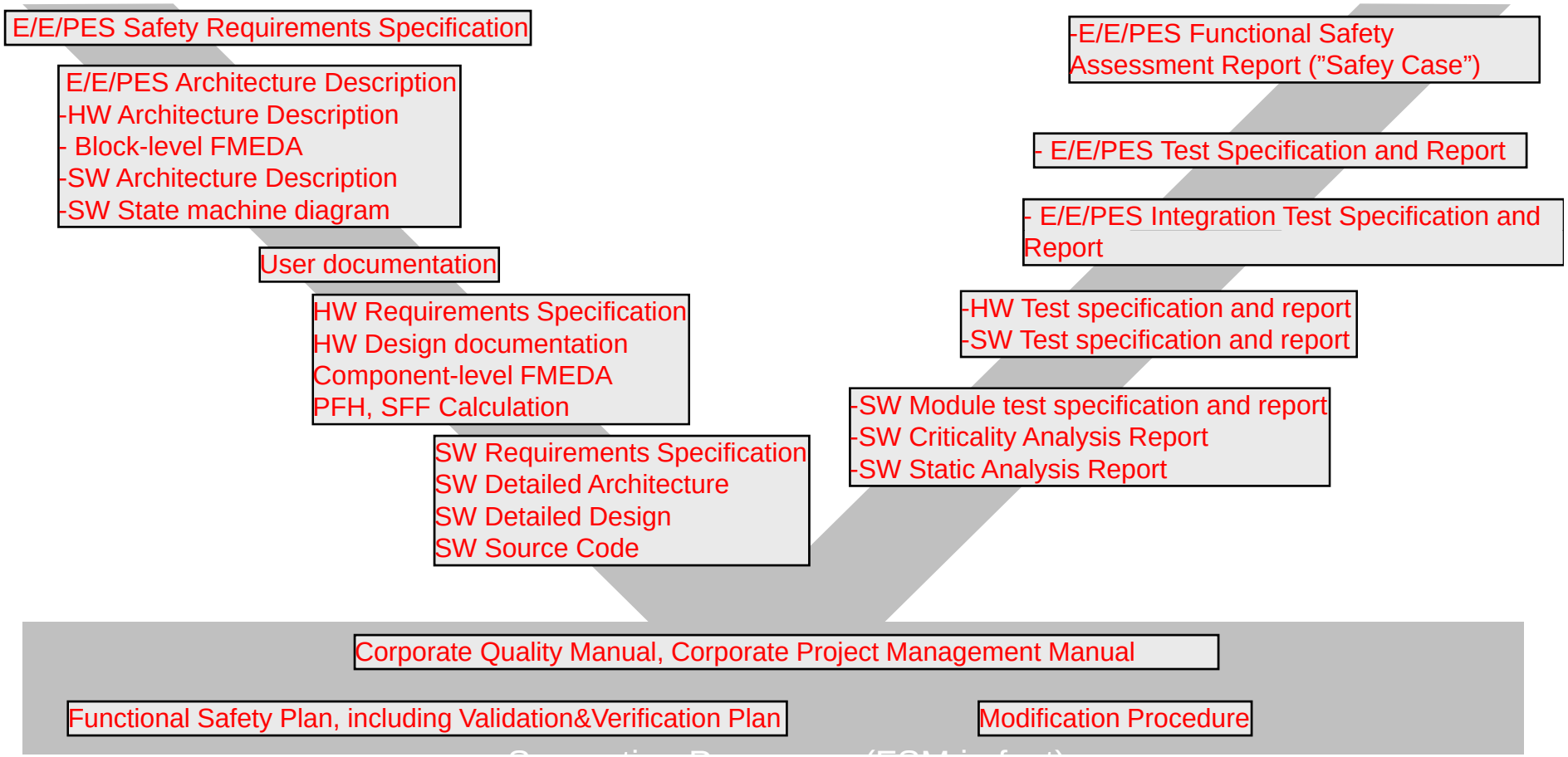
Key concepts

- **Functional Safety Management System** - Ensure that the full lifecycle management of a component, product or system incorporates the principles of FS
- **Reliability** – A product intended to ensure safe operation must be reliable commensurate with the risks
- **Fault Tolerant** – A product intended to ensure safe operation must be able to withstand faults proportionate with the risks
- **Environmental Resiliency** - Safety related systems shall withstand adverse environmental conditions corresponding with the risks and anticipated environment. Includes EMC.

Behind the SIL

- Failure Mode Effects Analysis (FMEA) or Failure Mode Effect Diagnostics Analysis (FMEDA)
  - Evaluating the hardware and component failure rates
- Reviewing the design
  - Hardware architecture can require redundancy or other methods of high reliability (diversity)
  - Software architecture and programming methods are also subject to requirements
- Testing
  - Fault insertion
  - EMC testing (Identification of Common Cause Failures or CCFs)
- Process Review
  - A quality product requires a quality process

V-Model and deliverables plan example for a E/E/PE (Sub-)system



Application Or Technologies That Do Not Fit “Nicely” Into ASME A17.1/CSA B44?

It may be an application → Wind Turbine Elevators do not fit “nicely” in ASME A17.1/CSA B44.

It may be an technology → Coated Steel Belts do not fit “nicely” in ASME A17.1/CSA B44.

Other unknown or unanticipated technologies, such as a Space Elevator, which is a combination of both an application and a technology that does not fit “nicely” in ASME A17.1/CSA B44.

What is the A17.7/CSA B44.7 performance based code process intended to achieve?

- Determine equivalent safety of new technologies based on performance
  - Equivalent to what? →
    - Requirements found in ASME A17.1/CSA B44
  - Determined by who? →
    - An independent 3rd party, authorized by ANSI and / or SCC to issue AECO Certificates.
  - How is Performance Determined? →
    - Risk Analysis, Engineering Analysis, Calculations, Testing, etc.

AECO

An Accredited Elevator/Escalator Certification Organization by

(ANSI) American National Standards Institute

or (SCC) Standards Council of Canada

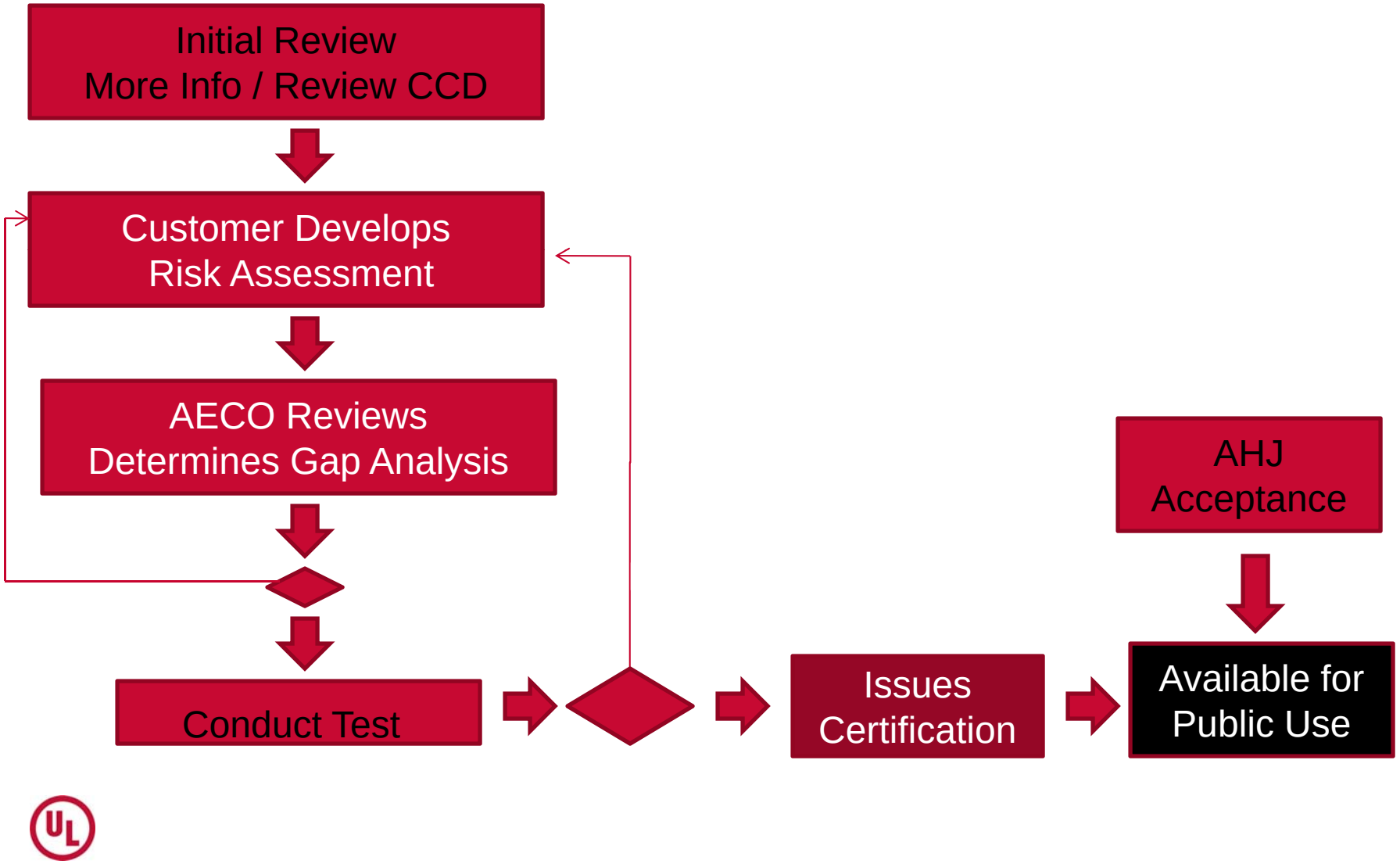
based on ISO Guide 65

ASME A17.7/CSA B44.7 Is A Performance Based Code

Performance Based Safety Codes Encourage Innovation:

- Provides equivalent safety to current prescriptive codes
- Process is proactive rather than driven by accidents and mishaps
- Risk Assessment process systematically identifies and addresses the hazards
- This enables the development team to greatly reduce risks to users, non-users, authorized elevator personnel
- Compliance to performance based code is verified by an authorized third party (AECO)

The AECO Certification Process



Example

Alternate suspensions means

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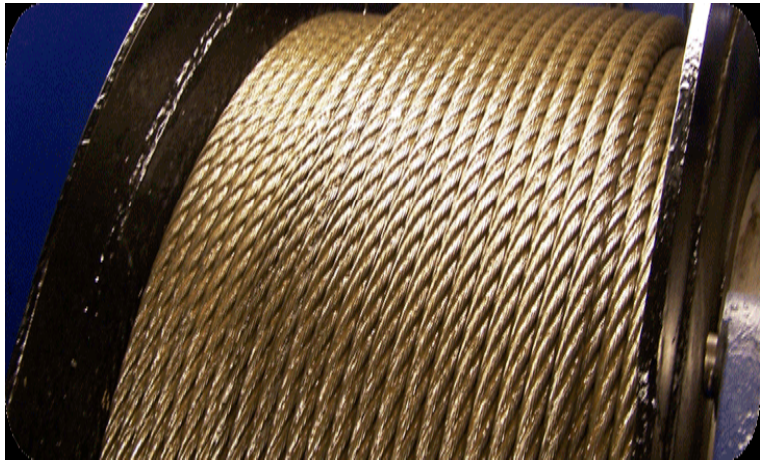
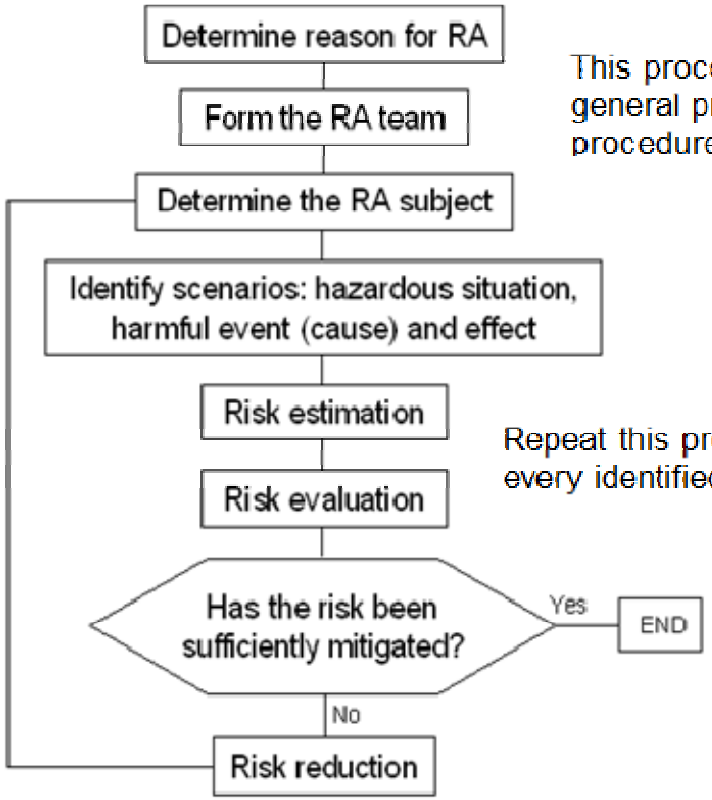


Risk Assessment (Manufacturers Process)



This process establishes the general principles and specific procedures for assessing risk

Repeat this process for every identified hazard

Reference ISO 14798

Lead with Severity!

Severity	Level	Description
1	High	Death, system loss or severe environmental damage
2	Medium	Severe injury, severe occupational illness, major system or environmental damage
3	Low	Minor injury, minor occupational illness, minor system or environmental damage
4	Negligible	Will not result in injury, occupational illness, system or environmental damage

Probability

Level	Description
Highly Probable	Likely to occur frequently
Probable	Likely to occur several times in the life cycle
Occasional	Likely to occur at least once in the life cycle
Remote	Unlikely, but may possibly occur in the life cycle
Improbable	Very unlikely to occur in the life cycle
Highly Improbable	Probability cannot be distinguished from zero

Estimate the risk

Level of Probability	Level of Severity of the Effect (Harm)			
	1-High	2-Medium	3-Low	4-Negligible
A-Highly Probable	1A	2A	3A	4A
B-Probable	1B	2B	3B	4B
C-Occasional	1C	2C	3C	4C
D-Remote	1D	2D	3D	4D
E-Improbable	1E	2E	3E	4E
F-Highly Improbable	1F	2F	3F	4F

The AECO Certification Process

Initial Review
More Info / Review CCD

Customer Develops
Risk Assessment

AECO Reviews
Determines Gap Analysis

Conduct Test

Issues
Certification

Available for
Public Use

AHJ
Acceptance

Underwriters Laboratories Inc.

Presents this

AECO Certificate

Certificate No. 1234567AB91011
Date: July 29, 2010

To

National Aeronautics and Space Admistration (NASA)

For certification in accordance with the ASME A17.7-2007/CSA B44.7-07 of the following Elevator System:

Space Elevator

Effective from: July 29, 2010 Until July 29, 2013

Part Numbers: ABC12345X1
Manufacturer: Boeing Corporation, Seattle, WA
Conditions of Conformance:
1) Use with Nano Suspension Technology
2) Use with MK1, MOD-0 Geosynchronous Anchor Satellite

Issued by: Daniel Pomer
AECO Certification Services
Issued: July 29, 2010

Reviewed by: Len Grant
AECO Certification Services
Issued: July 29, 2010

Reviewed by: William N. Bartunek, PE
AECO Certification Services
Issued: July 29, 2010

Please look for the UL Classification Mark on the product

Questions?

For more information please feel free to contact us

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