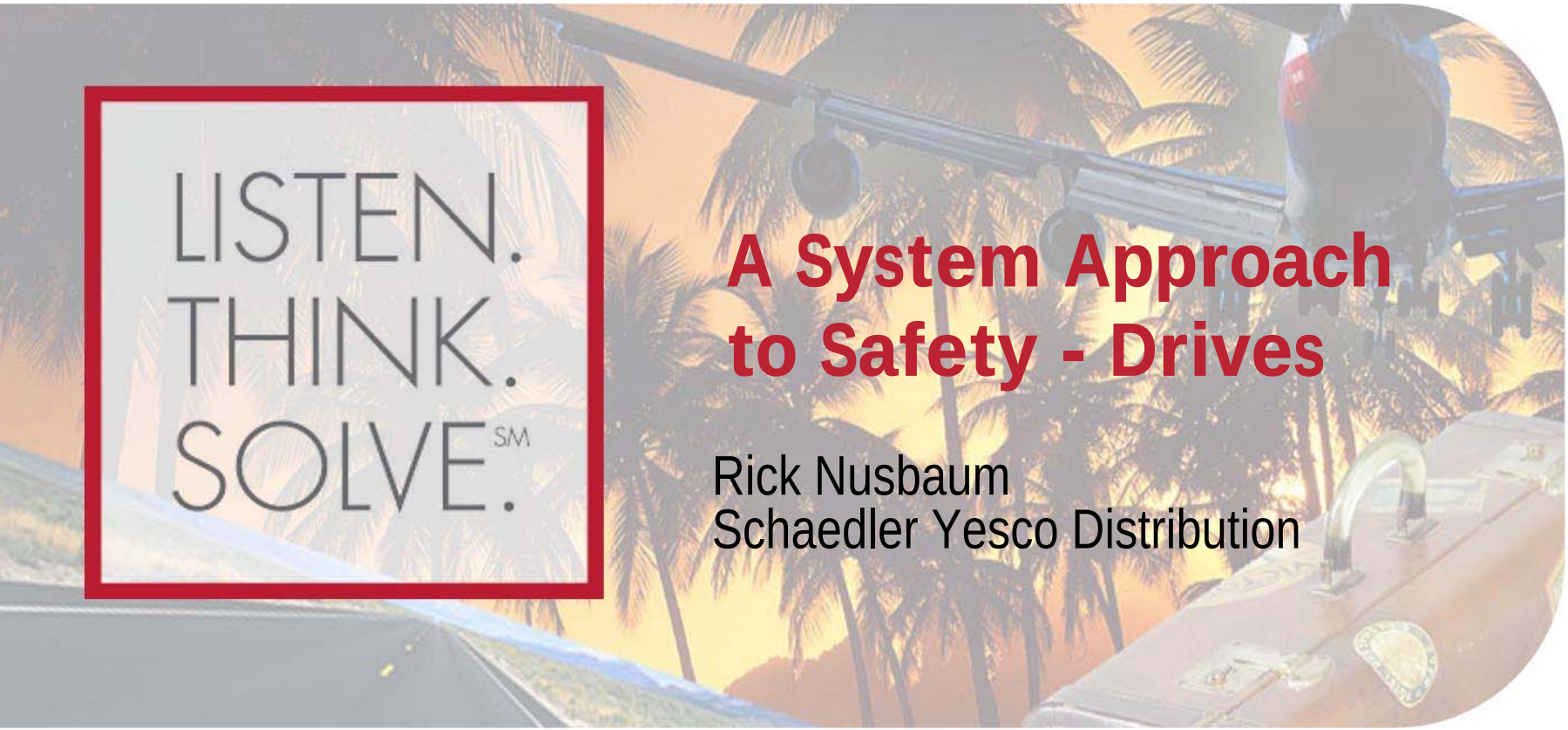

A System Approach to Safety - Drives

Rick Nusbaum
Schaedler Yesco Distribution

ALLEN-BRADLEY • ROCKWELL SOFTWARE

Rockwell Automation

Discussion Goals

- Safety Concepts
- What Makes a Drive Safe?
- Rockwell's Safety Offering

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Why is Safe Design Important?

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What Are Typical Hazards On A Machine Or Process?

- Physical
  - Falling / Moving Objects
  - Collisions
  - Collapsing Structures
- Chemical
  - Explosion
  - Fire
  - Toxic Material Release
  - Wrong mix of chemicals
  - Radiation
- Electrical
  - Flashover and Burns
  - Electrocution
  - Wrong Connection / Loose Connection
- Mechanical / Process
  - Pinch Points or Entanglement
  - Abrasion, Grinding, Cutting
  - Thermal
  - Pressure Releasing Effects (Bursting Vessels, Jets of Gas or Liquids)
  - Welding Torches, Gases etc.

Hazards are physical objects or chemical substances that have the potential for causing harm to people, property or the environment

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Which of These Affect An Operator The Most?

- Physical
  - Falling / Moving Objects
  - Collisions
  - Collapsing Structures
- Chemical
  - Explosion
  - Fire
  - Toxic Material Release
  - Wrong mix of chemicals
  - Radiation
- Electrical
  - Flashover and Burns
  - Electrocution
  - Wrong Connection / Loose Connection
- Mechanical / Process
  - Pinch Points or Entanglement
  - Abrasion, Grinding, Cutting
  - Thermal
  - Pressure Releasing Effects (Bursting Vessels, Jets of Gas or Liquids)
  - Welding Torches, Gases etc.

The Standards We'll Focus On Today Are Referred to as Function Safety Standards and are Intended to Protect People, Property, and Environment

What Does “Functional Safety” Mean?

- Functional safety is the part of the overall safety that depends on the correct functioning of the process or equipment.

In this example the most severe injury would be "fatal".

In this example the probable most severe injury would be "serious", with the possibility of bruising, breakage, finger amputation or injury from ejected chuck key, etc.

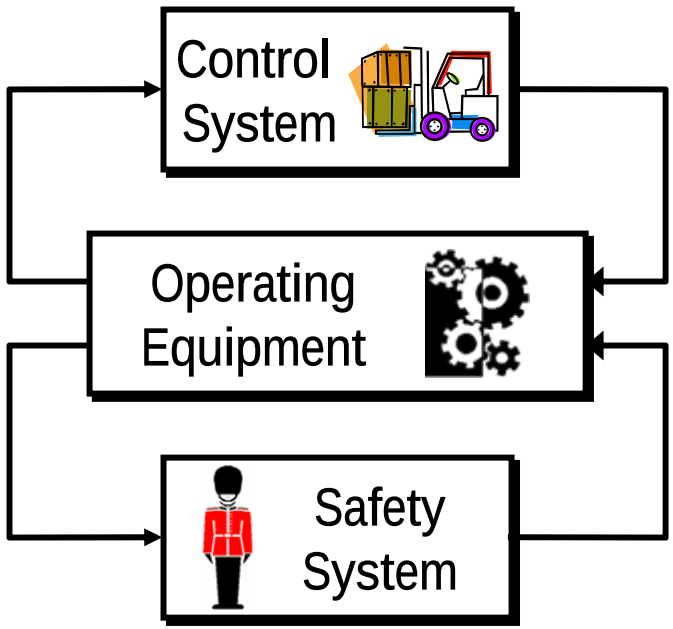
Think Of It As Safety That’s Geared Towards The Operator

What Is The Purpose Of A Safety System?

- The Purpose Of A Safety System Is To Monitor And Control Conditions On A Machine Or Process That Are Hazardous In Themselves Or, If No Action Were Taken, May Give Rise To Hazardous Situations

- The Safety System Runs In Parallel With The Production System
  - Focus Of Production System Is Throughput
  - Focus Of Safety System Is Protection

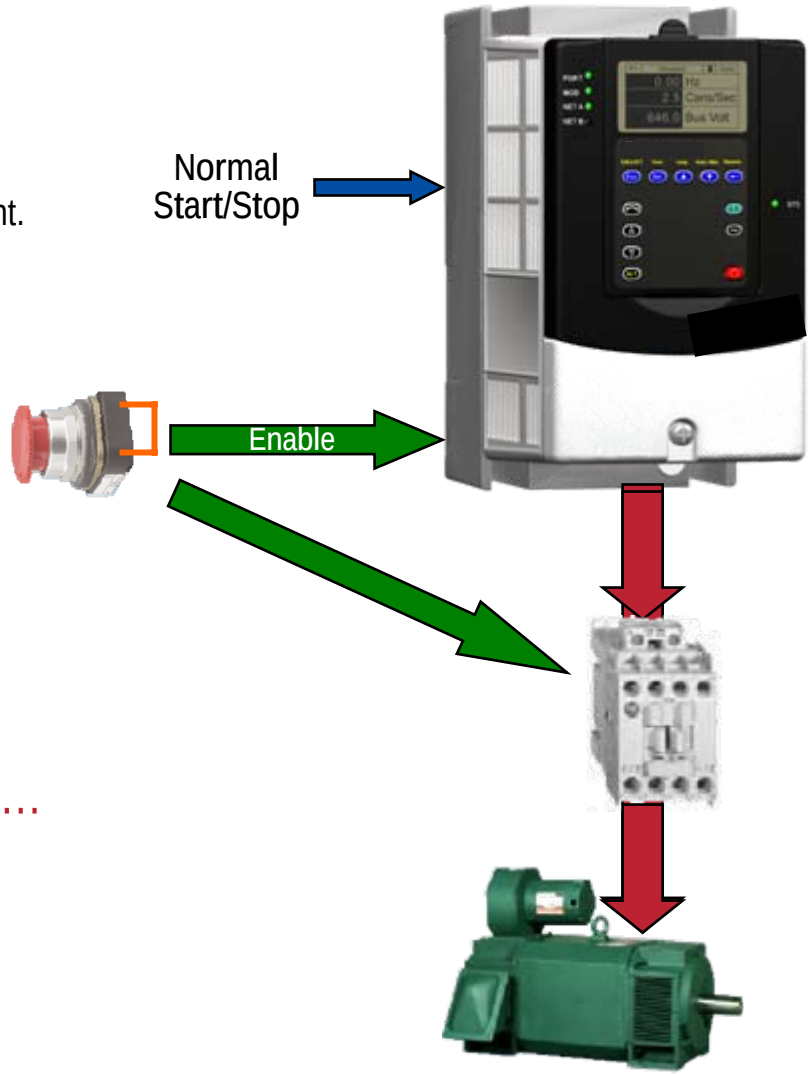
- A Safety System Is Designed To Protect (In The Following Order):
  - People
  - Environment
  - Machinery



Does Emergency Stop Satisfy Safety System Requirements?

Emergency Stop Requirements

- Must Be A Category 0 Or 1 Stop.
- The Final Removal Of Power Must Be By Electromechanical Components.
  - Drives Do Not Qualify as an Electromechanical Component.
- Standard Allows Electronic Safety Devices in E-Stop String.



Hint:

The Purpose Of A Safety System Is To Monitor And Control Conditions On A Machine Or Process That Are Hazardous…

The "Three D's" Of Safety

What Makes a Product Safe?

- Duality *(Also known as Redundancy)*
  - If one thing fails, there is another thing that can bring the system to a safe state
  - In parallel for Inputs or in series for Outputs
- Diversity
  - Protects against two things failing in exactly the same way at the same time
  - Example: Using one NO and one NC set of contacts
  - Example: Using both a high and a low input channel to a safety device
- Diagnostics
  - Safety products spend much of their time performing self-diagnostics
  - If a problem is detected, the system will go to its "safe state" and will not allow the system to be restarted until the problem is fixed
  - Example: A safety PLC has a significantly higher degree of self-diagnostic versus a standard PLC (> 90% vs. ≈ 50%)

Goals

- Safety Concepts
- What Makes a Drive Safe?
- Rockwell's Safety Offering

Safety Systems

- Safety Systems Have Three Essential Parts
  - Sensor Or Input Device
  - Logic Solver
  - Actuator
  - These Are Separate Functions, But Do Not Have To Be Separate Devices
- Each Safety Product Must Be Applied As A Whole To Effectively Reduce Risk
  - Safety Is The Sum Of Its Parts And Safety Is Only As Good As Its Weakest Link
- The Complexity Of The Inputs (Sensors) And Outputs (Actuators) And The Flexibility Of The Control Will Determine The Type Of Logic Solver
  - Stand-alone Relay, Modular Relay Or Safety PLC

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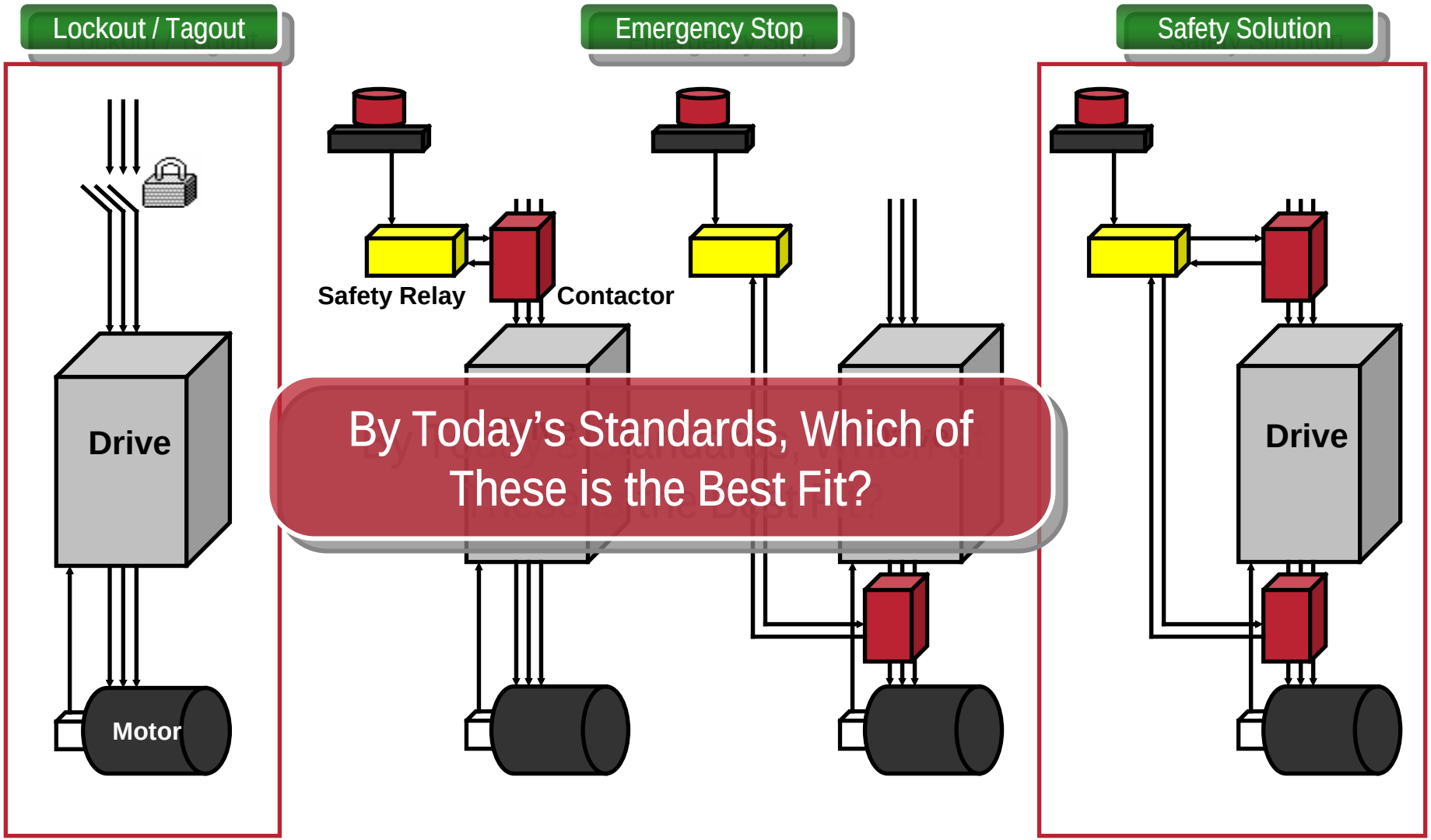
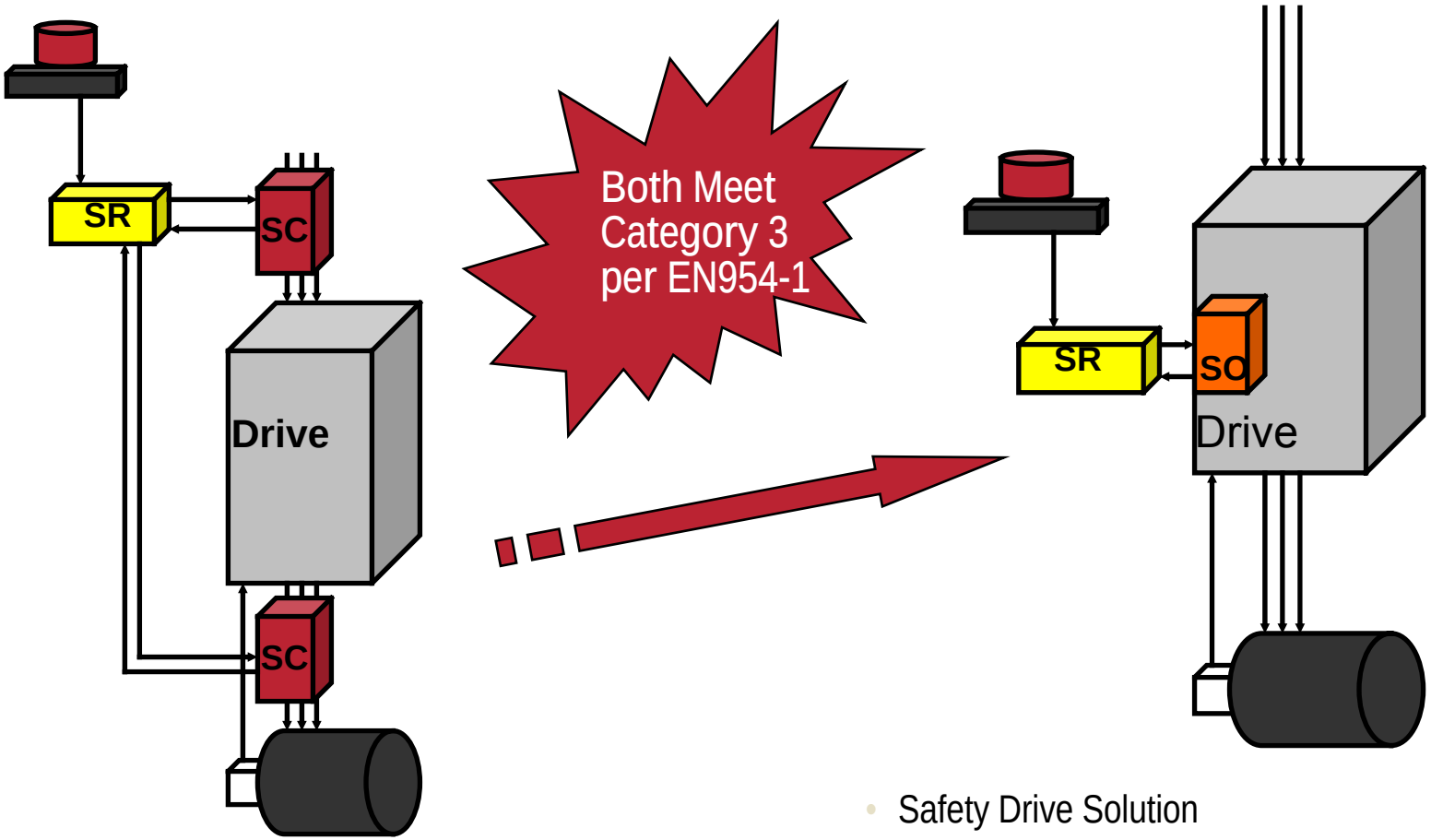
Which of These Safety Systems Meet Cat 3 per EN954-1 ?



Incorporating Safety Into Drives

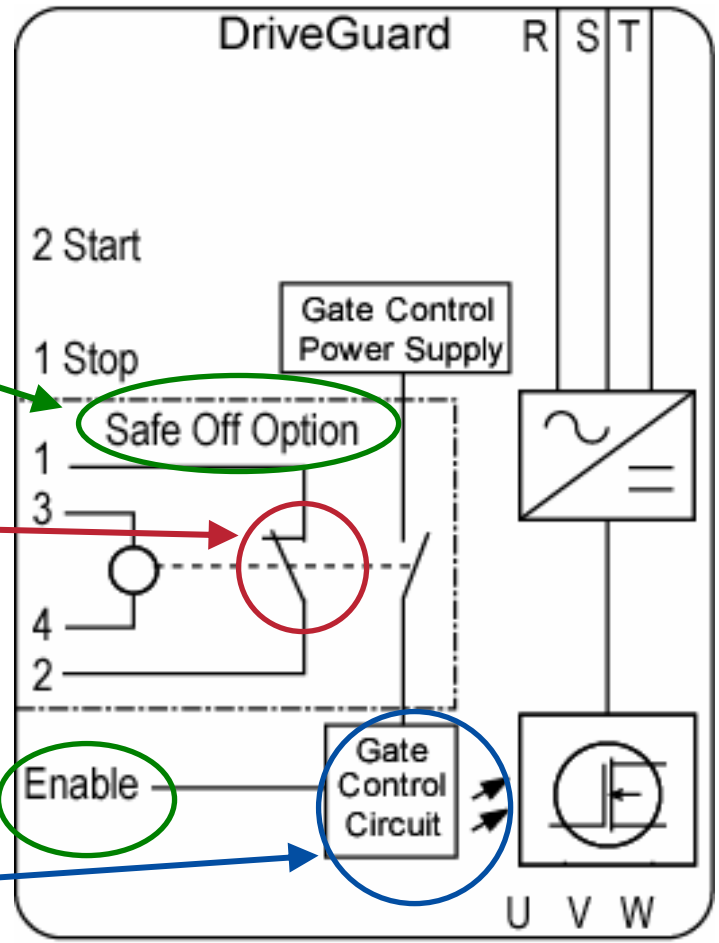


- Power Removal Solution
  - Safety Contactors
  - Not Certified But Can Be Used If All Components Are Safety Devices

- Safety Drive Solution
  - Certified by a 3rd Party
  - Dual Channel, Checking, & Monitoring
  - When A Single Fault Occurs The Safety Function Is Always Performed

How Safe-off Works in a Drive

- Safety Channels Put Drive in Safe State
- Removal of Either Prevents Motion
- State of Safety Channel is Monitored and Mismatch Prevents Motion
- Internal Gate Driver Circuits Control Motor Commutation



NFPA79 2007 Changes to Emergency Stop

Previous Emergency Stop Requirements

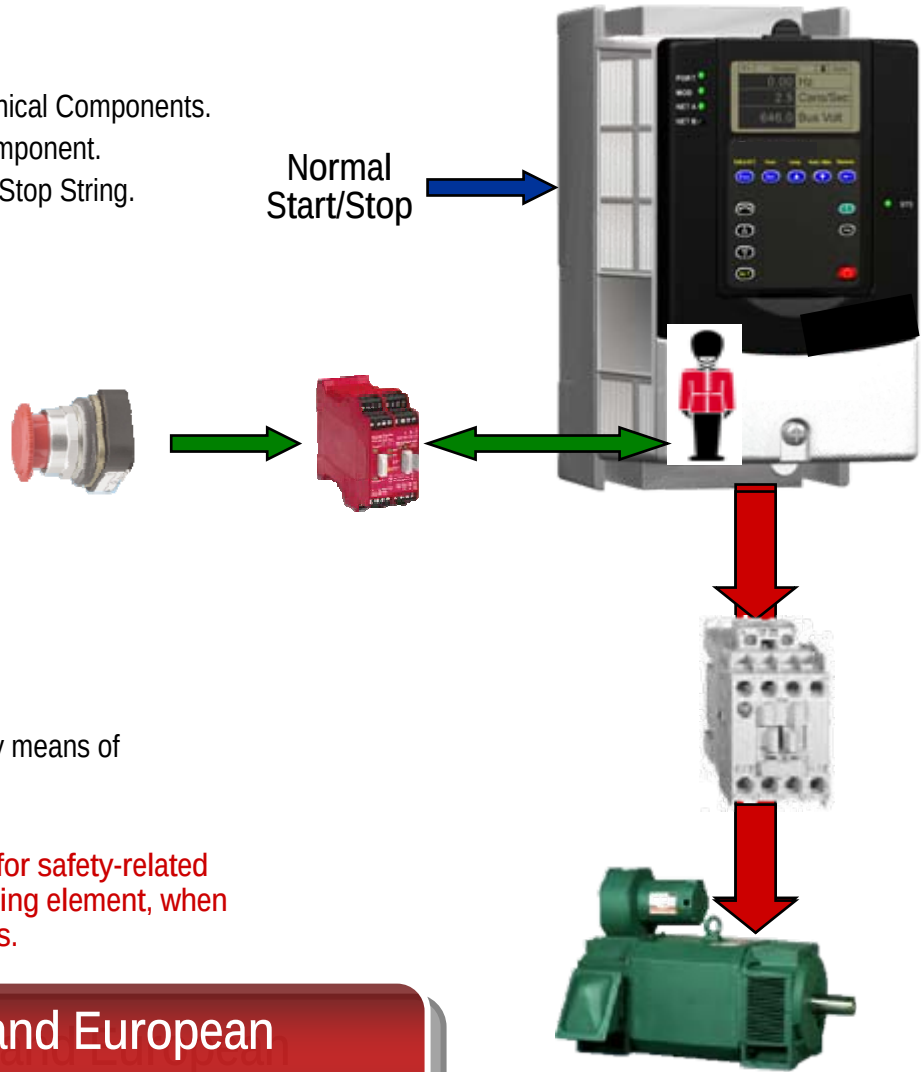
- Must Be A Category 0 Or 1 Stop.
- The Final Removal Of Power Must Be By Electromechanical Components.
  - Drives Do Not Qualify as an Electromechanical Component.
- Current Standard Allows Electronic Safety Devices in E-Stop String.

Safe-off (EN954-1, Category 3)

- Must Be A Category 0 Or 1 Stop
- Single Fault Does Not Lead to Loss of Safety Function
- Reset of Safety Function Cannot Cause Hazardous Operation
- Safety Categories Are Often Confused with Stop Categories

NFPA79 2007 Emergency Stop Requirements

- Must Be A Category 0 Or 1 Stop.
- "Final removal of power shall be ensured and shall be by means of electromechanical components"
- exception:
  - Drives, or solid state output devices, designed for safety-related functions shall be allowed to be the final switching element, when designed according to relevant safety standards.



This Change to NFPA79 (and European Equivalent) Makes Safety Drives More Attractive

Goals

- Safety Concepts
- What Makes a Drive Safe?
- Rockwell's Safety Offering

Rockwell Safety Drive Solutions

Drive Guard®	Standard	Description
PowerFlex 40P	Category 3 per EN954-1	• Option, identical to PowerFlex 70
PowerFlex 70	Category 3 per EN954-1	• Option, Enhanced Control only • 600V Drives: Safety function-only approved
PowerFlex 700L	Category 3 per EN954-1	• Option, 700S Control only
PowerFlex 700S	Category 3 per EN954-1	• Option, Requires Phase II w/Expanded Cassette • 480V Drives: F9-13 – Safety function-only approved • 600V Drives: F1-4 & F9-13 Safety function-only approved

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  - 35+ Encompass Partners

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