



Achieving redundant intrinsically safe fieldbus segments for FISCO and ENTITY devices

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Foundation Fieldbus End Users Council Australia Incorporated
"Jump Aboard 2009" Conference May 15, Perth, Australia



Intrinsic Safety vs. Fieldbus

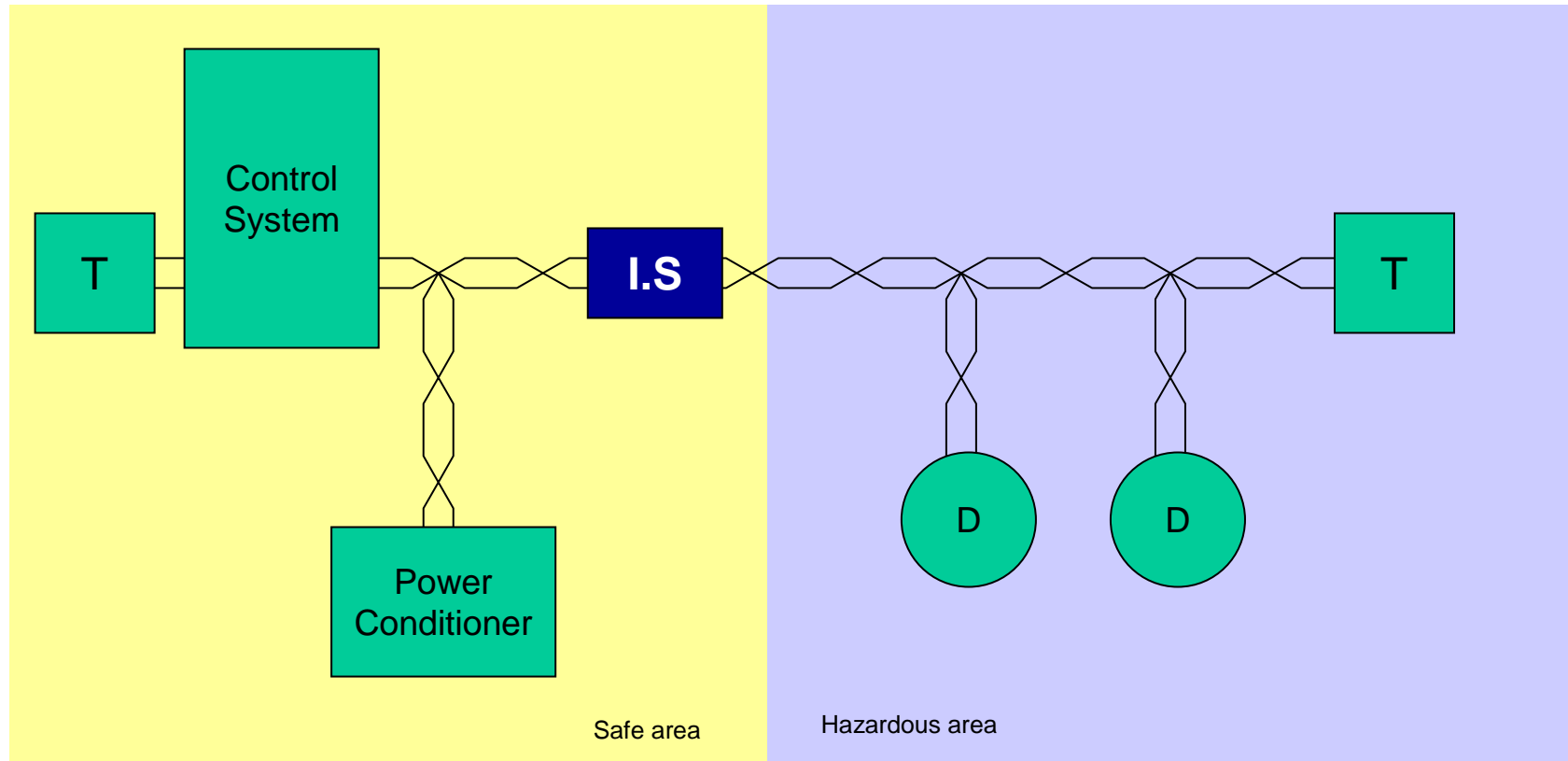


- Intrinsic Safety
 - Limits energy available in hazardous area to below level capable of causing ignition
 - Circuit to limit energy is called an I.S interface (barrier / isolator)
- Fieldbus seeks to put power for many devices on one twisted-pair





Intrinsically Safe Systems





AG163 – Application Guide



- Section 1 Introduction
- Section 2 ENTITY Systems
- Section 3 FISCO Systems
- Section 4.3.1 Fieldbarrier
- Section 4.3.2 Split-Architecture Systems





Current Limiting Technology

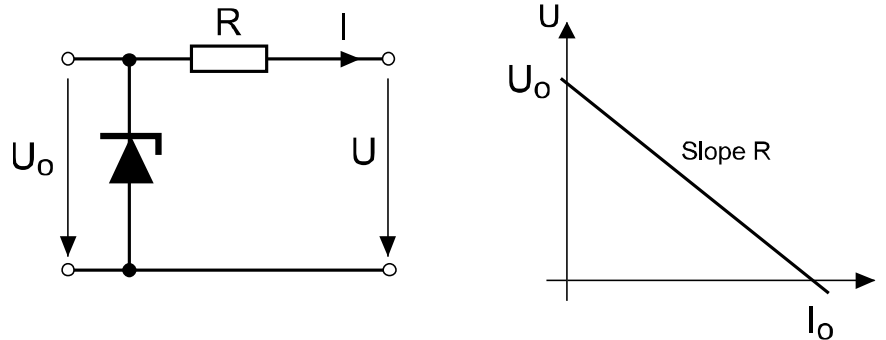


Figure 1(a): Linear Limitation

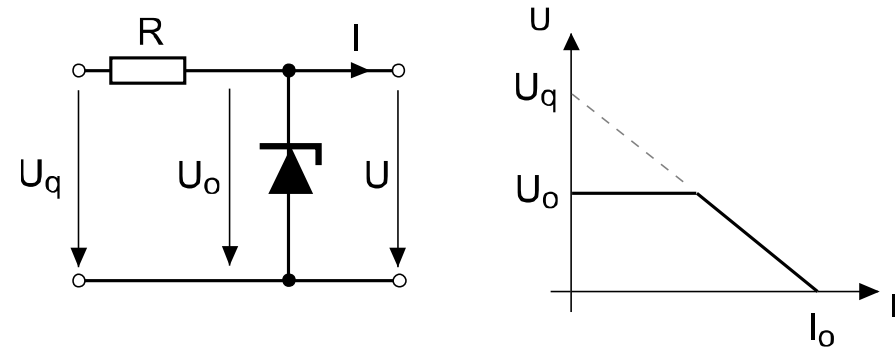


Figure 1(b): Trapezoidal Limitation

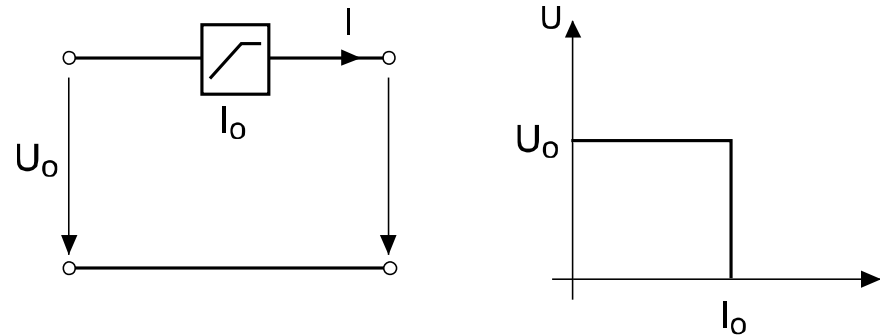


Figure 1(c): Rectangular Limitation





I.S.Design Configuration 1

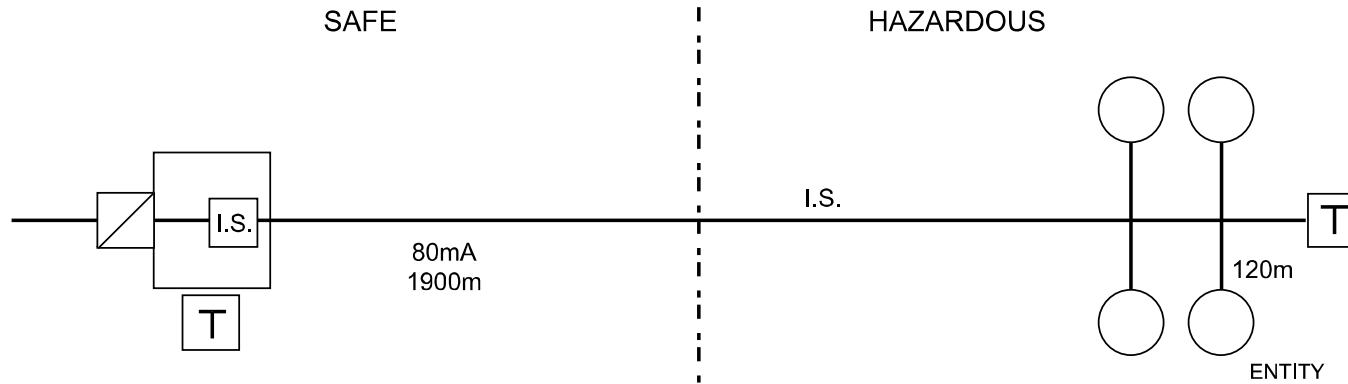


Fig 2 (a) Entity Segment Design

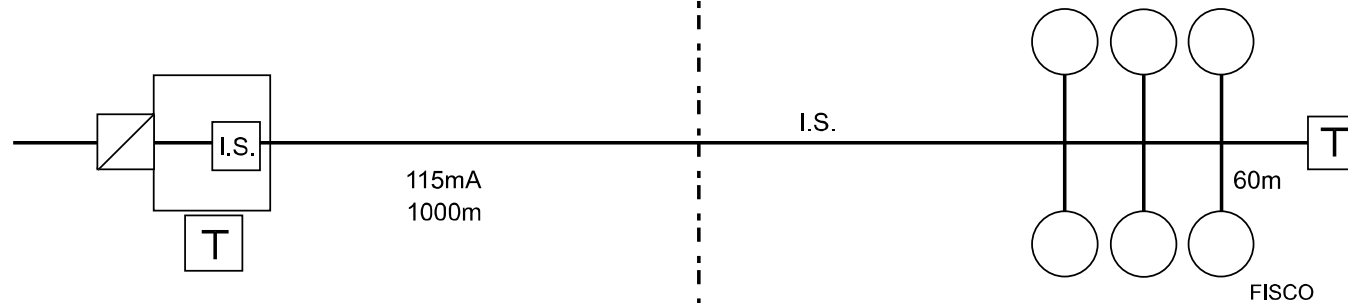


Fig 2 (b) FISCO Segment Design





I.S. Design Configuration 2

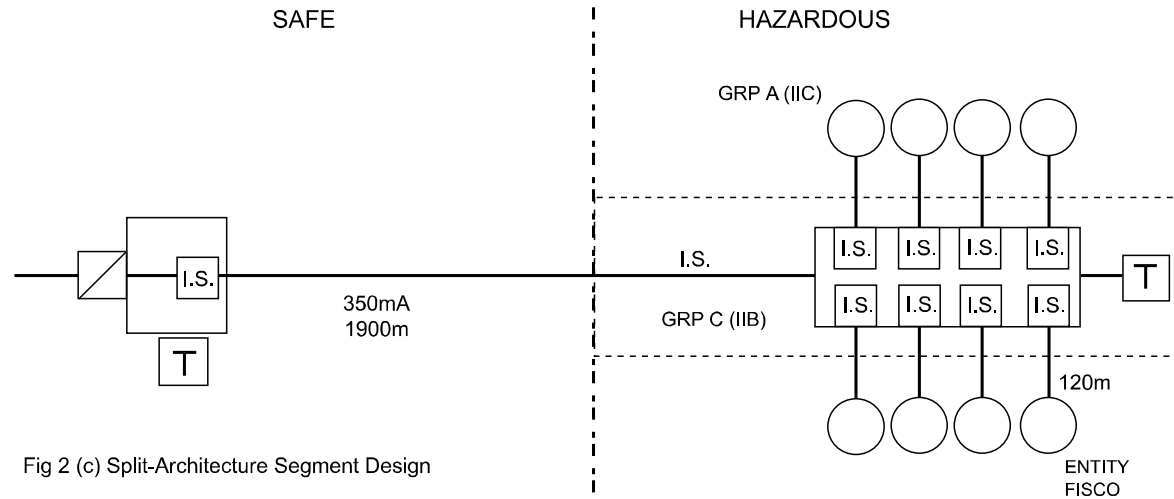


Fig 2 (c) Split-Architecture Segment Design

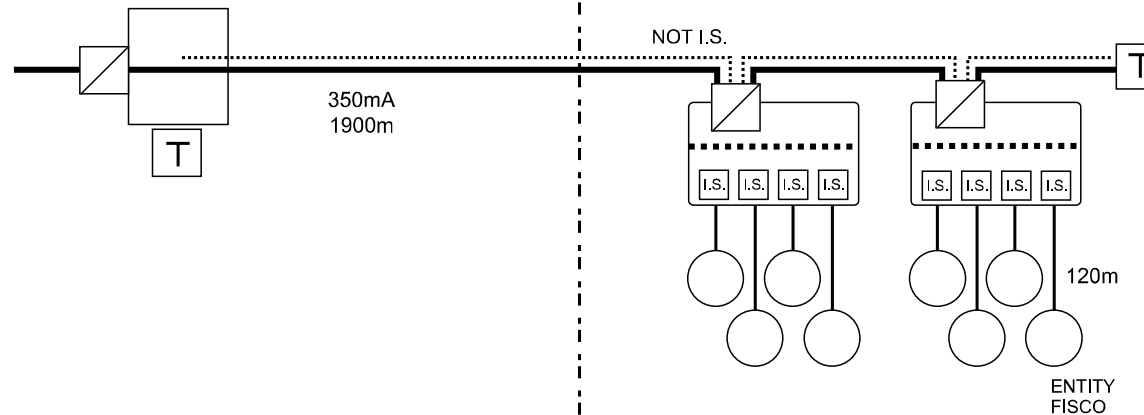


Fig 2 (d) Fieldbarrier Segment Design





Standard ENTITY interface



- Fieldbus I.S. specification (FF816)
 - Device parameters 24V / 250mA / 1.2W
- IIC barriers preferred
 - Covers all gas groups
 - typical safety description 22V 216mA
 - operational characteristic 18.5V **80mA**
- **80mA \Rightarrow 4 devices per segment!**





FISCO



- **F**ieldbus **I**ntrinsically **S**afe **C**oncept
 - Developed by PTB (Germany)
 - Attempts to overcome limitations on I.S fieldbus
 - Uses practical testing of all parts
 - Restricted to 1000m (IIC) trunk & 60m spurs, uses specific FISCO cable (generous parameters)
 - No ENTITY parameter calculations required, just a list of conforming devices & cable specification

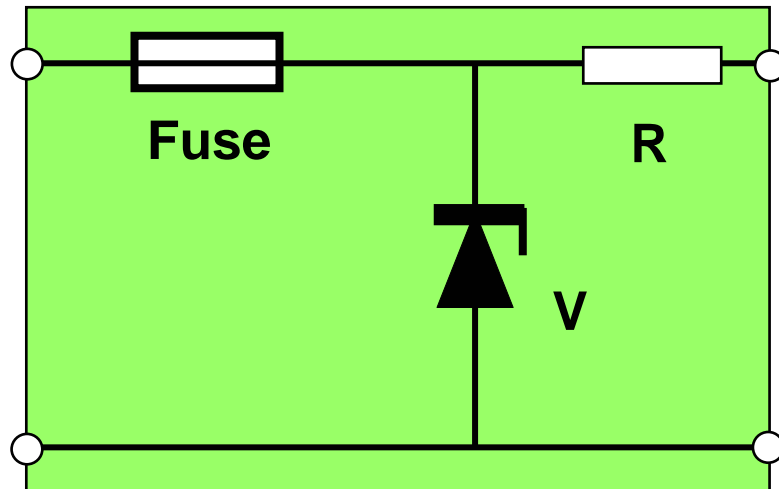




FISCO Changes for Interface Design

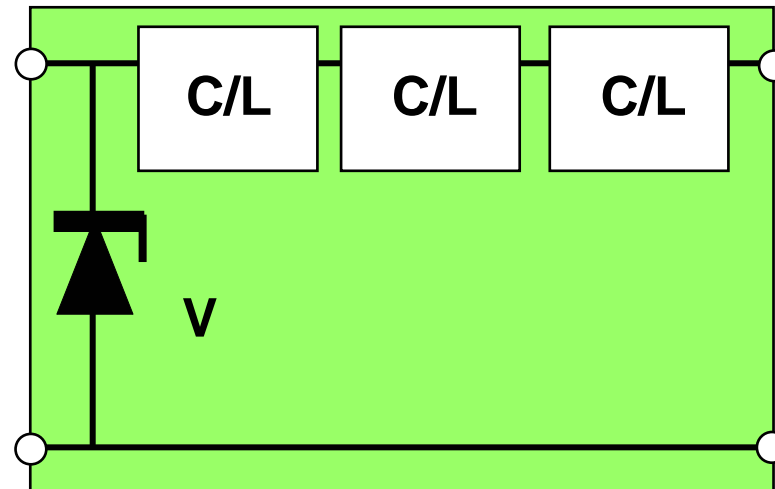


One resistor



FF816
<24V
<250mA
<1.2W

Multiple electronic circuits in series

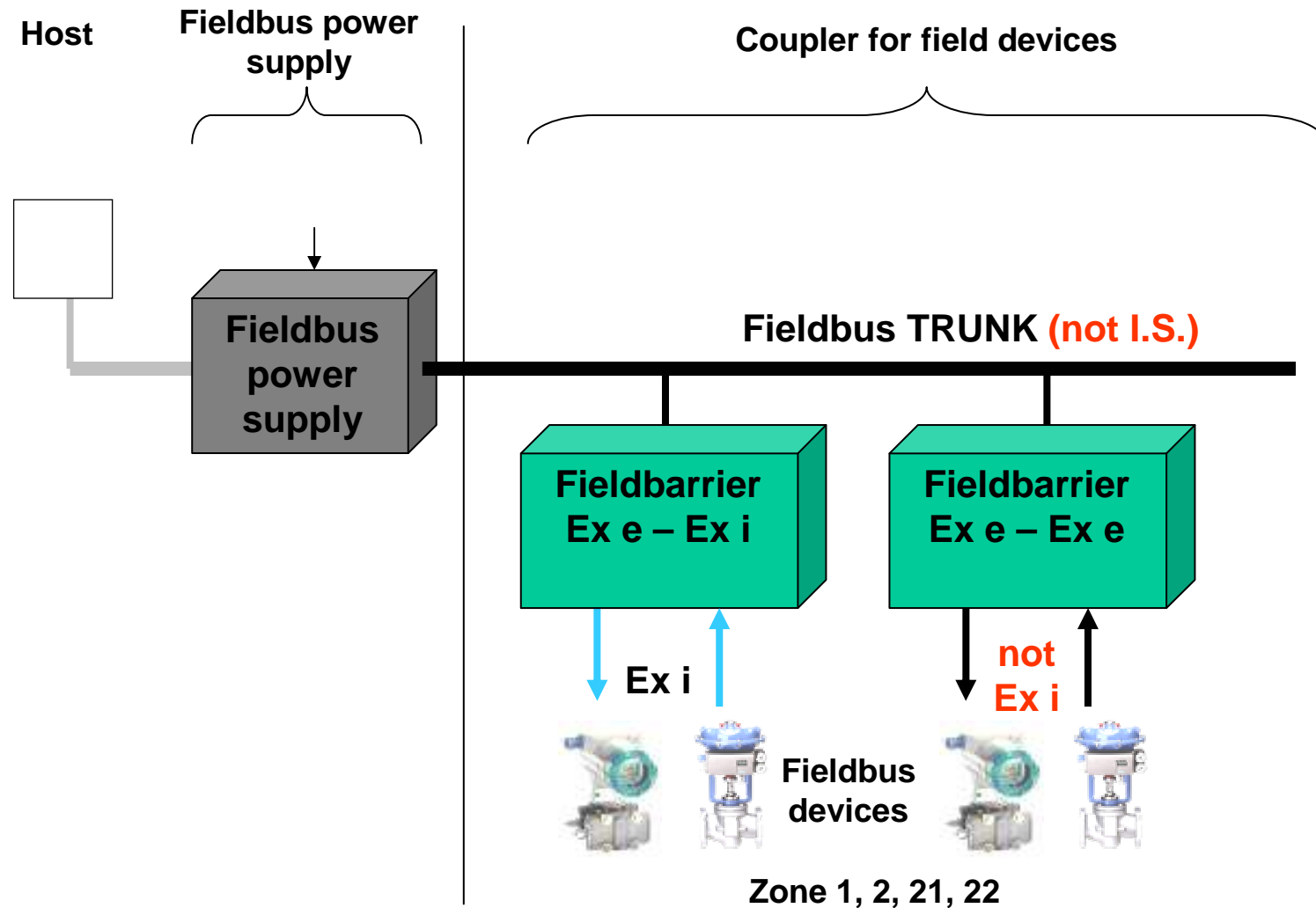


V _{min}	14V	380mA
V _{max}	17.5V	213mA
P _{max}	5.32W	



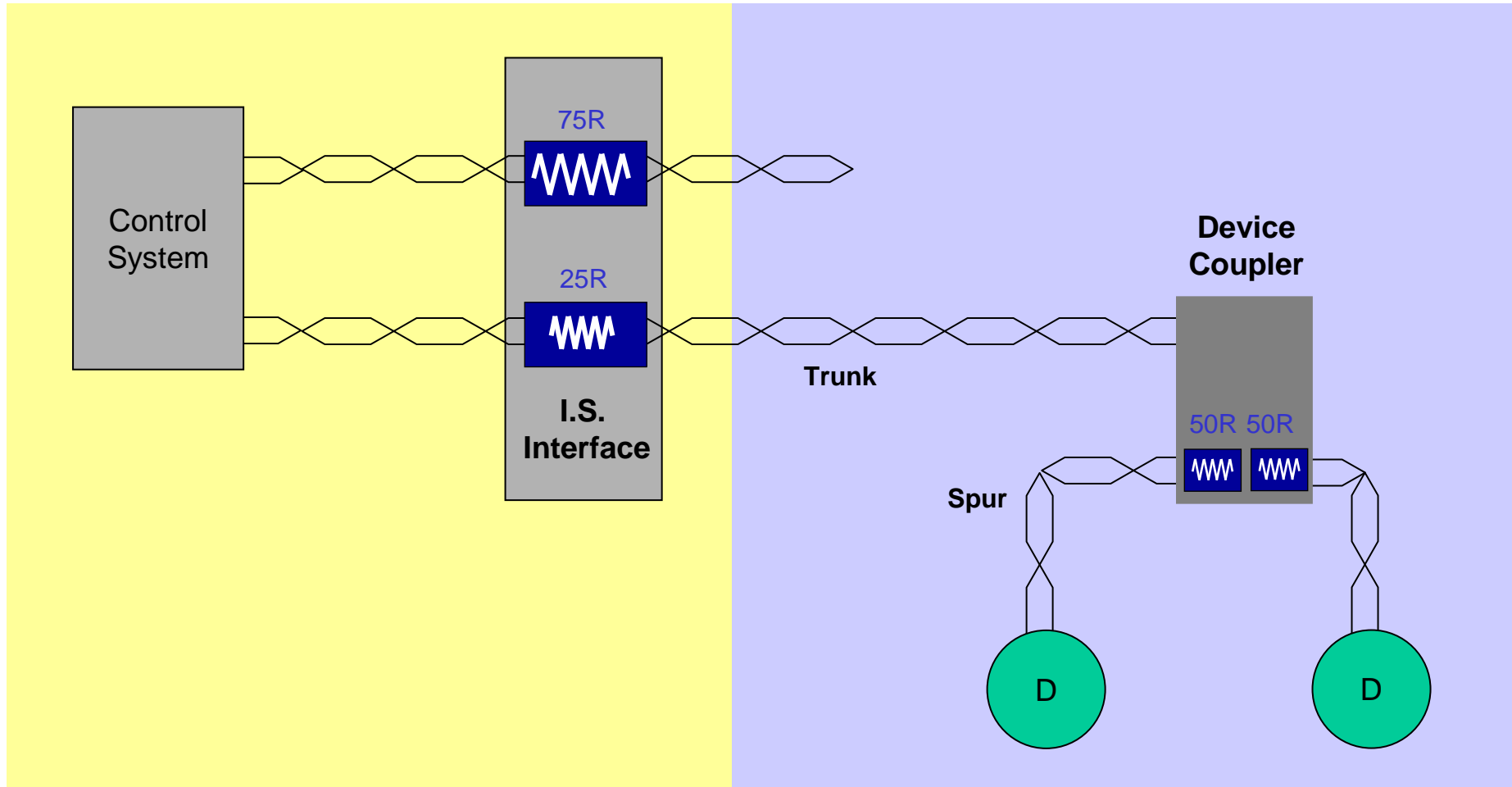


Fieldbarrier



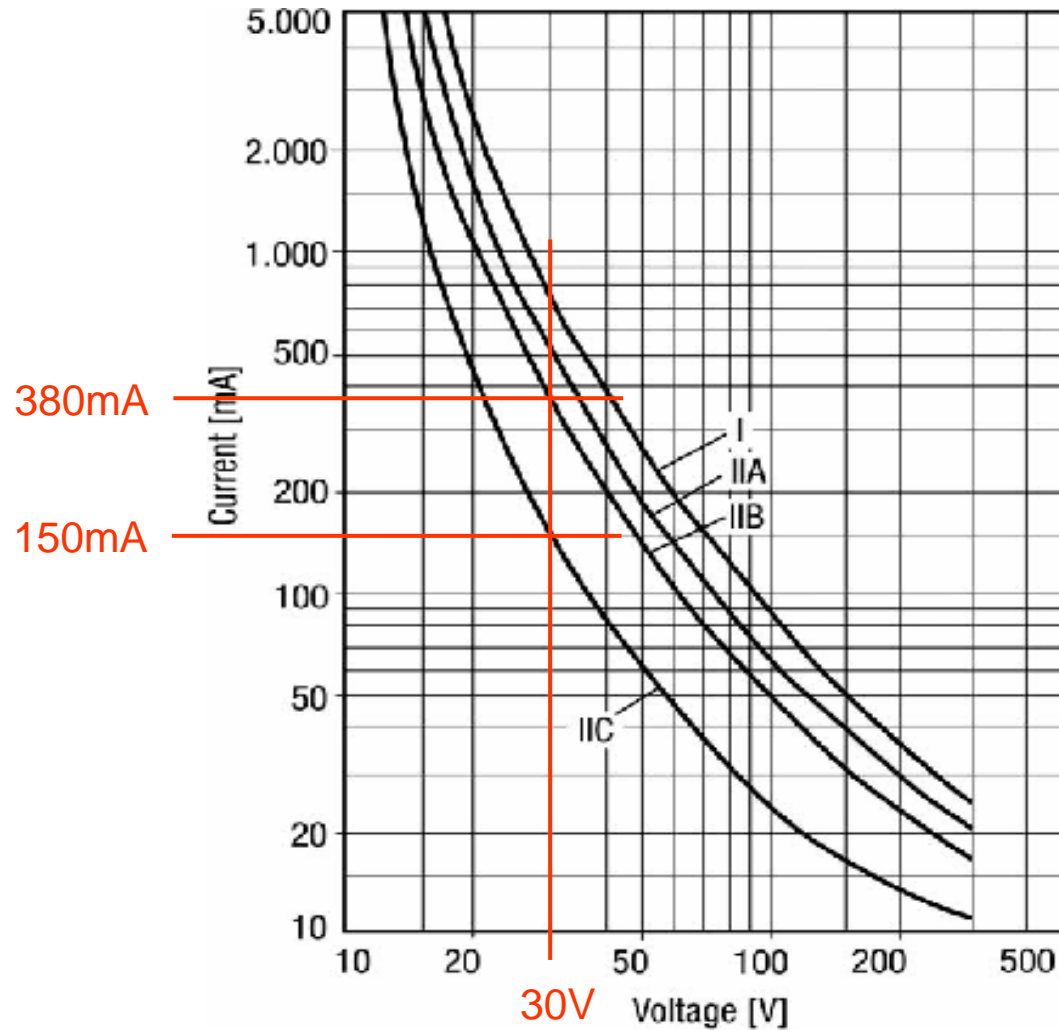


Split-Architecture Concept





Ignition Curves

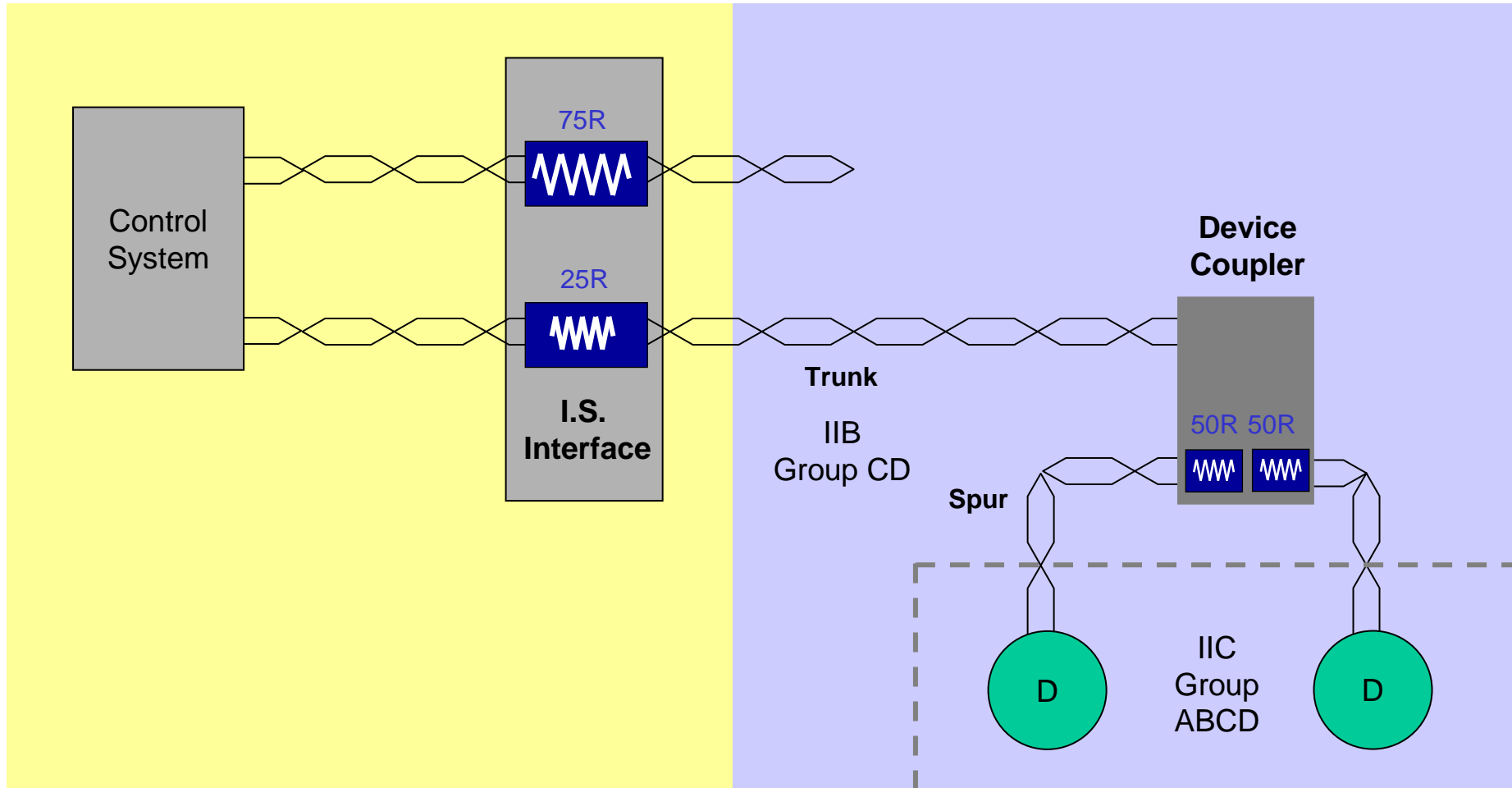


Safety factor of 1.5 required



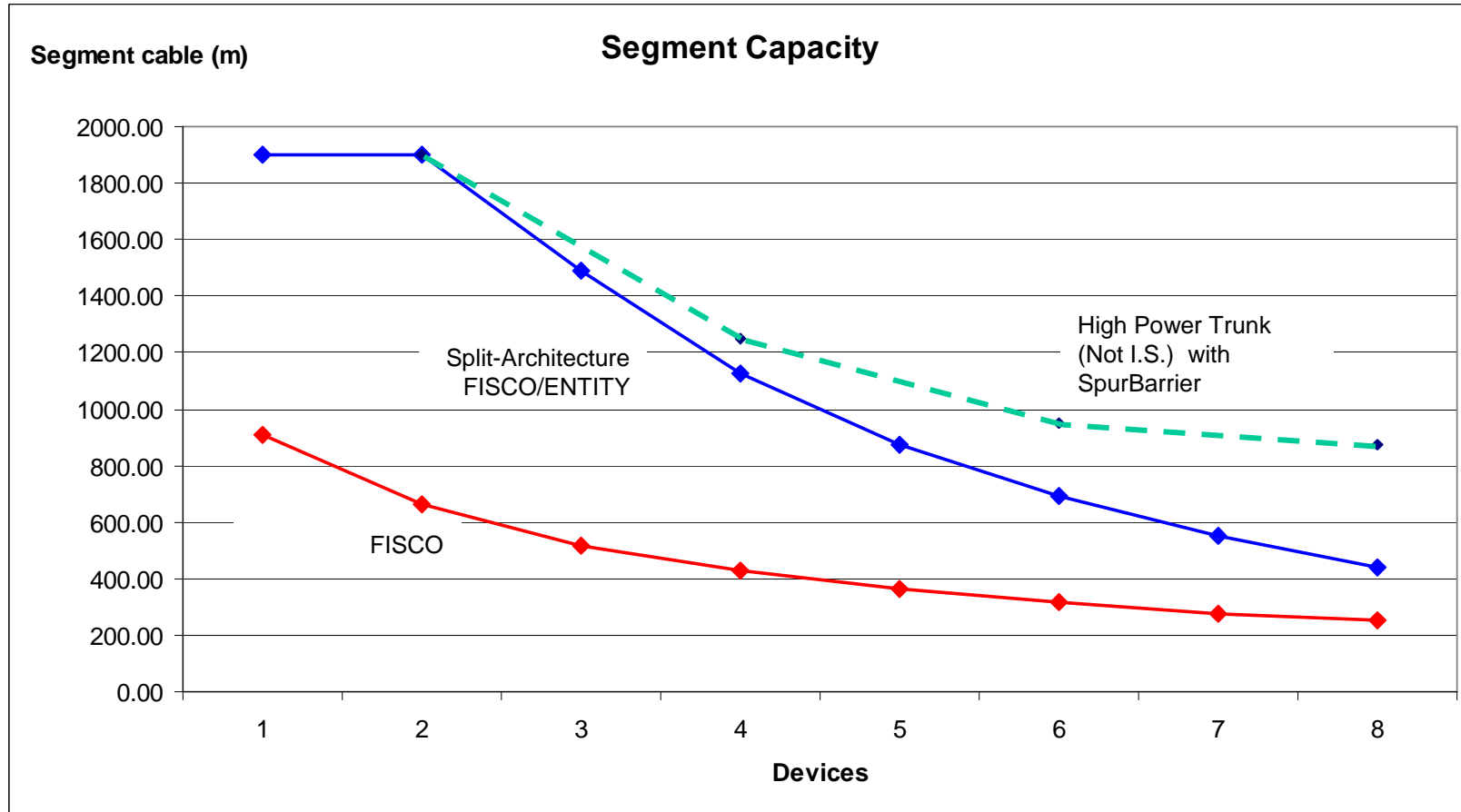


Split-Architecture Concept





I.S. Segment Capacity



17mA devices, 44R/km/loop cable, 11V minimum per spur, 42mA spur S/C load

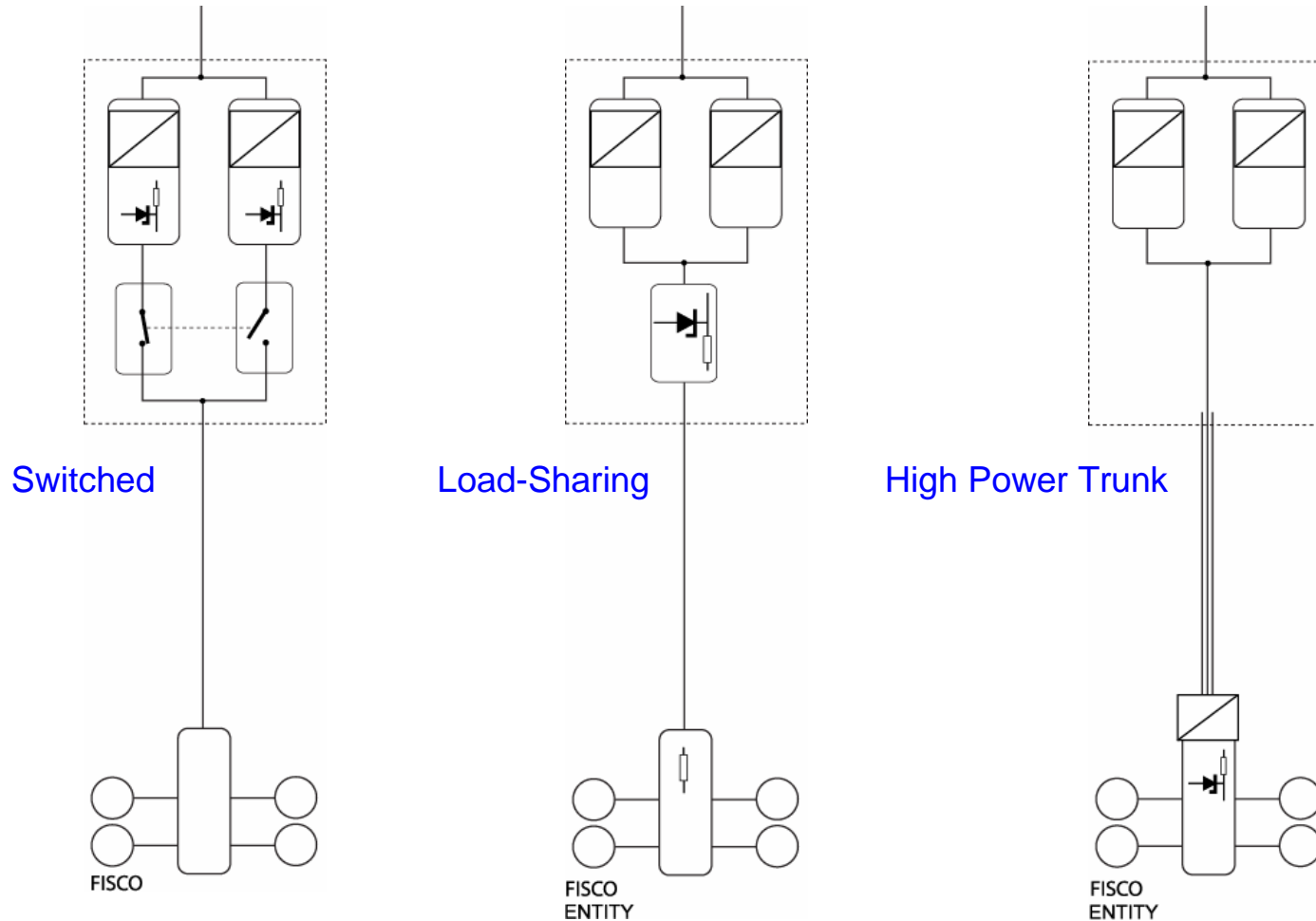
FISCO supply 12.9V, Split-Architecture supply 18.65V, HPT supply 24V



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Redundant I.S. Configurations





Switched FISCO

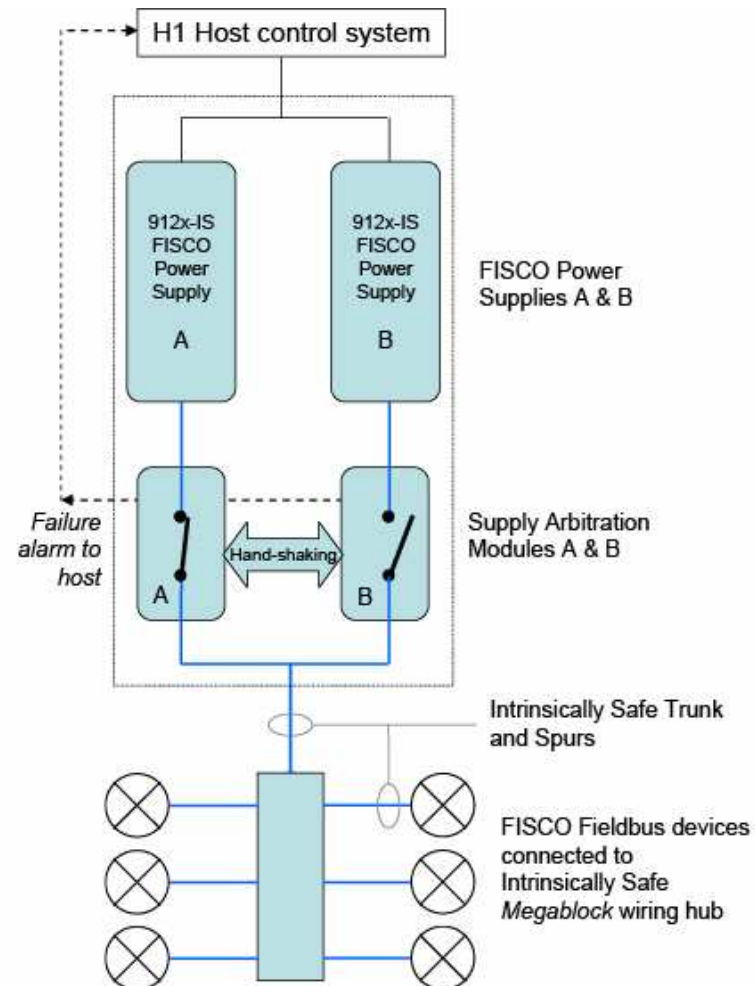


On power-up, field output = FISCO A

On detection of failure of FISCO A or failure of Supply Arbitration Module A, FISCO B is selected

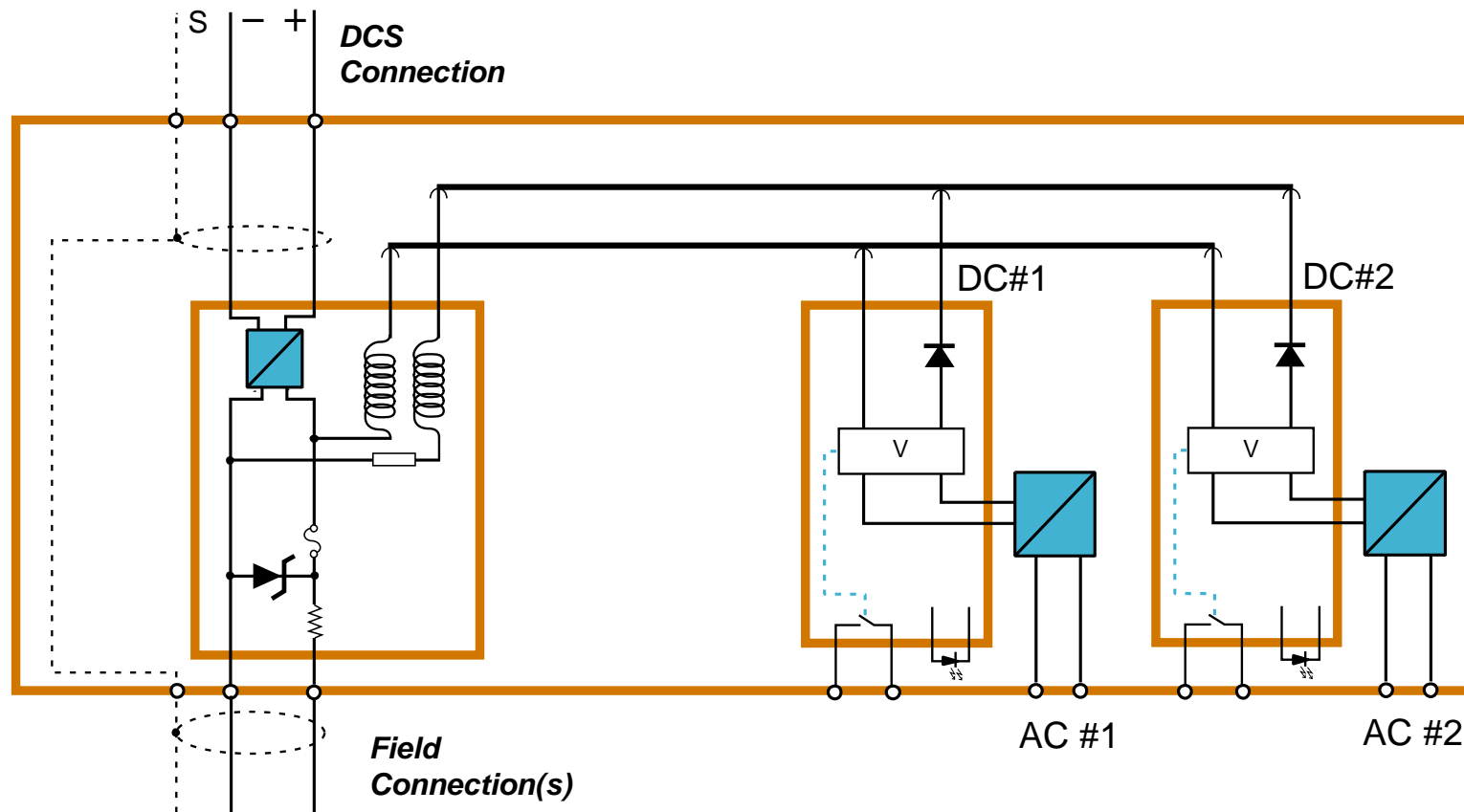
Failure notification is given (open-circuit alarm)

LED indicators identify failed module.



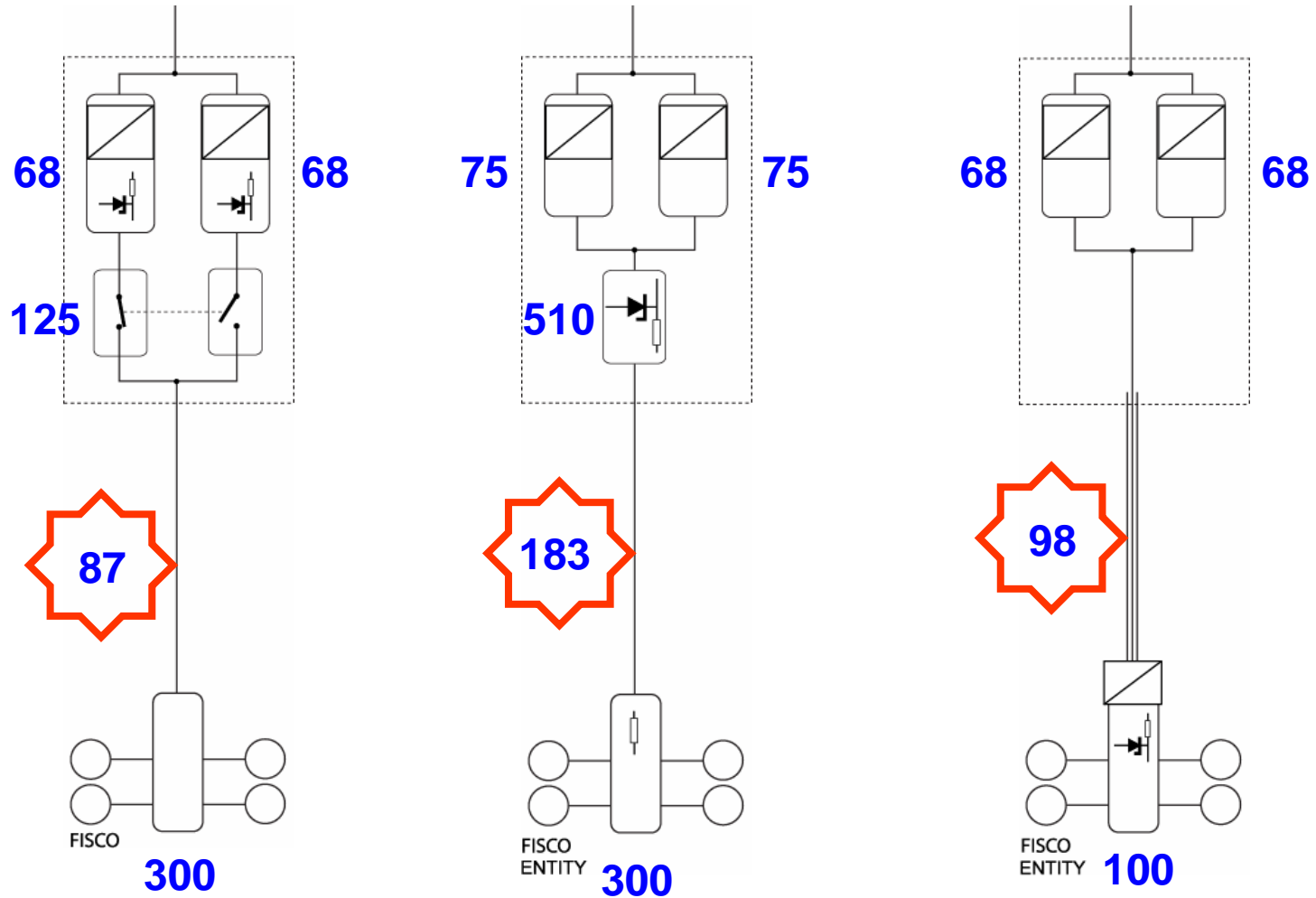


Load Sharing Redundancy





MTBF Impact of Redundant Design



MTBF in years to MIL217K, estimates for comparative purposes only





Segment Calculations – I.S. Redundant



- Total Load =
 - + [Sum of all devices]
 - + [Sum of all device couplers]
 - + [Addition of 1 short-circuit load]

- Total Voltage Drop =
 - [Source impedance drop at Total Load]
 - [Spur voltage drop at max. Device Load]
 - [Device voltage minimum setting]





Cable Voltage



- Voltage available for cable =
Source Voltage – Total Voltage Drop
- Cable length (Ω) =
$$\frac{\text{Voltage available for cable (V)}}{\text{Total segment load (A)}}$$
- Cable length (m) =
$$\frac{\text{Cable length } (\Omega)}{\text{Resistance / km / loop } (\Omega/\text{m})}$$





Dual Trunk Facility

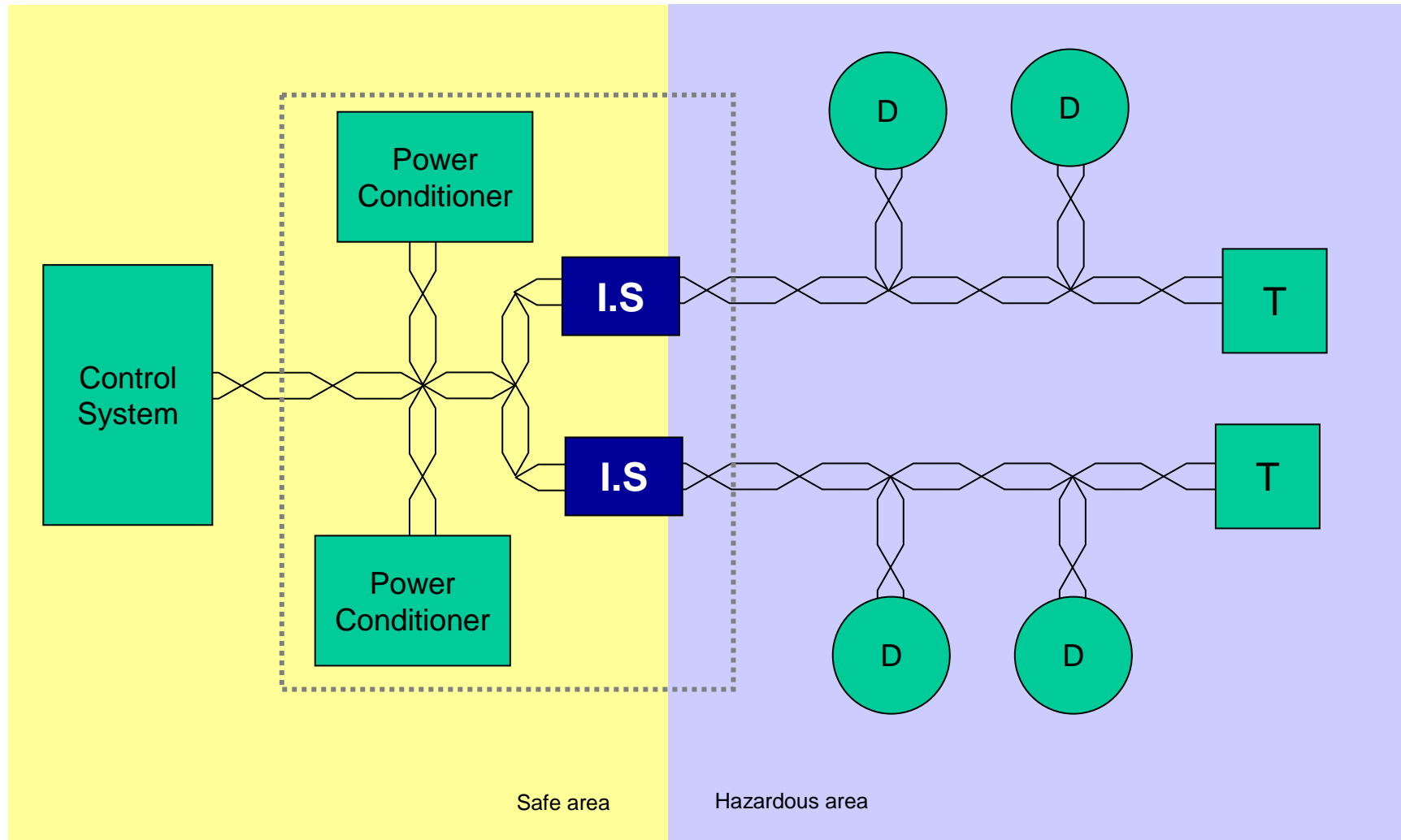


- Technique reduces impact of segment cable
- Usable with all I.S. designs, where space permits.
- Trunks are 2 separate I.S. circuits but still 1 segment
- Power Conditioner can still be redundant



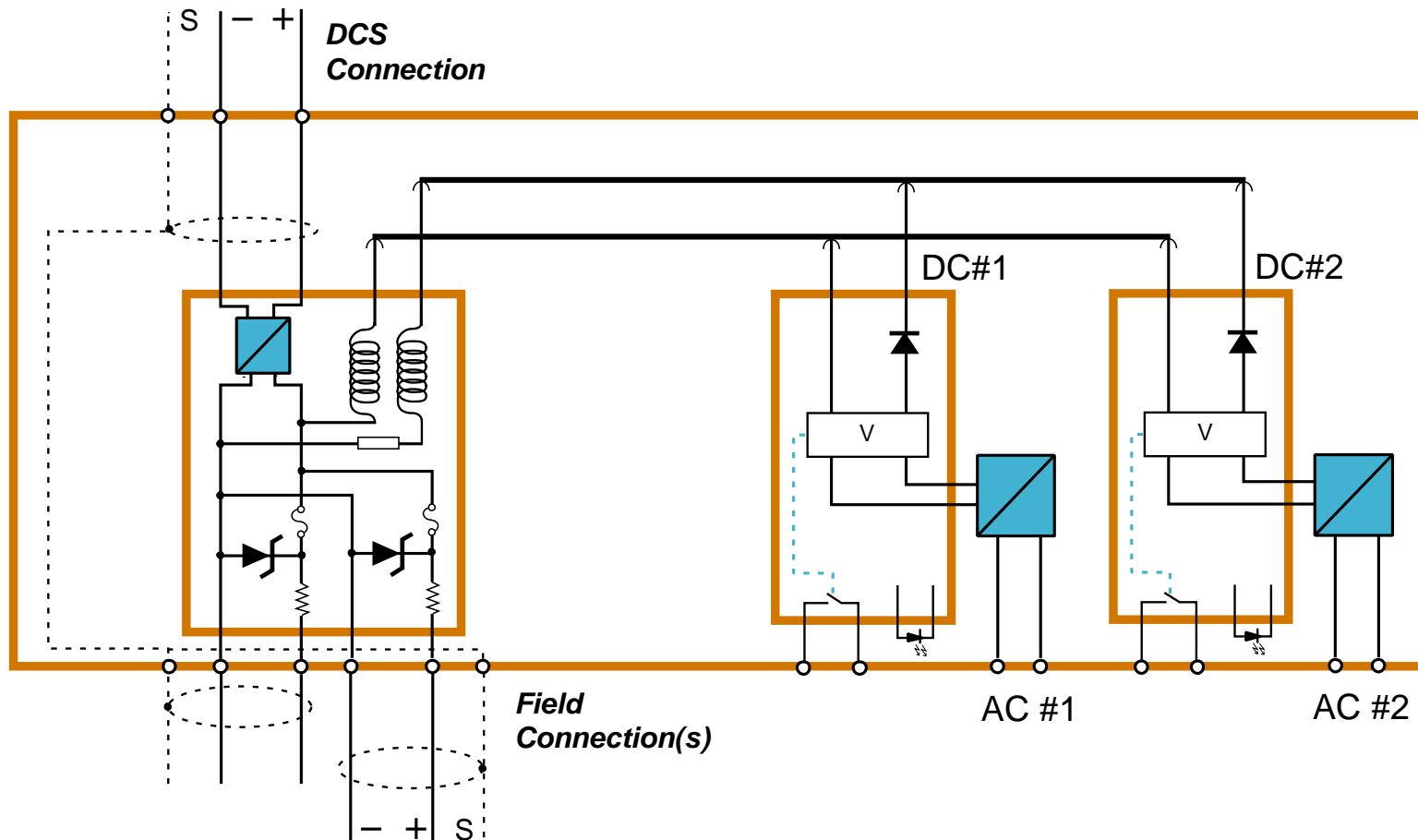


Dual Trunk I.S. Segments



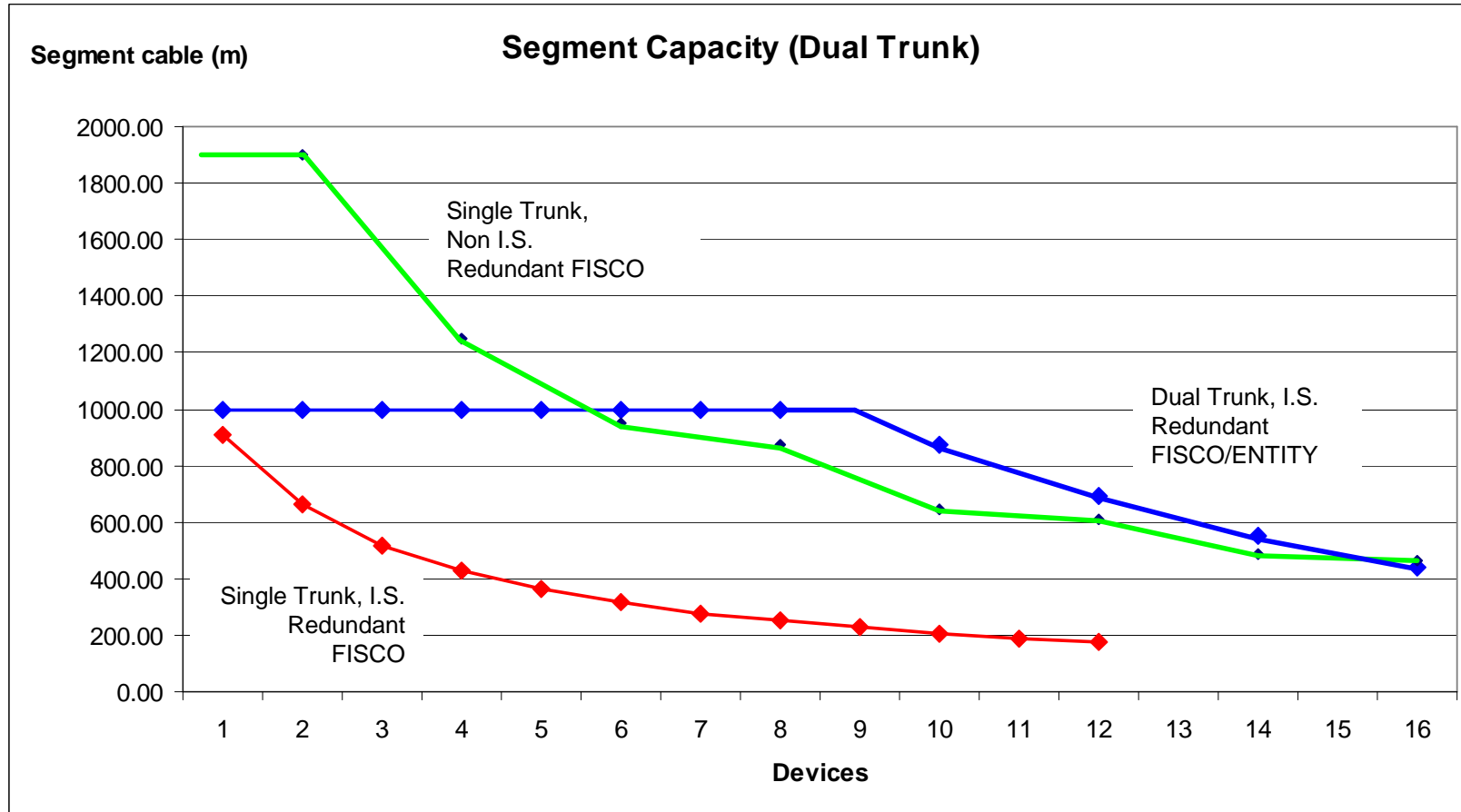


Dual Trunk Design





Segment Capacity for Redundant I.S.



17mA devices, 44R/km/loop cable, 11V minimum per spur, 42mA spur S/C load
FISCO supply 12.9V, Split-Architecture supply 18.65V, HPT supply 24V



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Thank You

QUESTIONS

