It's Often Not an "Accident" But a Multiple Factor Failure

Too often industrial accidents are defined as "unavoidable accidents".

However most are 'Multiple Factor Failures' and avoidable through analysis and better engineering or process design.

Peter Taylor's Presentation to
Safety Connect Conference Aug-18

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A Safety Moment

https://youtu.be/4bBvmPRqfmo
A Death in Holland

A Safety Moment

Arc-blast is a Significant Risk to Personnel

- Blast fireball is like dynamite
  - Intense radiant heat + light + noise
  - Plasma cloud of super ionised toxic gas
- Vapourises metal
  - Fireball destroys everything nearby

Incidents

- Australia;
  - 39 Hospitalisations / year *
  - Occasional fatalities (2 in WA 2016)
- US Stats;
  - 2-3,000 non-fatal incidents / yr**
  - 100-150 fatal /yr **

Public space switchboards explode too

* Arc Fault Incidents in Australia - IE Jan_Mar 2016.

** Occupational Injuries Electrical Shock and Arc Flash Events – Fire Protection Research Foundation – Mar 2015

My Own Arc Fault Experience

Involved in an Incident in 1983

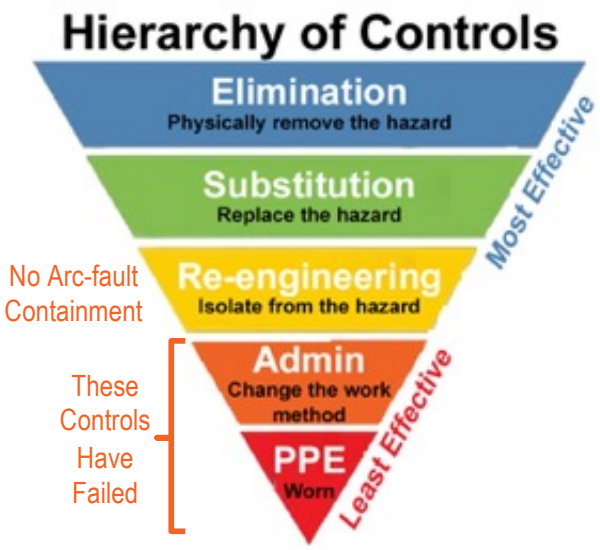
- Commissioning a paper mill PLC controlled MCC
  - Spanner left across busbars + unauthorized access during lunch break + no ‘rechecking’
  - Main breaker arc-fault in a (3b) cubicle
  - Extensive 2nd & 3rd degree burns
  - Carried out unconscious. Never returned to work.

Motivated to Design & Build Safer Switchboards

- Partner for the Cubic™ Modular System
  - Enduring relationship for inside s/boards to IP54
- PTAS own R&D investments
  - Ingress Protection (to IP66) for marine & industry
  - Designed, developed and certified the ‘Arc-Blast Containment’ Outdoor Safety Switchboard’.
  - Reduced hazard exposure with QR - Online Customer Support System

Typical Lesser Injuries

Risk Taking is Human Nature



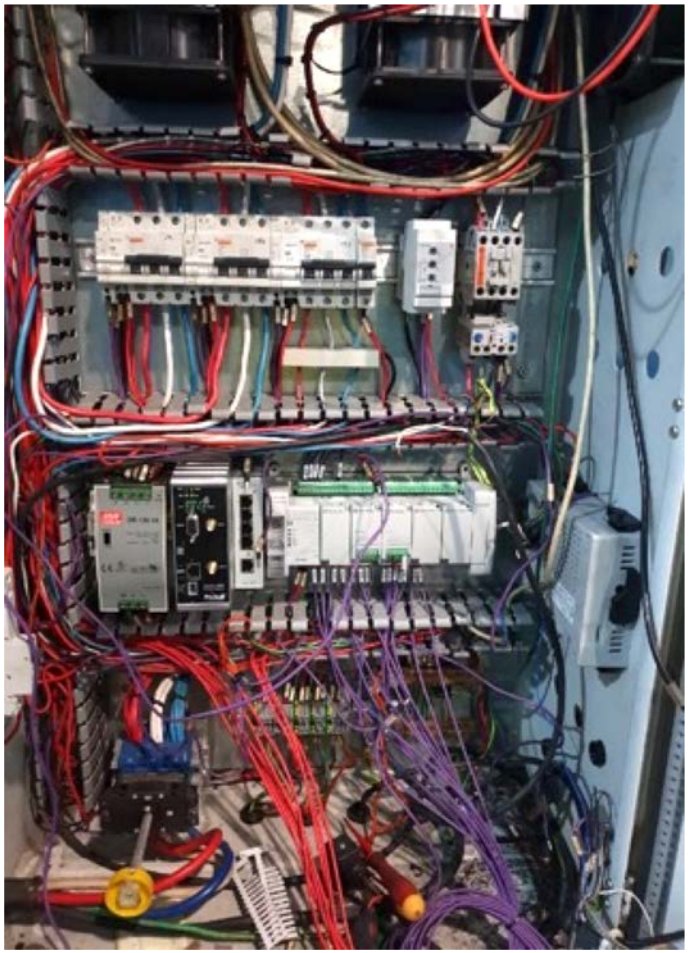
Sewerage Pump Maintenance Activity

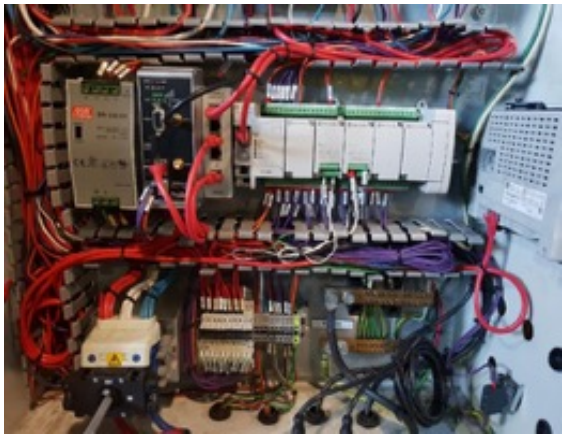
1. Switchboard has 9.9 cal/cm2 (Cat 3) arc-fault incident potential
2. PPE being worn – not correctly and wrong category
3. Open unprotected sewerage pit
4. Pump hanging from crane hook
5. Supervisor distracted with phone call
6. Open public space – no barriers and beside a walkway

Over Time, Hazards Accumulate

Electrical Maintenance Activity

1. Production equipment suffering intermittent faults
2. No drawings available
3. Pressure to restart / maintain production
4. Undocumented changes – no wiring identification
5. Multiple power feed inputs to switchboard – so couldn't isolate locally
6. Add-ons over time makes fault-finding near impossible
7. High risk of working live to trial & error test circuits





Required an expensive production shutdown, but too often people illegally "work live"

Cause v Contributing Factor

Cause

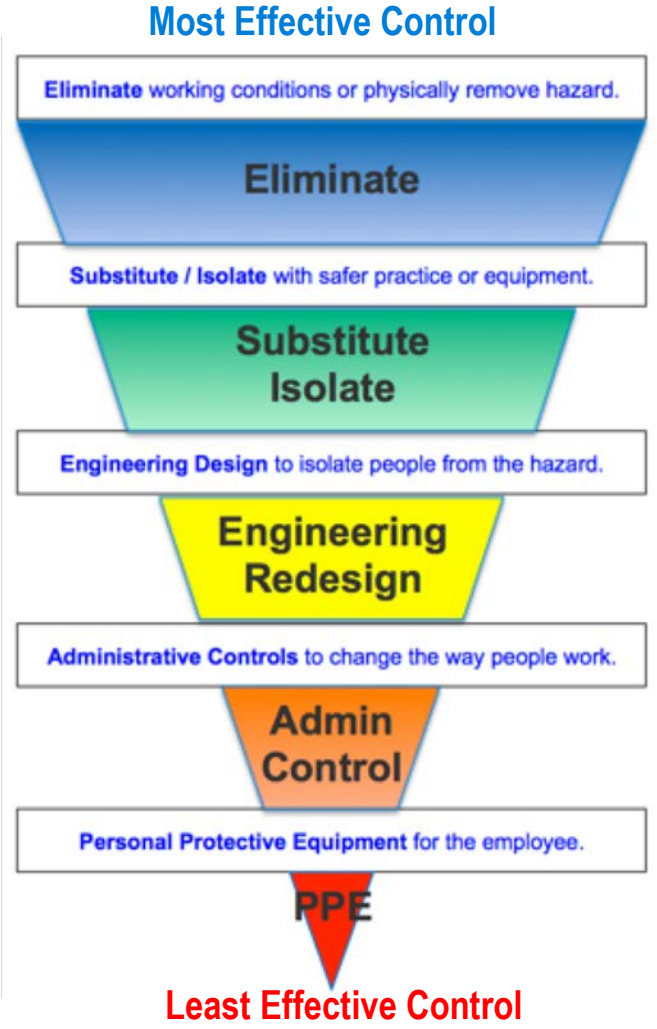
- A condition that produces an effect
- Eliminate cause/s will eliminate the effect

Contributing Factors

- A condition that influences the effect
  - Increases the likelihood
  - Accelerates the effect in time
  - Affects the severity of consequences
- Eliminating contributing factor/s won't eliminate the effect

Hazard Control

- PPE: must be worn properly by workers
- Administrative Controls: often ignored
- Engineering Redesign: desirable and effective
- Substitution or Elimination: rarely possible



Using Root Cause Analysis

Cause & Effect Analysis

Not always 1:1 – Find one & keep looking

Too easy to blame a “someone” and stop

Rarely a Single Root Cause

Each cheese slice is a risk management process

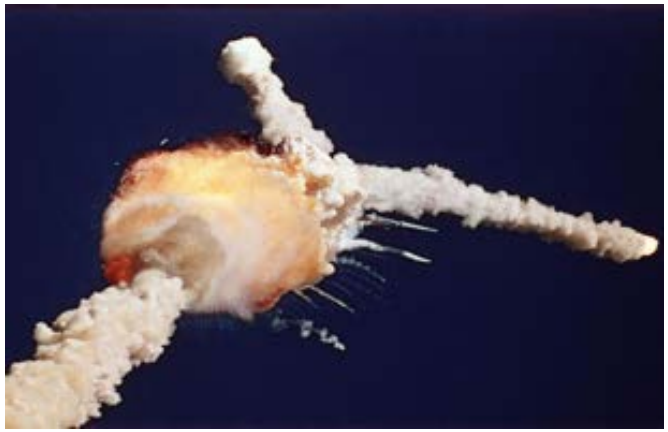
- Each system will have holes
- When holes align, failure occurs
- Objective is less and smaller holes in systems

Contributing Factors

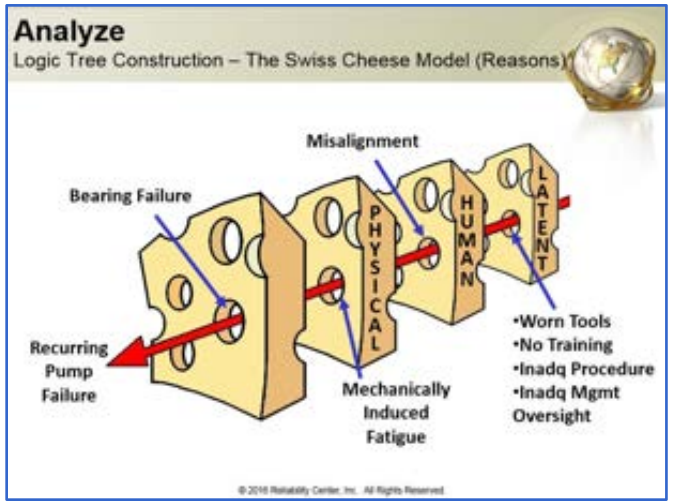
Physical: observable causes

Human: we are not infallible – we take risks, indirect / non-technical pressures, process short-cutting, org’n culture

Latent: original manufacturing variations, add-on changes of application, systemic issues



NASA Challenger failure was more than the physical ‘o-ring failure’; crossing the jet stream + public pressure to launch + oscillation of booster



Dr. James Reason’s Swiss Cheese Model (see Figure 1) from his text ‘Managing the Risks of Organizational Accidents’ (Reasons, J. 1997..

Re-engineering Switchboards

Isolate Personnel from the Hazard

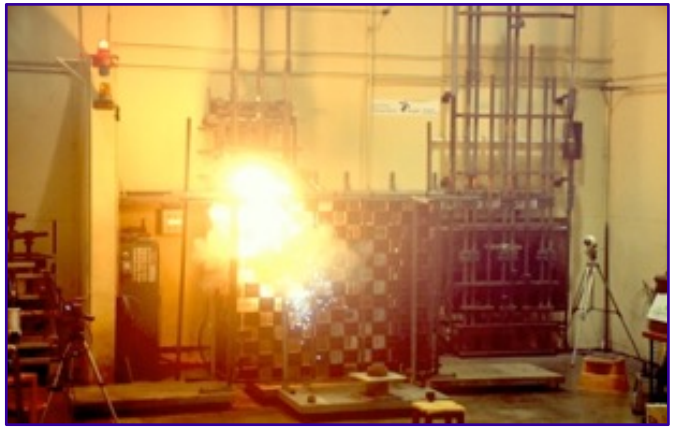
- Redesigning the switchboard to contain and diffuse arc-fault explosion energy internally
- Improve user-ability for operations
- Engineering out risk is both cost effective and desirable

Increased Safety

- Safety of personnel is not reliant on proper wearing of the right PPE for risk
- Supervision of administrative controls less critical for safety of employees and public

Easier Working – Higher Productivity

- Bulky ‘bomb-suits’ not required
- Operators can work board without electrician
- Reduced need site fencing & traffic controls



Top: ‘Fail test’ to identify arc-fault hazard
Btm: Certified safe containment – no doors

Reducing Hazard Exposure

Isolate Personnel with a Safer Practice

- Research site and circuit info offsite before work commences
- Scan QR code makes safer work environment. Relevant safety information always available
- Eliminates trial & error fault finding, significantly reduced exposure to arc fault incidents

Productivity Gain with Right Info

- Reduced cost of upgrades, scheduled and breakdown maintenance work
- Scan of internal QR code accesses all drawings and component data sheets
- Right parts on hand and work method ready before travelling
- Less lost production due to extended shutdown

Scan to Try >>

Top: Know the job task remote from hazard
Btm: Ensuring all information is available with QR scan onsite and in a safe location

Safety's Far-reaching Impacts

Dreamworld Incident *

- Cost cutting on safety – maintenance spending?
- Two different buttons – confusion?
- Regular breakdowns – not heeding near misses?
- Staff training – emergency drills?
- Workload – too many tasks?
- Safety audit recommendations – not followed?
- Physical spacing of the conveyor slats – changed?
- Water level control – not automated / interlocked?

Impact *

- Four lives, with families that will never recover
- $75M asset value written off - $50M losses
- Industry downturn in all theme-parks
- Multiple lawsuits
- Executive careers in ruins
- Legislative change – industrial manslaughter laws

* Images and impact info from GCB, QCM and AFR reports on Dreamworld inquest

SEQCD|P – Integrated Culture

Integrated Management System

Catalyst for Change
Built out of ISO AS 31000 Risk Management
Takes a full view of company. Cultural foundation
Drives continuous improvement process

ISO Accreditation Components

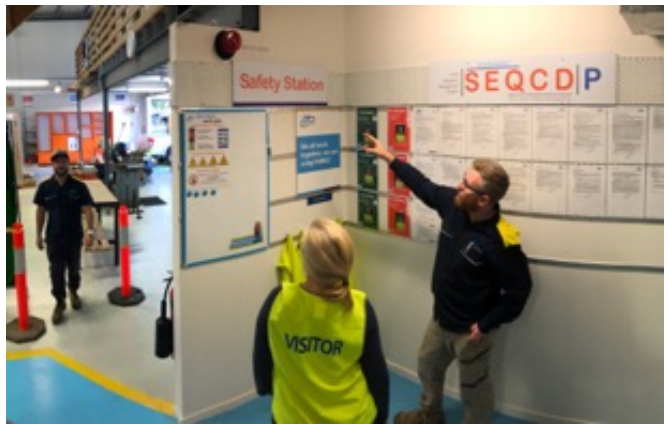
Safety: AS/NZS 4801:2015
Environment: ISO 14001:2015
Quality: ISO 9001:2015

Lean Manufacturing Components

Cost: on budget | to plan
Delivery: in full | on time

'P-word'; People find their own favourites

Performance, **P**roductivity, **P**lanning, **P**roactive, **P**…



Top: Visitor inductions at Safety Station
Btm: Weekly update monitors preformance

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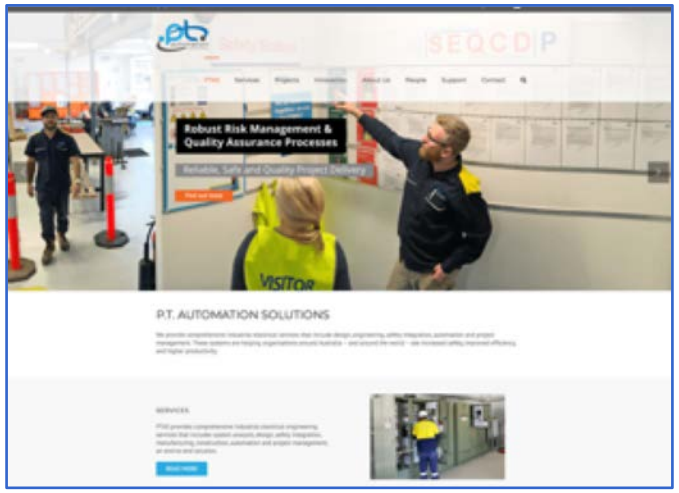

Thank you.

We are committed to safety