PSCI PHARMACEUTICAL SUPPLY CHAIN INITIATIVE

Building responsible supply chains

Electrical Safety & LoTo

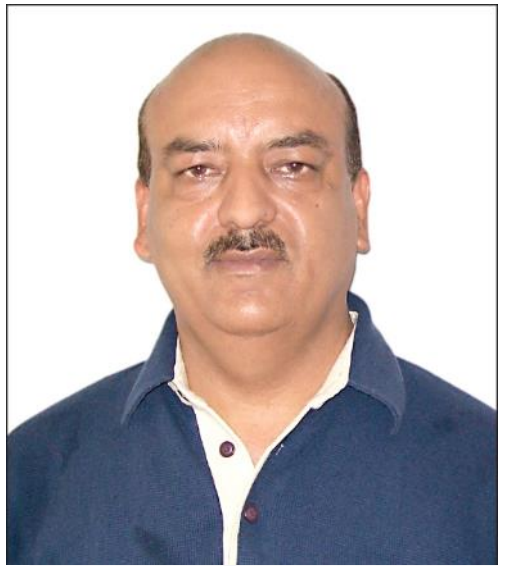
Bio

ROBERTA HASKI

Company Role	
2015 - present	HSE Adviser, Elanco Asia- Pacifc, Japan, ANZ
2012 – 2015	Legal work and practice
Prior to 2012	Variety of positions in HSE and HR senior management at global pharmaceutical company, university, hospital.
2011:	Variety of consulting work.
2011:	Admitted to practice law, graduated JD from UTS
2007	MLLR – Sydney Uni
Prior to 2007	MSc – UNSW
	BSc – Sydney Uni

Bio

RAJIV NARANG



Company Role	
Present	Associate Director Safety, Health & Environment – Corporate
	Centrient Pharmaceuticals (previously known as DSM Sinochem Pharmaceuticals)
2015 / 2016	Special assignment as Corporate Safety, Health and Environment auditor with DSM Netherlands Corporate.
1996 – 2017	Various roles in Safety, Health and Environment
1986 – 1996	Various roles in Production
1986	Graduation from Punjab University, Chandigarh

Examples of High Risk Safety Programs

What we explore today

Why Focus on Electrical Safety / LoTo?

‘Electricity is not just a lifeline, it can also take away life when handled improperly’

Electrical faults seem to be the major reason for industrial disasters in the country as 56 per cent of incidents are reportedly caused by them.

Overheating, ageing of the material and use of sub-standard quality of electrical gadgets have been the main factors contributing to the increasing fire accidents in industries in the past four years.

V. Srinivas, member of the Fire and Security Association of India (FSAI) National Executive Board.

Why Focus on Electrical Safety / LoTo?

Year	Electrocution	Fire
2009	8539	23268
2010	9059	24414
2011	8945	24576
2012	8750	23281
2013	10218	22177

Source: National Crime Records Bureau, Ministry of Home Affairs.

Figure 1. Annual Number of Fatal Electrical Injuries at Work, 2007 – 2016

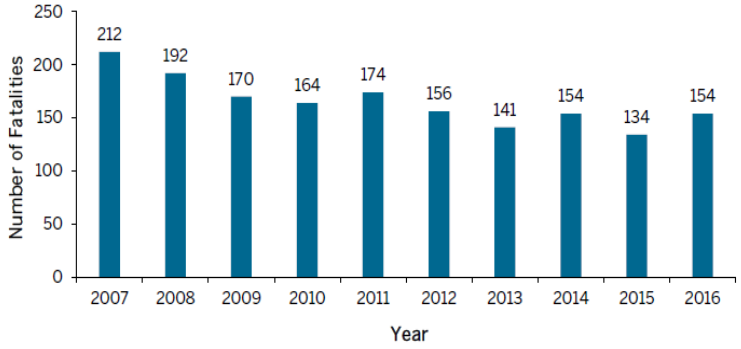


Figure 6. Fatal Work Injuries from Direct Exposure to Electricity by Location of Injury Event, 2012 – 2016

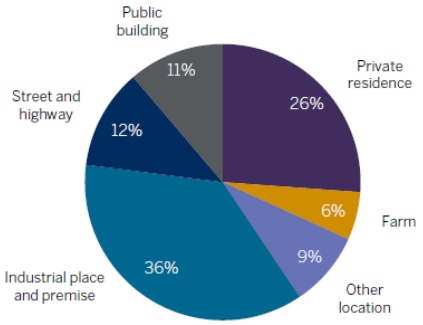


Table 2. Fatal Electrical Injuries by Occupation, 2012-2016

Occupational Group	Fatalities	Percentage
Construction and extraction occupations	346	47%
Installation, maintenance, and repair occupations	165	22%
Building and grounds cleaning and maintenance occupations	86	12%
Production occupations	31	4%
Management occupations	29	4%
Farming, fishing, and forestry occupations	27	4%
Transportation and material moving occupations	25	3%
Other occupations	30	4%
Total	**739**	**100%**

U.S. Bureau of Labor Statistics (BLS)

Why Focus on Electrical Safety / LoTo?

- High Risk Work or SIF (Serious Injuries or Fatalities) programs;
- High risk work – but risks can be controlled;
- One of main causes of serious injuries & fatalities in the workplace;
- Applicable to all workplaces;
- Applicable to own and contractor employees and third party vendors.
- Focus of regulatory requirements;
- PSCI focus;
- Information readily available for workplace improvements;

PSCI Questionnaire – Q55, Q56

55	Does the facility have a safe work permit system for the following?	Hot Work: Yes No NA Confined Space Work: Yes No NA Energy Isolation or Lock Out/Tag Out: Yes No NA Line Breaking: Yes No NA Work at Height: Yes No NA General Permit Yes No NA Other: Yes No Please describe:	Yes No Comments

56	Has the facility developed and implemented an Electrical Safety Program that includes:	Installation of lockable disconnects interlocks, and emergency stop devices? Yes No Labeling of switches, outlets, breakers, panels, and disconnects? Yes No Designating keep clear areas around electrical equipment for safe work practices? Yes No Electrical cabinets are locked? Yes No Arc Flash Analysis? Yes No	Yes No Comments

PSCI Questionnaire – Q79

79	Does the facility perform risk assessment related to the explosion of flammable liquids, vapors, powders, and gases in processing operations (including storage, transfer and charging)? Does it include the following steps?	• Assessment of the hazards (Minimum Ignition Energy, Kst classification rating, Impact sensitivity etc.) of the handled combustible dusts and powders **Yes No** • **Hazardous area classification (zones according EU-ATEX and Classes according to US-NFPA) including documentation (drawing) and is the equipment appropriate for respective zoning? Yes No** • Installation of special electrical equipment for flammable vapors, gases, combustible dusts, and wet areas? Yes No • **Periodic testing of grounding and bonding circuits, lightning arresters, and electrical distribution equipment?** Yes No • Maintenance/calibration done for critical safety equipment (e.g. sensors, instruments, valves, interlocks, reactors, condenser etc.) at suitable intervals. Yes No • Assessment of the hazards due to mechanical ignition sources? Yes No • What types of engineering controls are used to prevent explosions or damage to personnel, equipment, or buildings? Yes No • Nitrogen as inerting gas: Yes No • Use of forced ventilation: Yes No • Oxygen level monitoring in process equipment: Yes No • **Grounding/bonding systems: Yes No** • Anti-static treated working surfaces: Yes No • Maintain temperatures below flash points: Yes No NA • Equipment that holds hazardous material has suitable basis of safety (e.g. inertion, ignition source prevention)? Yes No • Other, please describe:	Yes No Comments

Electrical Safety – Common Observations

- Site has not identified high risk electrical work;
- Site is unaware / not complying applicable legal requirements for electrical work;
- Site is lacking electrical safety programs, or major parts of programs;
- Lock out, Tag Out, (LoTo) not applied (or not fully applied).
- No documented programs – or worse – what is documented is not what is implemented;
- Workers not trained in these programs;
- Programs not applied to third party contractors;
- High voltage areas not secured for unauthorized access;
- No special procedures for high voltage.
- No Arc Flash Analysis is available.
- Changes done in electrical system are not governed through Management of Change.
- Emergency stops when necessary not available, not identified or not readily accessible to operators

Electrical Safety – Common Observations contd..

- Field Observations;
  - No tagging of electrical equipment.
  - Damaged Cables, Damaged grounding
  - Resistance for grounding is higher than threshold.
  - No maintenance program for checking effectiveness of grounding.
  - Electrical equipment installed (including in Ex-Zone) don't comply to standard OR not maintained.
  - Electrical work done by non-certified electricians.
  - Open / accessible electrical terminals.
  - No PPE's / damaged PPE's used.
  - LoTo is not followed by electricians while doing maintenance work.
  - Use of temporary installations / connections.

Some Case studies

Employee sustained broken shoulders when testing an incorrectly wired appliance

- An employee sustained a 240volt electric shock that broke both shoulders **whilst attempting to test a newly manufactured appliance** that had been incorrectly wired to the mains lead.

  - Suitable precautions had not been taken to prevent electrical injury to employees engaged in testing work on electrical appliances.
  - Employees were exposed to live wires at 240 Volts ac,
  - there was exposed metal in the test area,
  - there was no procedure to pre check of mains lead prior to live test and
  - no risk assessment for electrical testing work.

Employee received a shock whilst insulating live wires

- An employee received a 650 Volt ac. **electric shock** when he picked up a cable lying on the ground that was connected to a generator and began to **apply insulating tape to exposed wires**.

  - No procedure to work on electrical equipment.
  - No Risk assessment.
  - No Power-Off

A worker was injured when working in a live electrical panel

- An employee was instructed to carry out work on an electrical control panel to reverse the phases and reverse the conveyor that had blocked. The panel was still live and **electrical shorting resulted in arcing and caused burns** to his face and arms.
  - Worker was not an electrician and had not received training in electrical work.
  - No risk assessment.
  - No Lock Out Tag Out procedure.

A contractor was electrocuted while servicing an Air Conditioner at office

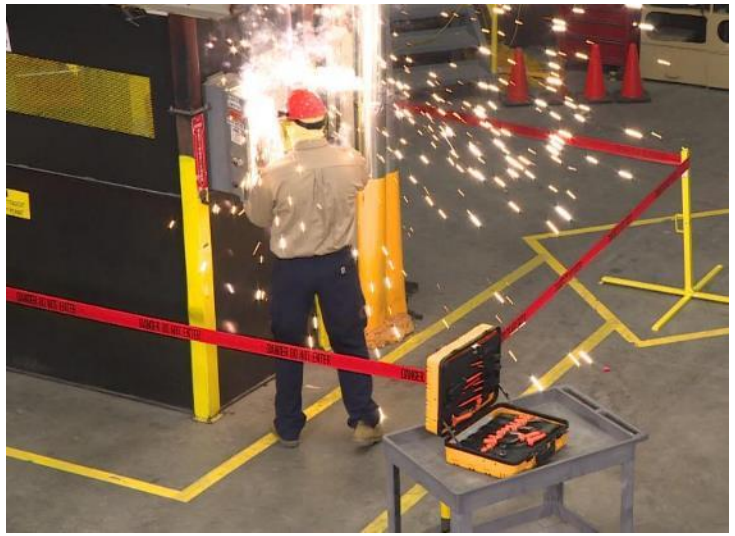
- A contractor was carrying out servicing of an office air conditioners, when **someone accidently switched on** the MCP **causing electric shock** to the working person.
  - No Lock Out Tag Out procedure applied for office work.

Consequence of Electrical Incidents

- Electric shock / Electrocution
- Fires / Explosion
- Arc Flash / Burns

Arc flash / Arc Blast

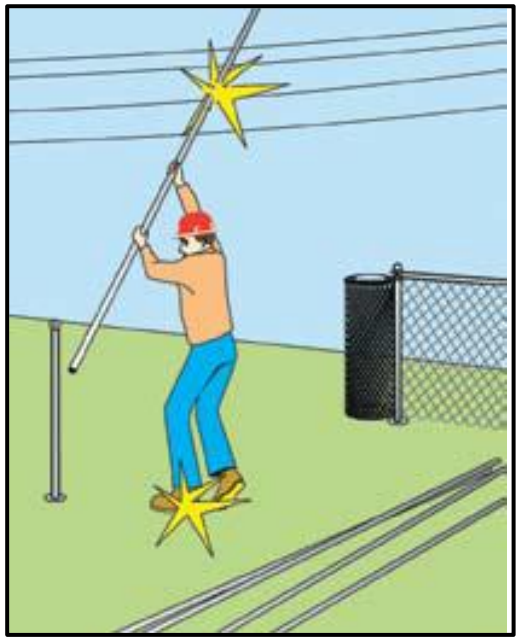
- Sudden release of electrical energy through air when a high-voltage gap exists and there is a breakdown between conductors
- Gives off thermal radiation (heat) and bright, intense light that can cause burns, temperatures as high as 35,000°F
- High-voltage arcs can also produce considerable pressure waves by rapidly heating the air and creating an Arc blast



Common Electrical Hazards

Contact with overhead power lines:

- Overhead and underground power lines carry extremely high voltage
- Risks
  - Electrocution (main risk)
  - Burns and falls



Incidents;

- Worker electrocuted when the ladder came in contact with overhead power lines
- Worker electrocuted when mast came in contact with high voltage overhead lines

Common Electrical Hazards

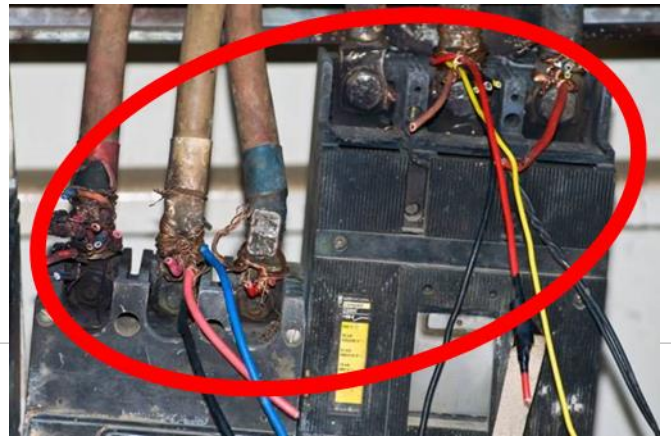
Damaged or bare wires / Damaged Tools

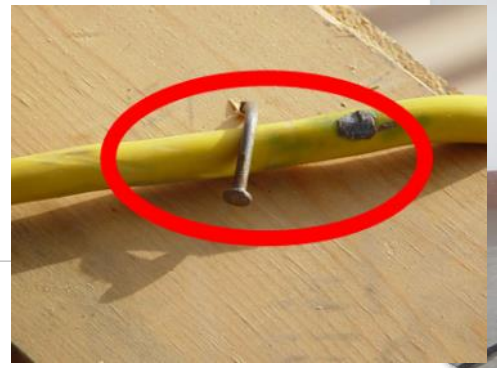
- Fault current may travel through a body, causing electrical burns or death, if
  - Power supply is not grounded
  - Path has been broken
  - There are live parts or bare wires
- Extreme conditions and rough treatment can change electrical equipment from safe to hazardous

Common Electrical Hazards

Unsafe Practices

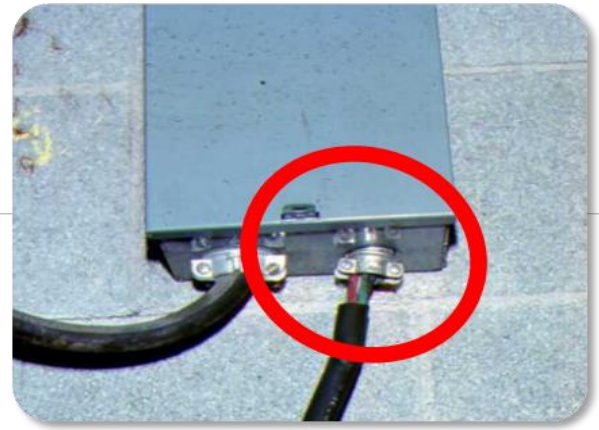
- Wires crossing through doors.
- Wires entangled through steel structure / scaffold.
- Temporary repairs.
- Overloading, Temporary connections.
- Construction site is a major challenge

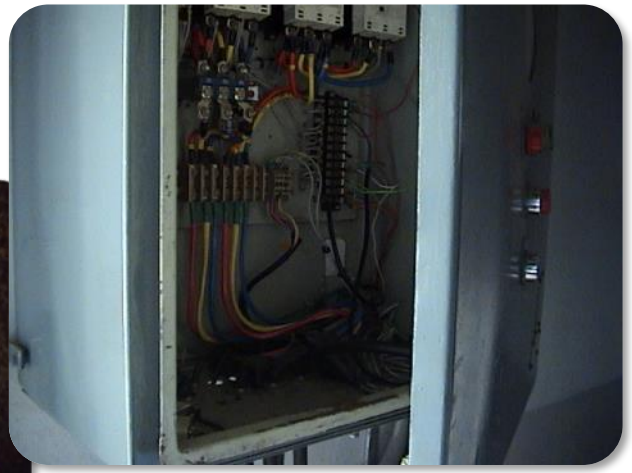


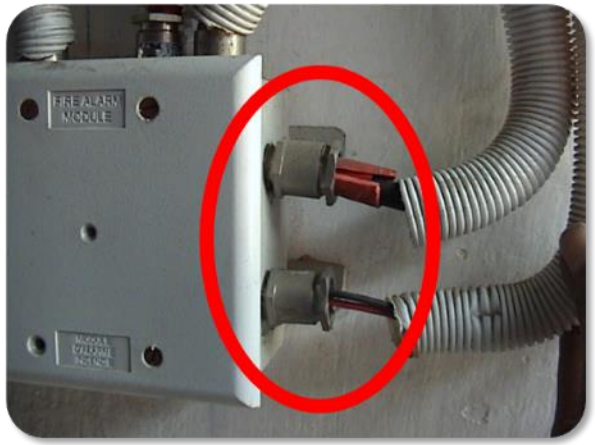


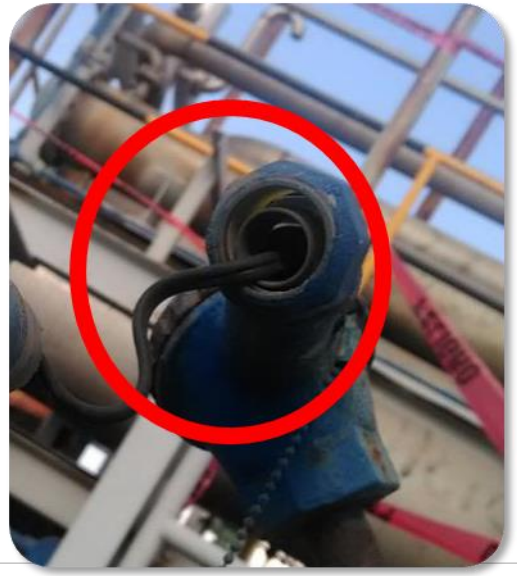
@PSCInitiative

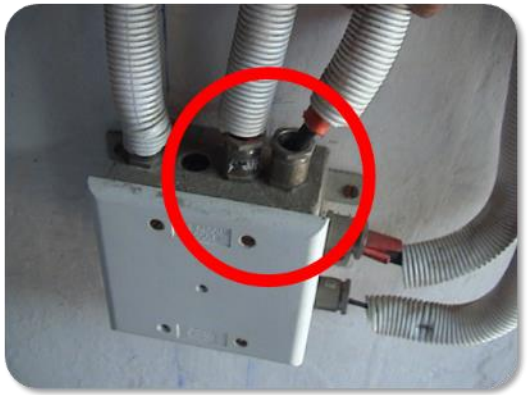
Common Electrical Hazards











Electrical Safety

Specialized Electrical Work;

- Use good quality certified electrical equipment suitable for the work requirement and conditions.
- Installation must fully comply to electrical rules / standards.
- Involve Specialized people to design.
- Don’t carry alterations / modification in original design of equipment.

For Ex Areas;

- Ex Zones have special requirements, generally covered under Process safety.
- Follow ATEX / other equivalent standards to identify applicable zones.
- Install equipment in line with applicable zone.
- Grounding and bonding plays important role.
- Maintenance is crucial.

In Day to Day work;

- Refer next slides..

Electrical Safety - basic requirements

- Work by Qualified and trained electricians.
- Use good quality certified electrical equipment suitable for the work requirement and conditions.
- Installation must fully comply to electrical rules / standards.
- All electrical appliances must be tagged / labelled.
- Grounding plays a crucial role, hence need extra attention.
- All electrical installations must be fully protected for unauthorized access.
- Carryout Risk assessment / Electrical hazard identification.
- Fully apply work permit procedure and Lock-Out, Tag-Out, Try-Out.
- Working on High Voltage require specialized People and Special work permit.
- Choose specialized Personal Protective Equipment for working at electrical installation.
- Changes in electrical system also need Management of Change.
- Precheck before startup (after every maintenance) has no substitute.

Electrical Safety – Portable equipment

- Very commonly used both at workplace and home;
- Identify which portable electrical equipment is to be used where, and needs to be maintained. Include in your maintenance plan and checked by trained person.
- Egs of best practice – test and tag; ERB interlocked circuit breaker receptacles.
- Provide training and information for all users to help carry out user checks including what to do if they find a fault;
- Use of damaged equipment can be risky, and may lead to Electric shock, Short circuit etc.
- Decide what to do about ‘unauthorised equipment’ brought in by employees;





Electrical Safety – Grounding and Bonding

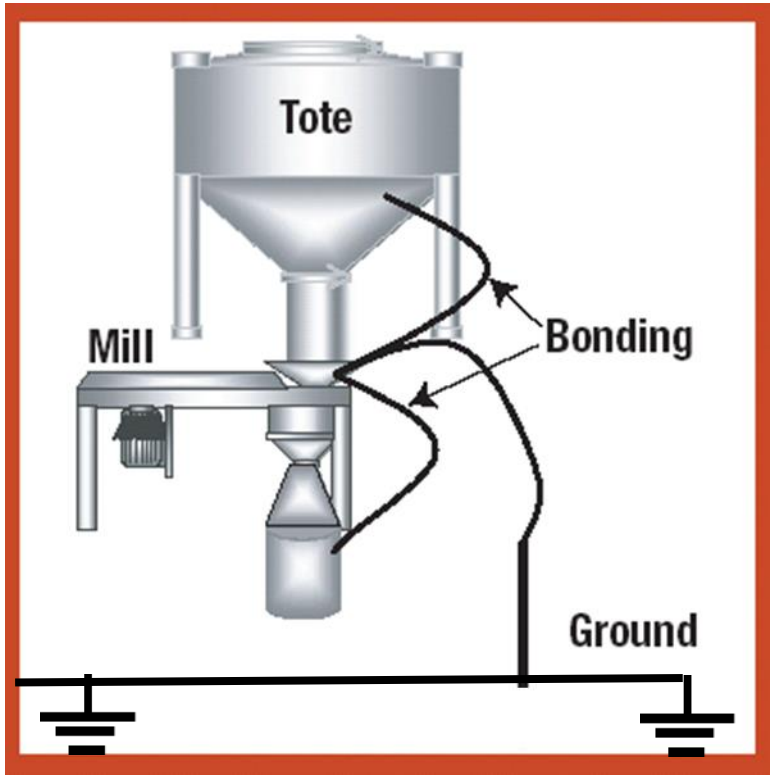
Grounding and Bonding plays a crucial role in electrical safety. If equipment is improperly grounded or bonded, it could result in damage to the equipment, electrical shock, injury, and / or electrostatic discharges that could ignite flammable atmospheres leading to fire or explosion.

Grounding;

- Is the method where you connect metal parts of the equipment to the earth to limit the voltage-to-ground on the metal parts.

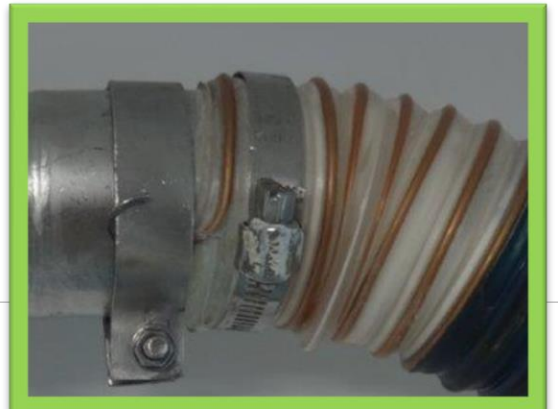
Bonding

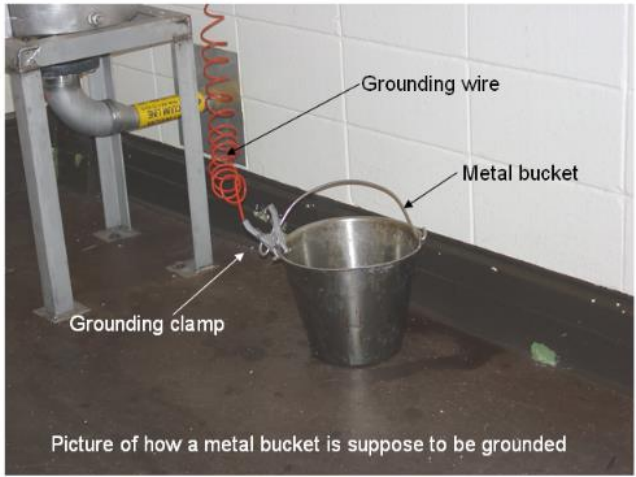
- Is the method where you connect metal parts of one equipment to other equipment to reduce the potential voltage difference.



Best Practice – Electrostatic Hazards

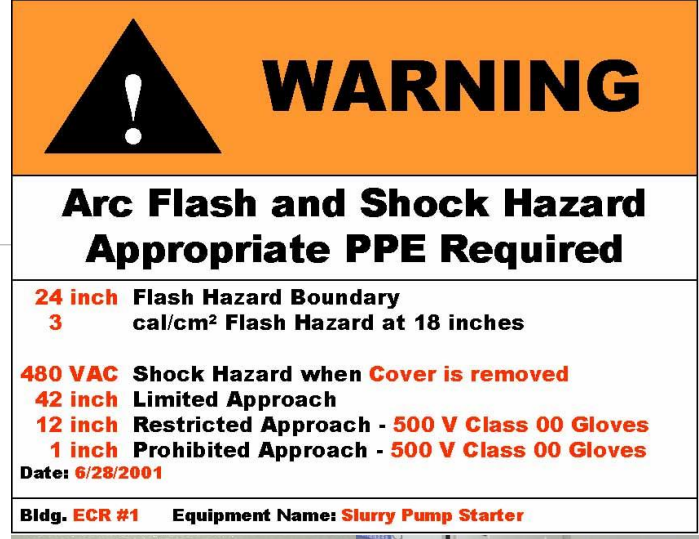
- Ground all metal equipment! to avoid ELECTROSTATIC HAZARDS e.g. Drums (metal), tote bins, dump chutes, buckets, utensils (scoops), metal wands, etc. Be aware painted / corroded terminals / parts can make grounding / bonding ineffective.
- Operator must use antistatic clothing, PPE's e.g. gloves, Shoes etc. and floor must be conductive. OR use electrostatic wrist bands.
- Practical limit for resistance to ground of metal items is <10 ohms. Must be checked periodically.
- When portable devices e.g. clamps / wires are used for Grounding / Bonding of mobile equipment, routine checks should be performed on grounding systems including Before operations are started.
- Connecting / disconnecting portable ground connections during process can be dangerous. Must be removed only After operations have ceased.





Arc Flash – Risk Assessment

- A specialized activity to be done by expert.
- This analysis determines the flash potential boundary and potential thermal exposure to personnel working on or near exposure live parts.
- It recommends special Personal Protective clothing required for various scenarios to protect people working in risk boundary.
- Equipment may be labeled with the results of the arc flash hazard analysis and shock protection analysis



Incident Energy From (cal/cm2)	Incident Energy To (cal/cm2)	Hazard Risk Category	Clothing Description	Clothing Layers	Required Minimum Arc Rating of PPE (cal/cm2)	Notes
0.0	1.2	0	Untreated Cotton	1	N/A	
1.2	4.0	1	FR Shirt & Pants	1	4	
4.0	8.0	2	Cotton Underwear + FR Shirt & Pants	1 or 2	8	
8.0	25.0	3	Cotton Underwear + FR Shirt & Pant + FR Coverall	2 or 3	25	
25.0	40.0	4	Cotton Underwear + FR Shirt & Pant + Multi Layer Flash Suit	3 or more	40	

Hazard Risk Category 0

Hazard Risk Category 1

Hazard Risk Category 2

Hazard Risk Category 3

Hazard Risk Category 4

Electrical Safety – LoTo

- Lockout Tagout and Tryout must be followed including when work is done by certified and trained electricians.
- When working on live circuits is allowed, must be made clear in the procedures duly supported with risk assessment and required controls.

Step 1	Prepare for shutdown	Get all required tools and LOTO gear
Step 2	Notify affected workers	Machine is being locked out
Step 3	Shutdown equipment	Follow standard shutdown procedure
Step 4	Isolate equipment	Physically turn off all energy isolation devices
Step 5	Apply LOTO	One lock per energy source per authorized employee
Step 6	Release stored energy	Bleed, purge systems per LOTO procedure
Step 7	Verify zero energy condition	Test controls and return to "OFF" position

Best Practice – LoTo

Use LoTo diagram, help people to know exact location and flow of actions before start of the work.

LOTO Diagram

Equipment Name:	Primary Packaging Line #4
Place: Room 0144	Effective Date: July 20, 2015

Must LOTO

Follow LOTO procedure

General Procedure:

1) Notify all affected personnel before the start of this LOTO procedure;

2) Lock the isolation point of compress air and power, release the residue energy if needed, lock applied to energy isolation points must be personally identified and in the "secured" position;

3) After lockout, test zero energy by turning normal operation controls to the on position and verify that no machine function or movement occur;

4) After service is completed, ensure all tools and items have been removed, the controls are in neutral and notify all affected personnel.

Apply Safety Rules, Save Your Life

Electrical Safety – What to do?

Check

- Have you applied electrical safety practices?
- Is your electrical installation as per applicable standards?
- Have you done electrical risk assessment and have defined procedures?
- Do you have certified / trained electricians.
- Do they follow safe work practices?
- Do you periodically check earthing / grounding?
- Do you inspect your installation periodically?
- Do you follow Management of Change for changes in electrical systems?
- Do you have procedures to test equipment before taking it on-line?

Electrical Safety – Personal Protection

Inspection of Insulating Equipment Before Use

Inspect insulating equipment for damage before each use and immediately following any incident. Insulating gloves shall be given an air test, along with the inspection.

1. Hold the Glove with thumbs and fore fingers as illustrated.

2. Twirl the glove around quickly to fill with air.

3. Trap the air by squeezing the gauntlet with one hand. Use the other hand to squeeze the palm, fingers and thumb in looking for weaknesses and defects.

4. Hold the glove to the face to detect air leakage or hold it to the ear and listen for escaping air.

References

India

- THE INDIAN ELECTRICITY ACT, 1910
- THE INDIAN ELECTRICITY RULES, 1956
- Code of Practice for Electrical Wiring Installation - IS – 732 (1989)
- GUIDE FOR SELECTION AND INSTALLATION OF ELECTRICAL EQUIPMENT IN HAZARDOUS AREAS (OTHER THAN MINES) - IS 5571 : 2009
- Code of practice for Earthing - IS – 3043 (1987)

International standards;

- Electrical Safety Rules - NFPA 70E
- OSHA 1910 Subpart S, Electrical, - 1910.303, General requirements, 1910.307, Hazardous (classified) locations, 1910.332, Training, 1910.333, Selection and use of work practices…..
- Electrical safety hazards; https://www.lanl.gov/safety/electrical/docs/arc_flash_safety.pdf

QUESTIONS, COMMENTS

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About the Secretariat
Carnstone Partners Ltd is an independent management consultancy, specialising in corporate responsibility and sustainability, with a long track record in running industry groups.

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