High Voltage Hazards
HV Hazards

- Substations, Overhead Lines, Cables
- Safety Incidents
- Requirements for Designers, Constructors
- Construction Regs 2013 and other Legislation
- Codes of Practice
- Other Guidance
- Relevant to Emergency Services
Switch Wire

Phase Conductor
Phase Conductor

Earth
How Current Affects Us.

- 0.5-1.5 mA  Percepcion
- 1-5 mA     Muscle Contractions
- 3-10 mA    Pain, half of people freeze
- 10-40 mA   Let-go Threshold
- 30-75 mA   Pain, breathing difficult, asphyxiation
- 75-200 mA  Possible ventricular fibrillation
- 200-300 mA Certain ventricular fibrillation
- 300+ mA    Severe burns, heart stops

100 Watt bulb = 500mA
Possible Outcomes

- Electric Shock
- Internal Burns - organ damage
- External Burns - high energy flash burns, eye damage
- Blast Injuries - falls, hearing damage, fractures
- Crush Syndrome - leading to renal failure
- Death by electrocution

**ALWAYS SEEK MEDICAL ATTENTION FOLLOWING A SHOCK**

- 12 Customer side
- 12 Networks side
<table>
<thead>
<tr>
<th>No. of 3rd Party Incidents</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014 (Nov)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UG cable Dig Ins</td>
<td>627</td>
<td>749</td>
<td>882</td>
<td>822</td>
</tr>
<tr>
<td>OH Lines Damages</td>
<td>205</td>
<td>330</td>
<td>616</td>
<td>562</td>
</tr>
<tr>
<td>Total Damages</td>
<td>832</td>
<td>1079</td>
<td>1498</td>
<td>1384</td>
</tr>
</tbody>
</table>
Code of Practice/Booklets.....

DVD/Videos

All available free of charge from ESB Networks – download from: www.esb.ie/networks or Tel. 1850 372 757
AVOIDANCE OF ELECTRICAL HAZARDS WHEN DIGGING
Guidelines for Safe Working Near Overhead Electricity Lines in Agriculture
Fatalities caused by Electricity: 2012

1. A 42 year old man was electrocuted while working on a construction site. The man was in contact with a load that was being moved with a mobile crane when the slinging rope on the crane made contact with a 20kV overhead line.
Pole Collisions – Urban

- Car struck a bundle LV pole
- Pole was snapped clean off at the butt and shoved 3 metres across the foot path
- Held by the aerials.
Scaffolding Near LV Overhead Aerials

- Call received to insulate wires to allow work to proceed on a damaged roof.
- Scaffolding already erected
- Aerials had been covered in places with red ducting and garden hose and was cable tied to the uprights.
  - Exclusion zone for insulated LV conductors is 1m.
  - (Code of Practice for Avoiding Danger from Overhead Electricity Lines)
- Aerials replaced and insulated
- Contractor warned.
A Farmer working in a field with tractor and trailer struck a 20kV single phase pole.

The side window opened on the tractor and when the driver turned to close it, he veered off track striking the pole.
LV Overhead – Christmas Lights
MV Overhead and Bunting
What to do in case of emergency

IF YOU CONTACT AN OVERHEAD WIRE

- Stay calm, disengage gently, back away if possible, call emergency number, STAY IN THE CAB
- If risk increases jump clear and keep others away DO NOT STEP DOWN
- EXTREME DANGER! NEVER MAKE CONTACT between truck and ground

Keep all people well clear of possibly electrified plant and damaged cable.

Call ESB emergency @ 1850-ESB-999
(easier to remember than 1850-372-999)
Code of Practice
for
Avoiding Danger from Overhead Electricity Lines
Code of Practice

Objectives:

- To give guidance and improve safety when working near overhead electricity lines
- To help parties involved in construction activities to understand and comply with their statutory safety obligations in relation to OHL
Relevant Legislation

- SHAWW ACT 2005
- Construction Regulations 2006
  - Work near HV lines (>1kV) is a “Particular Risk”
- General Application Regulations 2007
SHAWW ACT 2005

Section 8 - Employer must:
- Ensure as far as is reasonably practicable the safety, health and welfare at work of his or her employees
- Manage work activities
- Have a safe work place
- Provide safe systems of work
- Obtain where necessary the services of a competent person etc.

Section 60(1) – Empowers the HSA to:
(a) Publish COP to give practical guidance to employers, employees and other persons.
(b) Approve COP’s published by other bodies.
Construction Regulations 2006

- Duties of Client
- Particular Risks
- Preliminary H & S Plan
- Construction H & S Plan
- Safety File
Overhead Electricity Lines should be shown on development site maps.
Scope of Code of Practice

- Primarily covers construction related activities
- Work on new and existing buildings
- Construction site works including road construction & road resurfacing works
- Storage of materials, dumping of spoil, loading & unloading
- Includes construction activities on farms but excludes general agricultural and forestry activities
- Includes process for transportation of high loads by road
What is covered?

- Role of Client
- Role of PSDP and Designers
- Role of PSCS, Contractor & Employee
- Role of Electrical Networks Operator
What is covered?

- Guidelines for Construction Sites
- Guidelines for operating Cranes and other High Reach Plant
- Guidelines for Road Strengthening and Resurfacing Works
- Transporting of High Loads by Road
Definitions in COP

1. HAZARD ZONE
2. EXCLUSION ZONE
3. CROSSING POINT
What is the “HAZARD ZONE”

The “Hazard Zone” is defined as an area in the vicinity of an overhead electricity line which must normally be isolated from the work site by the use of physical barriers, in order to minimise the risk of accidental contact or near contact with the overhead line by plant, equipment, scaffolding or other materials while carrying out construction work. The dimensions of the Hazard Zone are related to the voltage of the overhead line.
Definition

Hazard Zone

A = 6 metres for LV/10kV/20kV/38 kV

A = 10 metres for 110kV/220kV/400kV

Fig 2. Hazard Zone
EXCLUSION ZONE

The “Exclusion Zone” is defined as a region around a live overhead electricity conductor which must never be breached.
Definition

Exclusion Zone (R)

Region around live conductor that **must** never be breached

“R” depends on line voltage

Fig 3. Exclusion Zone

For dimension R please see Table 1, Section 8
## TABLE 1 - EXCLUSION ZONES IN METRES FOR OPERATING PLANT NEAR OVERHEAD ELECTRICITY LINES

<table>
<thead>
<tr>
<th>Nominal Phase to Phase Voltage of Overhead Line (kV)</th>
<th>Exclusion Zone (Radial distance) (metres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulated LV in consultation with ESB Networks</td>
<td>1.0</td>
</tr>
<tr>
<td>(Insulation to be verified in all cases by ESB Networks prior to the commencement of the work)</td>
<td></td>
</tr>
<tr>
<td>Bare LV and bare and covered 10kV, 20kV &amp; 38kV</td>
<td>3.0</td>
</tr>
<tr>
<td>110kV</td>
<td>4.5</td>
</tr>
<tr>
<td>220kV</td>
<td>6.0</td>
</tr>
<tr>
<td>400 kV</td>
<td>8.0</td>
</tr>
</tbody>
</table>
A “Crossing Point” is a demarcated corridor crossing under an overhead electricity line with height restricted “Goalpost” type barriers and warning signs at both the entry and exit positions of the crossing passageway. It is designed to limit both the location and the height of plant that can cross under the line to that of a safe height as determined by the design of the goalposts and to alert the drivers/operators of vehicles and plant of the hazard of the overhead line before crossing under it.
Construction Sites

- Where SO or Diversion is not practical then other protective measures needed

- 3 categories of sites considered
  a) No work or crossing in Hazard Zone
  b) Plant crossing HZ but no work in HZ
  c) Work will be carried out in HZ
Category (a)
No work or crossing in the HZ

Here suitable barriers, bunting and warning signs are required to prevent inadvertent breach of the Hazard Zone.
Networks

Bunting 3.0m min
4.2 max over ground

Bollards spacing
6.0m max

Warning signs at 20m intervals along guarded area

Horizontal rail 0.8m to 1.4m above ground

Timber Post

Plan

Hazard Zone

For value of dimension “A” see footnote text

Work Site side

Dimension A = 6.0m minimum for LV, 10kV, 20kV, 38kV.

Dimension A = 10.0m minimum for 110kV, 220kV, 400kV.

Fig 5. Site where Plant will not pass under power lines.
Category (b)

Plant crossing the HZ but no work in the HZ

Where movement of plant is necessary under a live overhead electricity line the Contractor should erect height restricting goalposts made from rigid non-conducting high visibility material at the entrance to the Crossing Point on each side of the line.
Barriers and Signs

**Barriers:**
- Rigid non-conducting high visibility material
- Daily visual check & weekly recorded check

**Signs:**
- Standard electricity warning signs
- Erected every 20 metres along barrier
Goalposts

- Suitable rigid non conducting high visibility material
- Maximum span width 9 metres
- Maximum height 4.2 metres unless higher clearance has been specifically approved by ESBN
- Crossing Point should be sited at highest suitable point in span i.e. closer to pole than to mid span
- If more than 1 Crossing Point they must be uniquely numbered
Guarding System constructed from red duct pipes and long-radius preformed bends supported on concrete bollards
Category (c)  
Work in the Hazard Zone

- Only allowed in limited circumstances

Case 1: Work that does not involve plant or activities that could cause Exclusion Zone to be breached e.g. mini digger, bulldozer

Control Measure: Written site specific RA and Work Method Statement
Category (c)
Work in the Hazard Zone

Case 2: Work using plant or equipment that could inadvertently breach the Excln. Zone

Requires prior consultation with ESB N

Confined to installation of UG Services and other works agreed in detail with ESB Networks where OHL will not be diverted
Very high level of safety management

Requires the following controls:
- Written site specific RA and WMS
- Daily Permit to Work System by contractor
- Use of certified mechanical, electronic or electromechanical limiters
- Use of competent dedicated observer for each item of plant
Road Strengthening and Resurfacing Works

- A safe system of work must be employed
- COP provides an alternative to the use of height restricting goalposts/barriers
- A written RA and WMS must be prepared and controls put in place
- Pre Patrol
  - Preliminary site survey before site works
  - Identify each OHL conflict and assign unique ID
  - Mark extremities of “NO-Tip-Zone” & ID No.
Road Strengthening and Resurfacing Works (contd)

Site Activity

- On day of work verify site against preliminary survey
- Appointed PIC must conduct an Electrical Hazard Risk Assessment (EHRA)
- Warning Notices must be in place at Entry and Exit of “No-Tip-Zone”
Step One: Load the paver hopper with cab outside the “No-Tip” zone.

Step Two: Lower the tipper skip (or any other high or elevated plant, e.g. Planer) while stationary, then pass through the “No-Tip” zone.
Step Two: Lower the tipper skip (or any other high or elevated plant, e.g. Planer) while stationary, then pass through the “No-Tip” zone.

Step Three: Continue normal operation when truck is completely clear of “No-Tip” zone.
Parallel Line Situations

- Prelim survey and RA must identify parallel or close approaches
- Minimum Horizontal Clearances determined by OHL voltage
- OHL voltages need to be determined either from ESB map records or by consultation with ESB Networks
1m minimum clearance (Low Voltage lines only)
# ON-SITE ELECTRICAL HAZARD RISK ASSESSMENT FORM – EHRA

This form must be used, whenever road strengthening or re-surfacing works are to be undertaken in the vicinity of Live Overhead Electricity Lines or Equipment.
This form must be completed for each overhead line conflict situation on a daily basis.

## Name of Contract: ___________________________  Road No./Section No.: ____________________________

<table>
<thead>
<tr>
<th>Conflict Identification No.</th>
<th>LV; 10/20kV/38kV; 110kV; 220kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specify Voltage (please circle) for lines that run parallel or closely approach a road</td>
<td></td>
</tr>
<tr>
<td>Are the crew familiar with the appropriate section of the <strong>Code of Practice for Avoiding Danger from Overhead Electricity Lines (Section 9)</strong> (please circle as confirmation)</td>
<td>Yes / No*</td>
</tr>
<tr>
<td>Are the extremities of the “No-Tip Zone” established and marked out on site?</td>
<td>Yes / No*</td>
</tr>
<tr>
<td>Are Warning Notices erected at both entry and exit of “No-Tip Zone”?</td>
<td>Yes / No*</td>
</tr>
<tr>
<td>Has a person being appointed to control work at the overhead line crossing/conflict location?</td>
<td>Yes / No*</td>
</tr>
<tr>
<td>Has a procedure for safe working at the overhead line crossing/conflict location been decided by the Person In Charge (PIC)</td>
<td>Yes / No*</td>
</tr>
<tr>
<td>Do <strong>All</strong> staff understand the proposed Safe Work Method and agree that work can proceed safely with the networks <strong>LIVE</strong>?</td>
<td>Yes / No*</td>
</tr>
</tbody>
</table>

*If the answer to any of the above questions is “No” then appropriate action must be taken to address the issue involved before proceeding with the work.*
Operating Cranes & High Plant

- Planning Requirements
- Risk Hierarchy Approach
- L1 - Set up outside falling distance from HZ
- L2 - Plant and Load outside HZ
- L3 – In Certain Limited Circumstances allowed to enter the HZ with very strict control measures
To conclude, please....

- Be aware of the risks from Overhead lines
- Ensure all contractors and other relevant parties are aware of the location/risks from OH lines
- Assess risks from OH lines on work sites
- Put Controls in place to minimise the risk
- LOOK UP, LOOK DOWN, LOOK OUT
- Do not approach closer than 5 metres. If driver is in cab and there is no risk from fire he/she should remain there until ESB Networks advise it is safe.

- If it is possible to lower the truck/machine or to drive away **without damaging the line** then ask/guide the driver away from the wires.

- If there is risk from fire, tell the driver to jump clear with both feet together.

- Hop or take short steps away.

- Once on the ground do not return to the vehicle.
Near Misses

2002

- Kilkenny. Fire Brigade hosed down fire in trees due to fallen 10kV Line that was still Live

- Waterford. Fire Brigade opened protective screen around 10kV/LV transformer to remove victim
Advice from ESB Networks

Contact: 1850 372 757
Email: esbnetworks@esb.ie

For Map Records:
Email: centralsiterequests@esb.ie
Fax: 01 6388169

EMERGENCY CONTACT 1850 372 999
Locating Underground Electricity Cables

DIAL BEFORE U DIG
1850 92 89 60
dig@esb.ie

FOR EMERGENCIES CALL 1850 372 999
END