Fire Risk and safety

• Increasing awareness of safety of people and property from fire risks is driving development of fire performance cables & new regulations.
• Initially it was considered mandatory for strategic buildings like airports, hospitals. With development of new materials and market demand fire performance cables are used in many normal applications.
• Phelps Dodge can offer a range of cable designs and material options to meet fire performance requirements of customers.
CHANGING LANDSCAPES FOR BUILDINGS & INFRASTRUCTURES
More Railways, Urban Mass Transport, Airports & Seaports

More Bridges & Roads

New & Better Cities
Fire Incidence in the Philippines due to Electrical Origin

Year 2005 - Year 2010

- Electrical Incidence: 31%
- Others: 22%
- Under Investigation: 17%
- Spontaneous Combustion and Open Flame: 22%

- Year 2015 - P 3.6 B Properties Damaged
- Year 2017 - P 2.27 B Property Damaged
CY 2015 : Damage to Properties –
Php 3,615,089,595.78

- 26.57% causes of fire – due to electrical in nature such as:
  
  Defective Electrical Device, Sub-standard electrical appliances and wires, circuit overloading, short circuits, arcing, overheating and malpractice of electricity.

- ‘Electrical Safety starts with me’
The Dusseldorf Germany Disaster

- 16 people killed, 60 hospitalized for smoke inhalation
- The fire appears to have been sparked off by welders working in a combined ventilation and cable shaft in the main arrival hall.
- Experts believe that the fire carried a flood of lethal fumes into elevators, ventilation ducts, and passenger lounges.
The fire started under a wooden escalator serving the Piccadilly line and, at 19:45, erupted in a flashover into the underground ticket hall, killing 31 people and injuring 100. The fire appears to have been sparked off by welders working in a combined ventilation and cable shaft in the main arrival hall.

The investigators reproduced the fire twice, once to determine whether grease under the escalator was ignitable, and the other to determine whether a computer simulation of the fire—which would have determined the cause of the flashover—was accurate.
Presentation Outline

• Cable Fire Performance
• Fire performance Cable designs and materials
• EU’s Construction Product Regulation CPR
• Fire Safety Regulations
• Standards & Cable Constructions
• Phelps Dodge’s Capabilities & Product Offerings
Fire Performance of Cables
Domino Effect of Electric System Failure
Fire Performance of Cable

Fire spreads along cable run into adjacent objects causing destruction and failure.

Decomposing materials release dense smoke, noxious fumes and corrosive acid-gases into the atmosphere.

HEAT AND FLAME IGNITE CABLE
Material Flammability
Key Performance Characteristics

- Level of flame retardancy – Resistance to ignition
- Amount of flame propagation-Up to what length of the cable the fire will propagate
- Volume of smoke generated
- Total Heat Release of materials (Intensity of Fire/Fuel Available)
- Volume and rate of corrosive and toxic gases
- How long the cable will continue to operate under fire
- Whether it can withstand fire, mechanical damage and water spray
## Fire Performance Definitions

<table>
<thead>
<tr>
<th>No flame propagation VW-1</th>
<th>Does not take part in flame propagation. Self extinguishes</th>
</tr>
</thead>
<tbody>
<tr>
<td>No fire propagation CT</td>
<td>Subjected to simulated fire conditions, does not generate new secondary fire sources</td>
</tr>
<tr>
<td>Halogen-free HF</td>
<td>Degree of acidity and conductivity of gases released during combustion</td>
</tr>
<tr>
<td>Smoke emission LS</td>
<td>Measurement of light transmittance by smoke emitted during combustion</td>
</tr>
<tr>
<td>Low toxic smoke emission</td>
<td>Permissible toxicity index for gases of combustion not to be exceeded</td>
</tr>
</tbody>
</table>
Understanding Cable Fire Performance Terminologies

Multitude of fire performance Terminologies used in the market place

- Flame Retardant
- Fire Survival /Circuit Integrity CI
- Fire Rated /Fire Resistant
- Zero halogen or Halogen Free
- Low or reduced smoke
- Mineral Insulated Cables MICC
Common Cable Constructions

• Standard PVC (VW-1)
• Reduced Propagation PVC (CT/Riser Cable/CMR)
• Low Smoke /Low acid PVC (LASEC)
• Halogen Free Fire Retardant HF
• Glass Mica tape Insulated Cable (GMT FR)
• Halogen Free Thermoplastic HF
• Halogen Free Thermoset materials HFFR
• Mineral Insulated Cables MICC
**Material Characteristics**

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standard PVC</strong></td>
<td>Self extinguishing, Contains Halogens, Dense smoke, corrosive and toxic gas emissions</td>
</tr>
<tr>
<td><strong>Low smoke, low emission PVC</strong></td>
<td>Self extinguishing, contains halogens but reduced corrosive gas and smoke</td>
</tr>
<tr>
<td><strong>PE / XLPE</strong></td>
<td>Non halogen. Burns. Low smoke, low toxic and corrosive emissions. XLPE crosslinked for higher temperature applications</td>
</tr>
<tr>
<td><strong>HFFR (EVA / Polyolefin)</strong></td>
<td>Non halogen mineral filled to impart fire retardancy, low smoke, low toxicity and corrosive emissions. Thermoplastic.</td>
</tr>
<tr>
<td><strong>XL HFFR</strong></td>
<td>As above but crosslinked for higher temperature applications</td>
</tr>
<tr>
<td><strong>Glass Mica</strong></td>
<td>Non flammable, non toxic or corrosive. Continues to perform as insulator at temperatures above 900°C</td>
</tr>
</tbody>
</table>
Polyethylene
Flammable
Support Combustion

PVC
H 0 & VW-1
REGULAR
Building Wires

PVC
(CABLE TRAY RATED VERTICAL Riser /CMR FLAME TEST)

LSHF Cables

Fire Rated Cables
(LSHF + Mica Tape)

Fire Rated (Mineral Insulated Cable) MICC
FIRE SAFETY REGULATIONS
FIRE SAFETY REGULATIONS

• Philippine Electrical Code (PEC)
• Fire Code of Philippines FCP
• National Electrical Code NFPA-70
NEW PHIL ELECTRICAL CODE 1
- NEW FIRE RATING
- ADDITIONAL REQUIREMENTS ON FIRE PROTECTION
OLD PHILIPPINE ELECTRICAL CODE
Requirements

• Article 6.95 - FIRE PUMPS

“(b) Circuit Conductors. ....and having a minimum of 1-hour fire resistance rating, or they shall be permitted to be within listed electrical circuit protective systems with minimum of 1-hour fire resistance.”

• Article 7.0 - EMERGENCY SYSTEMS

“..... b. Be a listed electrical circuit protective system with a minimum 1-hour fire rating ..... c. Be protected by a listed thermal barrier system for electrical system components”

• Article 7.6 - FIRE ALARM SYSTEMS

“Fire Alarm Circuit Integrity (CI) Cable. Cable used in fire alarm systems to ensure continued operation of critical circuits during a specified time under fire conditions.”
• Article 6.95 - FIRE PUMPS

“(b) Circuit Conductors. .....and having a minimum of 1-hour fire resistance rating, or they shall be permitted to be within listed electrical circuit protective systems with minimum of 2-hour fire resistance.”

• Article 7.0 - EMERGENCY SYSTEMS

“..... b. Be a listed electrical circuit protective system with a minimum 2-hour fire rating ...... c. Be protected by a listed thermal barrier system for electrical system components”

• Article 7.6 - FIRE ALARM SYSTEMS

“Fire Alarm Circuit Integrity (CI) Cable. Cable used in fire alarm systems to ensure continued operation of critical circuits during a specified time under fire conditions .”
(D) Fire Protection. Emergency systems shall meet the additional requirements in (D)(1) through (D)(3) in the following occupancies:

(1) Assembly occupancies for not less than 1000 persons.

(2) Buildings above 23m in height (8 storey building).

(3) Health care occupancies where persons are not capable of self preservation.

(4) Educational occupancies with more than 300 occupants.
• Article 7.28 - FIRE RESISTIVE CABLE SYSTEM

“A cable and components used to ensure survivability of critical circuits for a specified time under fire conditions—minimum of 2 hour Fire Rating.”

“Fire-resistive Cables, fire-resistive conductors, and components shall be tested and listed as a complete system, shall be designated for use in a specific fire rated system, and shall not be interchangeable between systems.”
European Construction Products Regulation (CPR)
In 2011 a new EU regulation concerning the CE marking was published, to take binding effect on July 1, 2017. The new regulation sets out test methods and fire classes for cables used in buildings.

The cables affected by CPR are power, control, optical and telecommunication cables intended for permanent incorporation in buildings and civil engineering works.
European Construction Products Regulation (CPR)

The CPR prescribes 7 basic requirements for construction works:

1. Mechanical Resistance and Stability
2. Safety in Case of Fire
3. Hygiene, health and the environment
4. Safety and accessibility in use
5. Protection against noise
6. Energy economy and heat retention
7. Sustainable use of natural resources
# European Construction Products Regulation (CPR)

<table>
<thead>
<tr>
<th>Euroclass</th>
<th>Classification criteria</th>
<th>Additional criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>$A_{ca}$</td>
<td>EN ISO 1716 Gross heat of combustion</td>
<td></td>
</tr>
<tr>
<td>$B_{1ca}$</td>
<td>EN 50399 Heat release Flame spread</td>
<td>Smoke production $s_1a, s_1b, s_2, s_3$ EN50399/EN61034-2</td>
</tr>
<tr>
<td>$B_{2ca}$</td>
<td>EN 60332-1-2 Flame propagation</td>
<td>Acidity $a_{1}, a_{2}, a_{3}$ EN 50267-2-3</td>
</tr>
<tr>
<td>$C_{ca}$</td>
<td></td>
<td>Flaming droplets $d_{0}, d_{1}, d_{2}$ EN50399</td>
</tr>
<tr>
<td>$D_{ca}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$E_{ca}$</td>
<td>EN 60332-1-2 Flame propagation</td>
<td></td>
</tr>
<tr>
<td>$F_{ca}$</td>
<td>EN 60332-1-2 Flame propagation</td>
<td></td>
</tr>
</tbody>
</table>

- **"Non combustible"** (e.g. mineral insulated)  
- **"Low-Fire-Hazard" cables** (various levels)  
- **"Standard cables"**  
- **No performance determined**
<table>
<thead>
<tr>
<th>Fire Protection Level</th>
<th>Euroclass</th>
<th>Classification Criteria</th>
<th>Additional Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very High Fire Protection</td>
<td>B&lt;sub&gt;2ca&lt;/sub&gt;</td>
<td>(FS \leq 1.5) (\text{m}) (\text{THR}_{1200s} \leq 15) (\text{MJ}) (H \leq 425) (\text{mm})</td>
<td>Smoke production (s_1a, s_1b, s_2, s_3)  (\text{EN50399/EN61034-2})</td>
</tr>
<tr>
<td>High Fire Protection</td>
<td>C&lt;sub&gt;ca&lt;/sub&gt;</td>
<td>(FS \leq 2.0) (\text{m}) (\text{THR}_{1200s} \leq 30) (\text{MJ}) (H \leq 425) (\text{mm})</td>
<td>Acidity (a_1, a_2, a_3)  (\text{EN50267-2-3})</td>
</tr>
<tr>
<td>Moderate Fire Protection</td>
<td>D&lt;sub&gt;ca&lt;/sub&gt;</td>
<td>(\text{THR}_{1200s} \leq 70) (\text{MJ}) (H \leq 425) (\text{mm})</td>
<td>Flaming droplets (d_0, d_1, d_2)  (\text{EN50399})</td>
</tr>
<tr>
<td>Basic Fire Protection</td>
<td>E&lt;sub&gt;ca&lt;/sub&gt;</td>
<td>(H \leq 425) (\text{mm})</td>
<td>-</td>
</tr>
</tbody>
</table>
# European Construction Products Regulation (CPR)

<table>
<thead>
<tr>
<th>Euroclass</th>
<th>Classification Criteria</th>
<th>Additional Criteria</th>
</tr>
</thead>
</table>
| **B2ca**  | FS ≤ 1.5m
THR1200s ≤ 15MJ
H ≤ 425mm | Smoke production
(s1a, s1b, s2, s3)
EN50399/EN61034-2 |

## APPLICATIONS

- Underground Railways
- Hospital Wards Areas
- Children's Nurseries
- Escape Routes in Public Buildings
- Airports
- Train Stations
- Buildings with High People Density

Acidity
(a1, a2, a3)
EN50267-2-3

Flaming droplets
(d0,d1,d2)
EN50399
## European Construction Products Regulation (CPR)

### Euroclass

- **C<sub>ca</sub>**

### Classification Criteria

- **FS ≤ 2.0m**
- **THR1200s ≤ 30MJ**
- **H ≤ 425mm**

### Additional Criteria

- **Smoke production**
  - (s1a, s1b, s2, s3)
  - EN50399/EN61034-2
- **Acidity**
  - (a1, a2, a3)
  - EN50267-2-3
- **Flaming droplets**
  - (d0,d1,d2)
  - EN50399

### Applications

- Public Buildings
- High Rise Buildings
- Escape Routes
- Hospital 'Horizontal/Main Bldg. Areas'
- Commercial Buildings
- Leisure Facilities
- Hotels
- Schools
- Office Buildings
### European Construction Products Regulation (CPR)

<table>
<thead>
<tr>
<th>Euroclass</th>
<th>Classification Criteria</th>
<th>Additional Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>D&lt;sub&gt;ca&lt;/sub&gt;</td>
<td>THR1200s ≤ 70MJ H ≤ 425mm</td>
<td></td>
</tr>
</tbody>
</table>

#### APPLICATIONS
- Considered in some countries to favor the use of LSOH cables with not high fire retardancy performance.
- General Installations

Additional Criteria:
- Smoke production (s1a, s1b, s2, s3)
  - EN50399/EN61034-2
- Acidity (a1, a2, a3)
  - EN50267-2-3
- Flaming droplets (d0, d1, d2)
  - EN50399
<table>
<thead>
<tr>
<th>Basic Fire Protection</th>
<th>Euroclass</th>
<th>Classification Criteria</th>
<th>Additional Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$E_{ca}$</td>
<td>$H \leq 425\text{mm}$</td>
<td></td>
</tr>
</tbody>
</table>

**APPLICATIONS**

- Residential
- Industrial
SMOKE PRODUCTION
EN 50399 / EN 61034-2

1a:  
1b:  
1:  
2:  
3:  

s1: <= 50 m²
s2: <= 400 m²
s3: not meeting s2 or no perfor
a: >80% light transmittance
b: >60% light transmittance

European Construction Products Regulation (CPR)
European Construction Products Regulation (CPR)

**FLAMING DROPLETS**

**EN 50399**

- **d0**: no droplets after 1200 s
- **d1**: no droplets persisting longer than 10 s within 1200 s
- **d2**: not meeting d1 or no performance
European Construction Products Regulation (CPR)

**ACIDITY**

EN 50399 / EN 60754-2

1. **a1**: conductivity < 2.5 μSmm⁻¹, pH > 4.3
2. **a2**: conductivity < 105 μSmm⁻¹, pH > 4.3
3. **a3**: not meeting a2 or no performance
SPECIFICATIONS & STANDARDS
Standards for defining fire performance

• A series of standards and tests have been developed in order to establish the behaviour of the cables in a fire situation.

• Some of the well known standards are:
  – IEC 60332-1 (AS/NZS 1660:5.6)
  – IEC 60332-3 (AS/NZS1660:5.1)
  – IEC 60331
  – AS/NZS 1660 :5.2 or ASTM D 2843
  – AS/NZS 3013
  – PNS 35
  – UL 83
  – UL 1666
  – UL 2196
FLAME RETARDANT PVC CABLES
BUILDING WIRES (THHN/THWN-2 CT)
THHN/THWN-2 (Building Wire)

Copper & Aluminum Conductor

Insulation: Lead Free PVC (THHN/THWN-2)

Jacket: Abrasion Resistant Nylon

For sizes 6AWG (14mm²) & bigger
No Flame Propagation - IEC 60332-1 (AS/NZS 1660:5.6) VERTICAL FLAME TEST VW-1

• A flame in contact with the cable over a set time must not cause it to catch fire.
• This is the minimum fire retardancy requirement for most of the cables.
• This avoids the situation where a flame come in contact with the cable accidently for a short duration. When the flame is removed the fire extinguish itself.
• Most of the PVC cables will meet this requirement.
• This test is called ‘vertical flame VW-1 propagation test’.
No fire propagation IEC 60332-3 (AS/NZS 1660:5.1) for CABLE TRAY /RISER Cables

• When cables are grouped and when there is a fire which does not involve the cable may affect a duct (becoming more serious if it is running vertically thus enabling air circulation to create what is known as the chimney effect). If the breakdown temperature of the organic materials is attained, exothermic combustion of the cables will take place (with energy input) and the attendant propagation of the fire.

• In order to simulate a situation such as this, the test consists in applying a high-power gas burner to a bundle of cables arranged such that they simulate a vertical duct with forced air. Under these conditions the fire started in the cables must self-extinguish within the time specified in the standard.

• This test is generally known as ‘Bundled or Bunched Cable fire test’.

• There are 4 categories based on volume of combustible materials/meter – A being demanding and D the least restrictive.
Cable Tray Rated Cable

Vertical Flame Test
PDP’s THHN/TWLN-2 is UL Certified

TW, THW, THHN, THWN & THWN-2:

UL file No. E-54448
UL 1666

- Cables Bundled together
- Test chamber simulates a three story building.
- 1ft x 2 ft man hole between each floor. Bundled cables attached to cable rack running through the man holes.
- High powered gas burner on first floor
- The fire will burn up the cables through the man hole into the floors above.
- The fire must self extinguish within 12 foot of the gas burner and the temperature of the chamber must not exceed 850°C .
- Compliant cables are labelled as “CMR”
- A standard test for Cat 5 and Cat 6 LAN cables
LOW SMOKE HALOGEN FREE CABLES
LSHF Building Wires

Low-Smoke Halogen-Free Insulation
Copper Conductor

LSGF Jacket
Mylar Tape (Core Wrap)
PP Filler (Optional)
LSHF Insulation
Copper Conductor
Halogen and Smoke Emission tests
IEC 60754 & 61034, AS/NZS1660:5.2&5.3

Measuring the amount of Gases released

Measures the visibility of a smoke filled room
HALOGEN AND REDUCED SMOKE EMISSION Testing

- In the event of cables being in the midst of a fire situation and depending on the materials they are made up of, gases may be released which are toxic to human health or corrosive affecting the proper operation and condition of electronic and IT components located in the surrounding area.
  - Acidity and corrosivity Tests

- Likewise, smoke may be discharged, impeding visibility of escape routes from the affected premises due to its opacity.
  - Smoke Density Tests
PVC vs. LSHF Cable

Start Time

10 minutes

20 minutes

30 minutes

Low Smoke Halogen Free Cable

PVC Cable

2 minutes

5 minutes
Superior Flame Retardant Property for Halogen Free Cable

A Halogen Free Cable would not burn easily unlike a traditional cable.
Advantages of Low-Smoke Halogen-Free (LSHF) Cables

- LSHF wire and cable produces **LESS SMOKE WHEN BURNED**, which permits people to exit a burning building more quickly.

- **LSZH RELEASES LITTLE OR NO HALOGEN GAS** when burned, it reduces the damage to the human respiratory system if inhaled.

- Safer for Equipment (Less corrosion damage to equipment)
Recommended Applications

• High-rise Buildings
• Hospitals and other institutions
• Historic Buildings
• Tunnels & Subways
• Airports, stadiums, hotels, banks, etc.
• Industrial Plants
FIRE RATED LOW SMOKE
HALOGEN FREE BUILDING WIRE
FR LSHF Cable

Cable Profile

- Low-Smoke Halogen-Free Jacket
- Low-Smoke Halogen-Free Insulation
- Fire Barrier Tape
- Copper Conductor

Cable Profile

- Low-Smoke Halogen-Free (LSHF) Jacket (Orange)
- Mylar Tape (Armour Wrap)
- Galvanized Steel Wire Armour (SWA)
- Low-Smoke Halogen-Free (LSHF) Bedding (Inner Sheath; Orange)
- Mylar Tape (Core Wrap)
- PP Filler (Optional)
- Low-Smoke Halogen-Free (LSHF) Belt++ (Color-coded)
- LSHF Crosslinked Polyethylene (XLPE) Insulation (Natural)
- Fire Barrier Tape
- Copper Conductor
Applications

• Emergency lighting and exit signs
• Life-Support Equipment
• Fire pumps
• Fire alarm and voice communication system
• Fire fighter’s elevator
• Smoke extraction fans
### BS6387 Fire Resistance Test

Categorize the cables according to cable withstand capacities (CWZ, CY.)

**Resistance to fire alone**

<table>
<thead>
<tr>
<th>Fire Condition</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>650 °C for 3 hours</td>
<td>A</td>
</tr>
<tr>
<td>750 °C for 3 hours</td>
<td>B</td>
</tr>
<tr>
<td>950 °C for 3 hours</td>
<td>C</td>
</tr>
<tr>
<td>950 °C for 20 minutes</td>
<td>S</td>
</tr>
</tbody>
</table>

**Resistance to fire with water (W)**

**Resistance to fire with mechanical shock**

<table>
<thead>
<tr>
<th>Fire Condition</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>650 °C</td>
<td>X</td>
</tr>
<tr>
<td>750 °C</td>
<td>Y</td>
</tr>
<tr>
<td>950 °C</td>
<td>Z</td>
</tr>
</tbody>
</table>

Cable in the following categories meets the following fire conditions:

- **CWZ** - 950° C for 3 hours, water spray, and mechanical shock at 950° C
- **CY** - 950° C for 3 hours, and mechanical shock at 750° C
- **ASWX** - 650° C for 3 hours, 950° C for 20 minutes, water spray, and mechanical shock at 650° C
PDP’s Certification for Fire Rated Cables
Fire resistance IEC 60331 Standard

- For safety circuits and units that are required to provide continued service even in the presence of fire, test conditions are specified to be undergone by cables required to continue in service even though their organic parts have been destroyed by the fire.

- For the most severe test the cable is exposed to the action of a burner at more than 830 °C for a period of 90 minutes, during which it is mechanically shocked at 5 minute intervals. The cable is to remain operational throughout the duration of the test.
Fire Resistant Test BS/IEC
PDP Test Facilities for FR Cable
Australian Standard AS/NZS 3013
Test classification WS52W

• Circuit integrity for 2 hrs
• Water Spray for 3 minutes
• Impact 15 joules. Cut through 1kN
1. UL 2196

- This standard fire rates cables in accordance with their ability to operate for given periods of time (1 hr. fire rated, 2 hr. fire rated, ) under fire conditions with Fire Hose Dosing
Mineral Insulated Cables
Copper Conductor + MgO Insulation + Copper Sheath
CABLE COST COMPARISON
## COST COMPARISON

<table>
<thead>
<tr>
<th>CABLE TYPE</th>
<th>Price</th>
<th>% Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>250mm² THHN/THWN-2 CT</td>
<td>1040</td>
<td>REF</td>
</tr>
<tr>
<td>250mm² Low Smoke Halogen Free (LSHF)</td>
<td>1131</td>
<td>+ 11%</td>
</tr>
<tr>
<td>250mm² Fire Rated Cable</td>
<td>1366</td>
<td>+ 34%</td>
</tr>
<tr>
<td>250mm² THW</td>
<td>1020</td>
<td>- 2%</td>
</tr>
</tbody>
</table>
## COST COMPARISON

<table>
<thead>
<tr>
<th>CABLE TYPE</th>
<th>Price</th>
<th>% Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5mm² THHN/THWN-2 CT</td>
<td>16.9</td>
<td>REF</td>
</tr>
<tr>
<td>3.5mm² Low Smoke Halogen Free (LSHF)</td>
<td>24.85</td>
<td>+ 47%</td>
</tr>
<tr>
<td>3.5mm² Fire Rated Cable</td>
<td>48</td>
<td>+ 84%</td>
</tr>
<tr>
<td>3.5 mm2 Mineral Insulated cable</td>
<td>267</td>
<td>+1500 %</td>
</tr>
<tr>
<td>3.5mm² THW</td>
<td>16.3</td>
<td>- 3%</td>
</tr>
</tbody>
</table>
OTHER PRODUCTS & SOLUTION OFFERINGS
MC Cable  CT Rated or LSHF

NEC 330/PEC 3.30

A FACTORY ASSEMBLY of INSULATED circuit conductors, enclosed in an ARMOUR OF INTERLOCKING METAL type.
MV Flame Retardant PDP’s Products

Underground Direct Burial
Flame Retardant /LSHF MV Cables

- Conductor
- Semiconductive Conductor Shield
- XLPE Insulation
- Semiconductive Insulation Shield
- Copper Concentric Neutral Wires
- Copper Tape Shield
- PVC Jacket

Concentric Neutral Cable

Tape Shielded Cable
Maximize savings and space with the same high quality and safety you have come to expect from Phelps Dodge.

Branch Cable Solution

- A safer, more reliable cable solution versus conduit wiring
- Makes higher revenues possible for the developer
- Cheaper than conventional cable installations (cables in conduits) and bus duct
- Space saver
- Easy to install
- Maintenance Free
Phelps Dodge
BUS DUCT SOLUTION for High Rise Buildings

LV Series Busway
CONTROL & INSTRUMENTATION
CABLES (LSHF/Flame Retardant Cable)

Single-Core
- PVC Insulation
- Soft Copper Conductor
- PVC Jacket

Multi-Core
- PVC Sheath
- Filler
- Binding Tape
- XLPE Insulation
- Conductor

Single-Core
- XLPE Insulation
- PVC Jacket
- Soft Copper Conductor

Multi-Core
- PVC Sheath
- Binding Tape
- XLPE Insulation
- Conductor

XLPE / PVC
PHELPS DODGE AS TOTAL SOLUTIONS PROVIDER - PD ENGAGE
PDP’s Services

1. Training in Cable Selection and Design
2. Supply of Connectors & other materials
PDP’s Services
3. Technical Presentations / Seminars
4. On Site Pre-installation trainings for Contractors
PDP’s Services

7. Thermal Scanning Services
THANK YOU!