

# Electrical Task Analysis Document Busway and Cable Tray Installation



## Busway and Cable Tray Installation

### What is this document for?

This document contains task-specific conditions and recommendations compiled from onsite observations and interviews with electrical workers and industry practitioners. It addresses safety and health hazards as well as production challenges associated with the task. This document can be used for training, hazard analysis, and pre-task planning. This information was gathered from new construction projects including a data center and a mixed-use office building.

### Task Description:

- **Busway Installation** is the process of hanging and connecting busway throughout a commercial or industrial facility. Busway (also known as bus duct) is a raceway consisting of metal enclosures containing factory mounted, bare, or insulated conductors. These conductors are usually copper or aluminum bars, rods, or tubes that are used in place of cables or wires to safely conduct very large electrical currents. The advantages of using busway include flexible access, simplified installation, lower installation cost, and safer design, as busway conductor bars are totally enclosed.
- **Cable Tray Installation** is the process of installing a structural system to securely fasten and support cables and raceways. It involves calculating angles and bends as well as measuring and cutting cable trays prior to overhead installation. Because this task requires work at elevation, ladders or other types of lift equipment are frequently used.

**Disclaimer:** Development of this document was supported with funding from a cooperative agreement between CPWR - The Center for Construction Research and Training (#U60 OH009762) and the National Institute for Occupational Safety and Health (NIOSH). CPWR provides this document at no cost to the user. Please note that this document is not intended as legal advice and is not for the purposes of complying with any federal, state, or local standard or regulation. Content in this document has been developed by CPWR and does not necessarily represent the official views of NIOSH.

## Busway and Cable Tray Installation

### Table of Contents

| <b>Conditions and Recommendations</b>               | <b>Page</b> | <b>Condition and Recommendations</b>                                | <b>Page</b> |
|---|-------------|---|-------------|
| Selecting busbars                                   | 3           | Complex Lockout/Tagout (LOTO) procedures                            | 8           |
| Accessing electrical installations in tight spaces  | 3           | Work disruptions due to high-traffic work area                      | 8           |
| Moving and lifting heavy busway                     | 4           | Walking on elevated data center containments                        | 9           |
| Busway installation on unlevelled ceiling and floor | 4           | Restrictive fall protection equipment                               | 9           |
| Lifting busway and tap boxes in tight spaces        | 5           | Difficulty accessing fall protection tie-off points in data centers | 10          |
| Misaligned openings                                 | 5           | Repetitive installation of data racks                               | 10          |
| Obstructed cable tray pathway                       | 6           | Electric-powered cable cutters don't produce clean cuts             | 11          |
| Cable tray installation at varying elevations       | 6           | Limited cable cutter availability                                   | 11          |
| Calculating bends and angles                        | 7           | Repetitively lifting and installing cable trays overhead            | 11          |
| Challenges using scissor lifts in crowded ceilings  | 7           | Ascending and descending ladders multiple times                     | 12          |

## Busway and Cable Tray Installation

| CONDITIONS  | RECOMMENDATIONS   |
|---|---|
| <p><b>Selecting busbars:</b><br/>Due to the variety in busbar sizes and shapes (e.g., 10x3, 9x6, or 6x1), making an appropriate selection can require frequently consulting project documents to avoid mistakes.</p>  | <ul style="list-style-type: none"><li>• Lay out bus duct on the ground beneath the installation area and shoot lasers up to verify the installation configuration</li><li>• <a href="#">Building Information Modeling (BIM)</a></li></ul>   |
| <p><b>Accessing electrical installations in tight spaces:</b><br/>Accessing tap boxes in tight spaces that are partially obstructed by, for example, data racks and cable trays, may require awkward postures that increase the risk of ergonomic injuries.</p>  | <ul style="list-style-type: none"><li>• Move data racks before commencing work</li><li>• Use compact and lightweight tools with ergonomic handles, flexible or extendable tools, and devices with adjustable angles or grips</li><li>• Use manageable pre-fabricated components if feasible</li></ul> |

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| CONDITIONS  | RECOMMENDATIONS   |
|---|---|
| <p><b>Moving and lifting heavy busway:</b><br/>Frequently moving and lifting heavy, bulky busway can lead to fatigue and raise the risk of ergonomic injury.</p>  | <ul style="list-style-type: none"> <li>• Plan and schedule heavy lifts between trades to ensure access to mechanical lift (e.g., assign specific time slots to each trade)</li> <li>• Select optimum material storage locations prior to beginning of project to minimize hauling distance</li> <li>• Use a two-person approach to lifting and carrying materials</li> <li>• When material is bulky or exceeds 50 lbs., consider mechanical lifts</li> <li>• <a href="#">Duct lift</a></li> <li>• <a href="#">Multiple panel slab cart (e.g., drywall cart)</a></li> <li>• <a href="#">Self-propelled platform truck</a></li> </ul> |
| <p><b>Busway installation on unlevelled ceiling and floor:</b><br/>Unlevelled ceilings and floors do not provide a uniform guideline for measurements and installations. As a result, workers in these facilities must regularly consult project documents to select the right size bus duct that can be hung at nonstandard angles. They must also measure, mark, and cut racks and struts without a level surface as a guideline, increasing the risk of errors and rework.</p> | <ul style="list-style-type: none"> <li>• Consult the isometric blueprints and/or manufacturers' recommendations and installation requirements</li> <li>• Use a laser to hang brackets rather than a tape measure</li> <li>• Use pre-fabricated racks and struts based on <a href="#">Building Information Modeling (BIM)</a> where feasible</li> <li>• Work with the manufacturer to label installation sequence</li> </ul>   |

## Busway and Cable Tray Installation

| CONDITIONS  | RECOMMENDATIONS  |
|---|--|
| <p><b>Lifting busway and tap boxes in tight spaces:</b><br/>Lifting busway and tap boxes overhead in tight spaces (e.g., network rooms) can require awkward body postures, which raises the risk of ergonomic injury.</p>  | <ul style="list-style-type: none"><li>• Raise bus duct piece by piece in smaller sections</li><li>• Use a two-person approach to lifting and carrying material</li><li>• <a href="#">Duct lift</a></li></ul>   |
| <p><b>Misaligned openings</b><br/>If openings pre-cut by another crew to accommodate cable trays are made in the wrong location, they must either be patched and re-cut, or pipes must be removed and replaced.</p>      | <ul style="list-style-type: none"><li>• Coordination between all crews involved in the operation</li><li>• <a href="#">Building Information Modeling (BIM)</a></li><li>• <a href="#">Pre-Task Planning (PTP) Guidelines and Resources for Construction</a></li></ul> |

| CONDITIONS   | RECOMMENDATIONS  |
|--|--|
| <p><b>Obstructed cable tray pathway:</b><br/>If the cable tray pathway is obstructed by other crews' out-of-sequence installation (e.g., lighting fixtures), it can cause rework.</p>   | <ul style="list-style-type: none"> <li>• Coordination between all crews involved in the operation                             <ul style="list-style-type: none"> <li>○ <a href="#">Pre-Task Planning (PTP) Guidelines and Resources for Construction</a></li> <li>○ <a href="#">Last Planner® System; Last Planner® System Workbook</a></li> </ul> </li> <li>• Regularly review project documents for project progress and changes (e.g., electronic models like <a href="#">Building Information Modeling</a>)</li> </ul> |
| <p><b>Cable tray installation at varying elevations:</b><br/>Installing cable trays at varying elevations requires taking multiple measurements to align them. Incorrect measurements can lead to rework and material waste.</p>  | <ul style="list-style-type: none"> <li>• Use pre-fabricated components where possible (e.g., pre-sized cable trays if rooms are uniform)</li> <li>• <a href="#">Building Information Modeling (BIM)</a></li> </ul>   |

| CONDITIONS  | RECOMMENDATIONS   |
|---|---|
| <p><b>Calculating bends and angles:</b><br/>Measuring and cutting cable trays precisely to accommodate conduit bends and angles can be challenging. Mistakes can result in rework and material waste.</p>    | <ul style="list-style-type: none"><li>• Use pre-fabricated components where possible (e.g., pre-sized cable trays if rooms are uniform)</li><li>• <a href="#">Building Information Modeling (BIM)</a></li></ul> |
| <p><b>Challenges using scissor lifts in crowded ceilings:</b><br/>Due to crowding in the ceiling, scissor lifts may be prevented from fully extending. As a result, workers may need to stand on the second rung of the lift basket and lean out to access work, which can raise the risk of falls.</p>  | <ul style="list-style-type: none"><li>• <a href="#">Access deck accessory on scissor lift</a></li><li>• <a href="#">Portable lift platforms</a></li></ul>   |

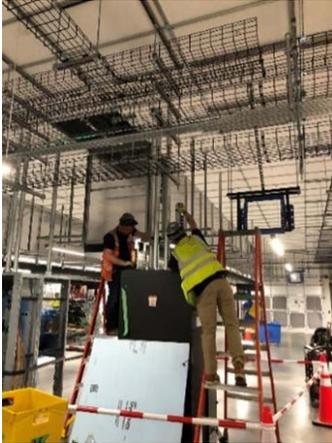
| CONDITIONS   | RECOMMENDATIONS  |
|--|--|
| <p><b>Complex Lockout/Tagout (LOTO) procedures:</b><br/>Complex LOTO procedures can be hard to understand, increasing the risk of confusion and subsequent mistakes.</p>    | <ul style="list-style-type: none"> <li>• Enhanced, site-specific LOTO training and frequent refreshers</li> <li>• Coordinate with management and other involved parties to implement a less complex LOTO procedure</li> </ul>  |
| <p><b>Work disruptions due to high-traffic work area:</b><br/>Workers on boom lifts in high-traffic areas (e.g., near doors) may need to stop work in the middle of a cable tray installation and allow other workers to occupy the area. This can disrupt the workflow and cause delays.</p>  | <ul style="list-style-type: none"> <li>• Coordination between all crews involved in the operation             <ul style="list-style-type: none"> <li>○ <a href="#">Pre-Task Planning (PTP) Guidelines and Resources for Construction</a></li> <li>○ <a href="#">Building Information Modeling (BIM)</a></li> </ul> </li> <li>• Set up a temporary perimeter with proper signage describing work</li> </ul> |

| CONDITIONS  | RECOMMENDATIONS  |
|---|--|
| <p><b>Walking on elevated data center containments:</b><br/>Data center containments are structures separating cold supply air and hot exhaust air from IT equipment. Walking on top of these containments can raise the risk of falls.</p>  | <ul style="list-style-type: none"> <li>• Use a horizontal life line</li> <li>• <a href="#">Mobile anchor system</a></li> </ul>   |
| <p><b>Restrictive fall protection equipment:</b><br/>Wearing improperly fitting fall protection harnesses can restrict or limit movement while tied off to ceiling anchor points or working in scissor or boom lifts. This can lead to poor body posture, tangled straps, and work disruption.</p>                            | <ul style="list-style-type: none"> <li>• Consult with fall protection manufacturer for adequate equipment selection</li> <li>• Coordinate the installation of anchor points prior to concrete pouring with the general contractor and other trades</li> <li>• Don formfitting fall protection harness based on employee size and ensure a snug fit before commencing work</li> </ul> |

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| CONDITIONS   | RECOMMENDATIONS   |
|--|---|
| <p><b>Difficulty accessing fall protection tie-off points in data centers:</b><br/>Data racks may block overhead tie-off access points during busway installation, raising the risk of injury.</p>    | <ul style="list-style-type: none"><li>• Coordinate the installation of anchor points prior to concrete pouring with the general contractor and other trades</li><li>• Remove all unnecessary materials from the area (e.g., data racks)</li></ul> |
| <p><b>Repetitive installation of data racks:</b><br/>Work in data centers can be repetitive and may involve the same steps in the same order with no variation, leading to complacency and boredom (e.g., installing identical data racks in all data halls).</p>  | <ul style="list-style-type: none"><li>• Rotate workers and/or tasks where possible</li><li>• Take periodic breaks</li></ul>   |

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| CONDITIONS  | RECOMMENDATIONS  |
|---|--|
| <p><b>Electric-powered cable cutters don't produce clean cuts:</b><br/>                     In crowded areas, cable cutters may need to be used upside-down in order to fit into the work space. However, it should be noted that hydraulic cutters will not work upside down when the hydraulic fluid is low. In this case, an electric-powered cutter that works upside-down can be a solution. However, some electric cable cutters may not produce clean cuts. Consequently, workers must file all cut edges, increasing the risk of lacerations.</p> | <ul style="list-style-type: none"> <li>• Implement an effective quality control process upfront to ensure equipment is in good working condition per manufacturer's recommendations (e.g., replenish hydraulic fluid, replace cutter blade)</li> </ul> |
| <p><b>Limited cable cutter availability:</b><br/>                     Lack of a sufficient number of cable cutters on the jobsite can increase the need for manual work.</p>  | <ul style="list-style-type: none"> <li>• Identify the number of cable cutters required and provide a sufficient quantity prior to the beginning of work</li> <li>• Maintain tool inventory to account for availability</li> </ul>                      |
| <p><b>Repetitively lifting and installing cable trays overhead:</b><br/>                     Repetitively lifting and holding cable trays overhead and pushing them through preexisting wall openings for installation can lead to fatigue and raise the risk of ergonomic injuries.</p> <div style="text-align: center;">  </div>  | <ul style="list-style-type: none"> <li>• Use a two-person approach to lifting and carrying material</li> <li>• <a href="#">Best Built Plans for safe material handling</a></li> <li>• <a href="#">Duct lift</a></li> </ul>                             |

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| CONDITIONS  | RECOMMENDATIONS   |
|---|---|
| <p><b>Ascending and descending ladders multiple times:</b><br/>Ascending and descending ladders multiple times in a shift can increase worker fatigue and may raise the risk of falls due to loss of balance.</p> | <ul style="list-style-type: none"><li>• Adopt a “ladders last” approach: only use ladders when scaffolding, aerial lifts, portable stairs, or pulleys are not available or feasible.</li><li>• Use platform or podium ladders with a platform and rail system for employees to stand and work from</li><li>• <a href="#">Mobile elevating work platforms (MEWP)</a></li><li>• <a href="#">Portable lift platforms</a></li><li>• <a href="#">Proper ladder selection</a></li></ul> |



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