

ABB Automation & Power World: April 18-21, 2011

WLP-121-1

Disconnect Switches for Solar and other Applications

WLP-121-1

Disconnect Switches for Solar and other Applications

- Speaker name: Steve Linn
- Speaker title: Senior Marketing Specialist
- Company name: ABB, Inc.
- Location: New Berlin, WI

Your safety is important to us

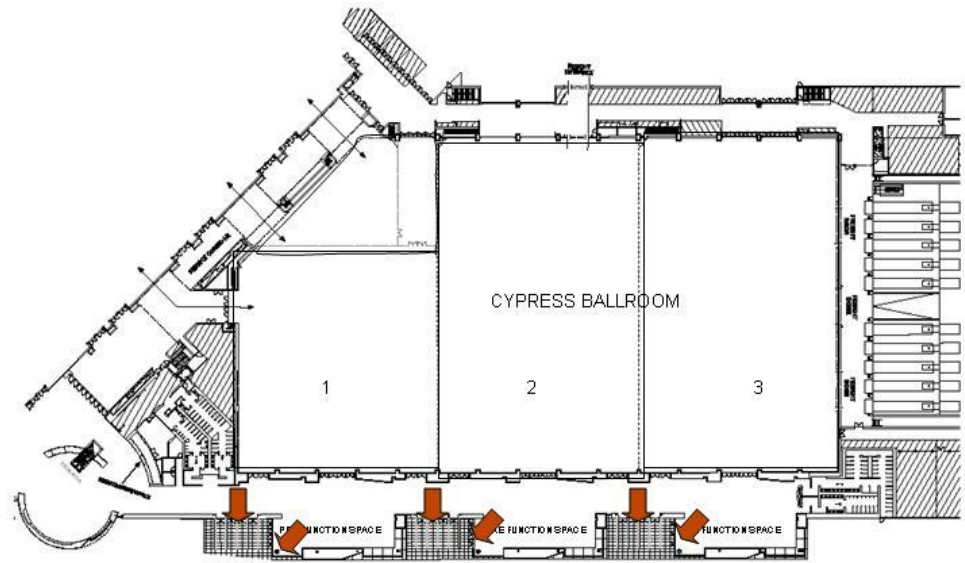
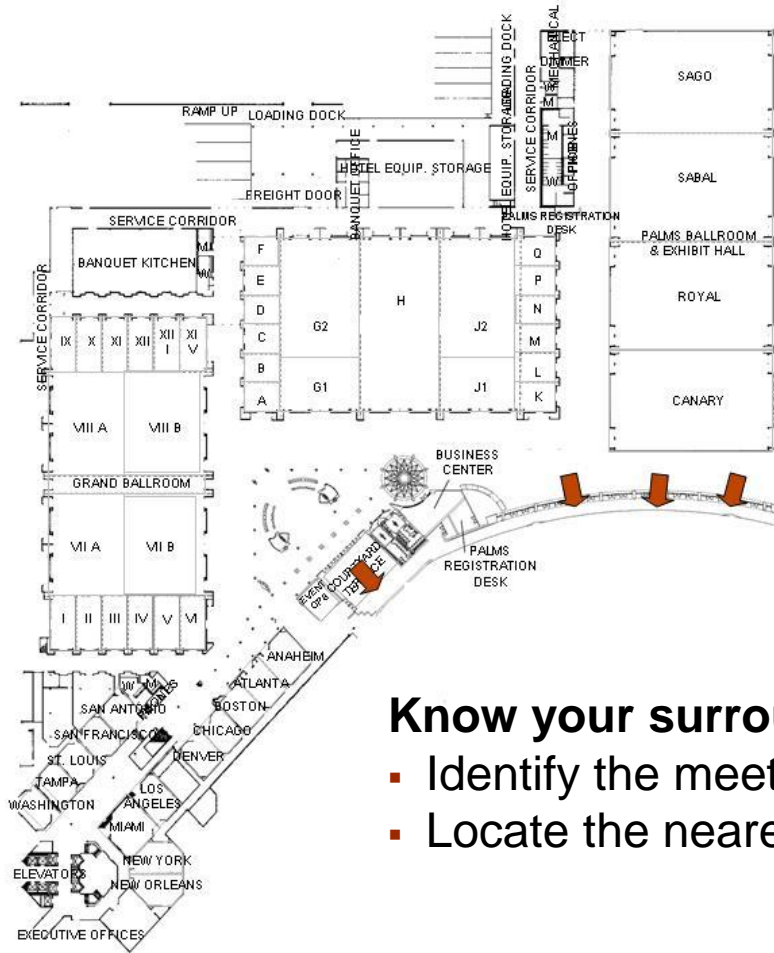
Please be aware of these emergency procedures



- In the event of an emergency please dial ext. 55555 from any house phone. Do not dial 9-1-1.
- In the event of an alarm, please proceed carefully to the nearest exit. Emergency exits are clearly marked throughout the hotel and convention center.
- Use the stairwells to evacuate the building and do not attempt to use the elevators.
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- **ABB** Do not re-enter the building until advised by hotel personnel or an “all clear” announcement is made.

Your safety is important to us

Convention Center exits in case of an emergency



Know your surroundings:

- Identify the meeting room your workshop is being held in
- Locate the nearest exit

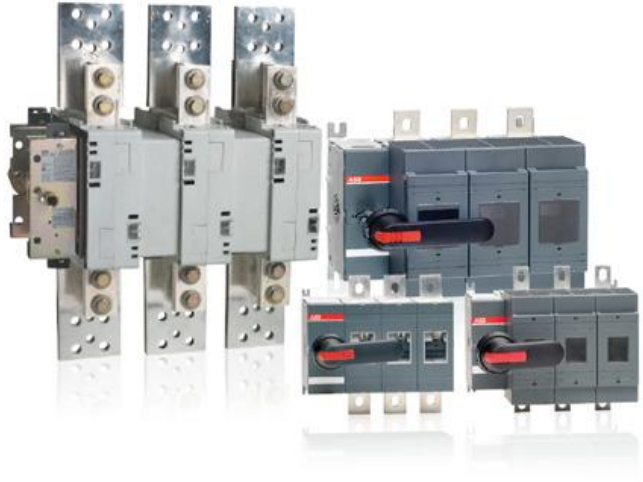
Overview



We will cover...

- HVAC/R
- Material Handling
- Food and Beverage
- Solar
- Summary

Overview



We will cover...

- HVAC/R
- Material Handling
- Food and Beverage
- Solar
- Summary

HVAC/R

Definitions

- ❖ **HVAC/R** – heating, ventilation, air conditioning and refrigeration
- ❖ **Heating systems** - equipment such as boilers, furnaces, or heat pumps to heat water, steam, or air
- ❖ **Ventilation** – Ventilation is the process of replacing air in any space to control temperature or remove moisture, odors, smoke, heat, dust and airborne bacteria
- ❖ **Air Conditioning** - the process of controlling the temperature, humidity, cleanliness and distribution of the air.
- ❖ **Refrigeration** - process for drawing heat from substances to lower their temperature, often for purposes of preservation.

HVAC/R Market Overview

- World HVAC Equipment Industry is \$68.9 BUSD †
- US HVAC in 2010 is estimated to be \$13.7 BUSD (approx 20% World market share) †
- US demand will rise 4.5% annually †

† The Fredonia Group, Inc.

HVAC/R Market Overview

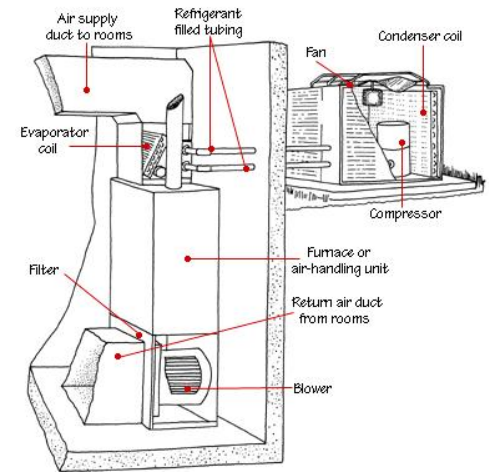
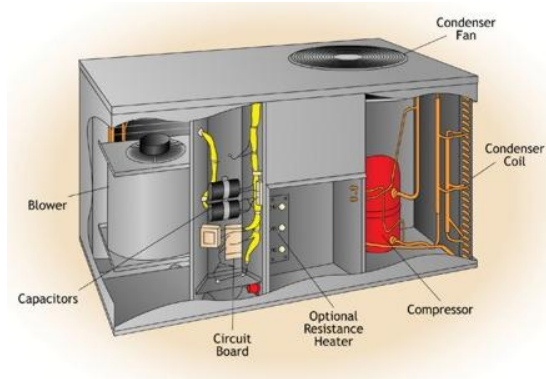
- Trends
 - Energy Efficient Systems
 - Cooling Equipment outpacing heating equipment
 - Phasing out of ozone-depleting refrigerants
- Goals
 - Improving productivity & efficiency
 - Improving overall operational, production, & inventory costs
 - Retrofit and replacement of existing equipment

HVAC/R Applications



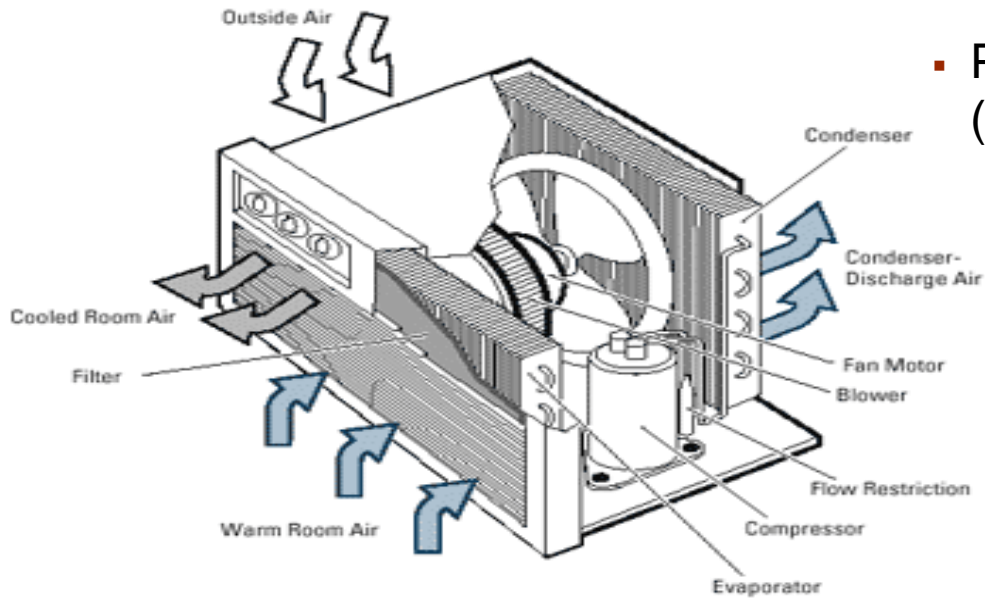
- Heating
 - Heating systems typically contain equipment such as boilers, furnaces, or heat pumps to heat water, steam, or air

HVAC/R Applications



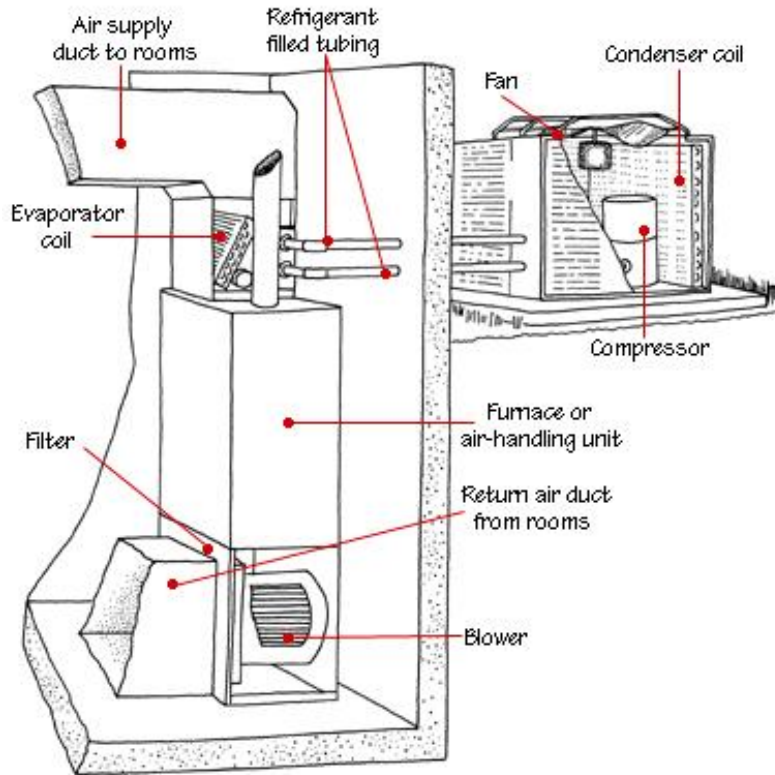
- Packaged AC Equipment (Unitary)
 - A small self-contained electrical unit enclosing a motor-driven refrigeration compressor, evaporative cooling coil, air-cooled condenser, filters, fans, and controls.

HVAC/R Applications



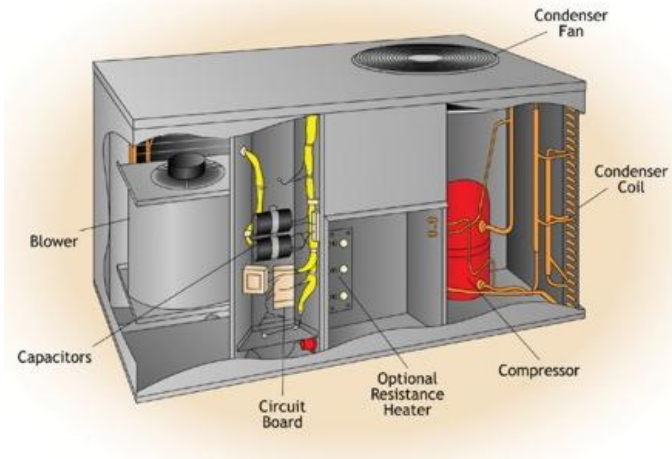
- Packaged AC Equipment (Unitary)
 - Room AC
 - Self-contained unit
 - Mounted in a window or wall
 - Typically used in residences
 - Portable

HVAC/R Applications



- Packaged AC Equipment (Unitary)
 - Ducted Split systems
 - Composed of:
 - Air handler (indoor)
 - Condensing unit (outdoor)
 - Used in residential and commercial settings

HVAC/R Applications



- Packaged AC Equipment (Unitary)
 - Roof Top Units (RTU's)
 - Installed on most commercial buildings
 - Include cooling equipment, air-handling fans, and sometimes gas or electric heating equipment
 - Range in size from 1 ton to more than 100 tons of air conditioning capacity

HVAC/R Applications



- Central Air Plant Systems
 - Commonly called HVAC Systems
 - Larger, more complex systems that most often utilize chillers.



HVAC/R Applications



- Central Air Plant Systems
 - Chillers
 - A machine which produces a large amount of very cold water.
 - Cold water is used to cool the air

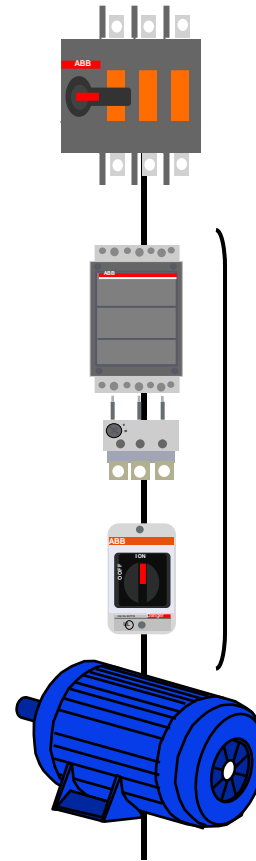
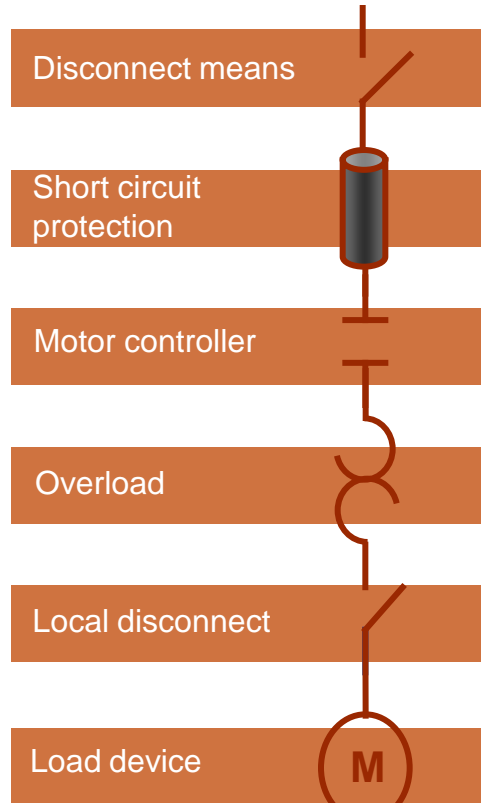
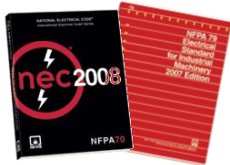
HVAC/R Applications



- Central Air Plant Systems
 - Air Handling Units
 - An assembly of fans and some or all of the following:
 - Circulating air
 - Cleaning air
 - Heating air
 - Cooling air
 - Humidifying air
 - Dehumidifying air
 - Mixing air



HVAC/R– Switch Applications

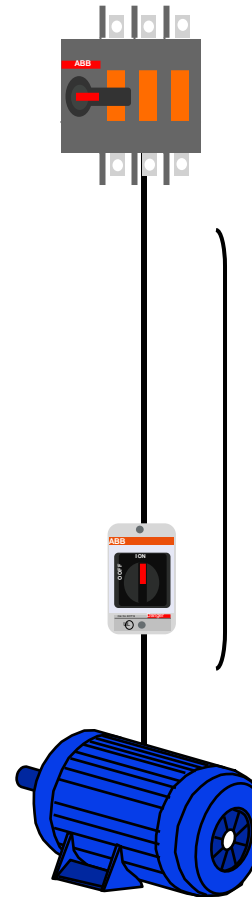
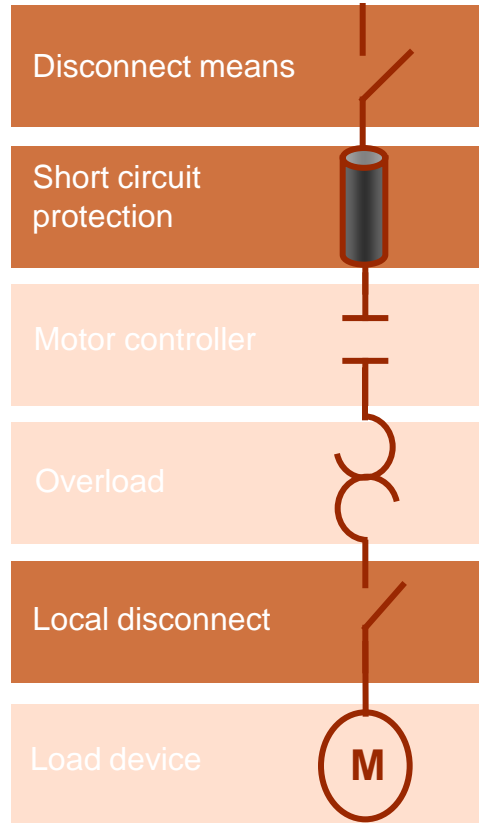
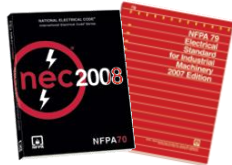


UL 98

UL 508

*OSHA Lockout / Tagout
(NEC 430.31-430.44)*

HVAC/R– Switch Applications



UL 98

UL 508

**OSHA Lockout / Tagout
(NEC 430.31-430.44)**

HVAC/R Application



- **Open Style Switches**
 - Non-fusible
 - Type OT 16-400A



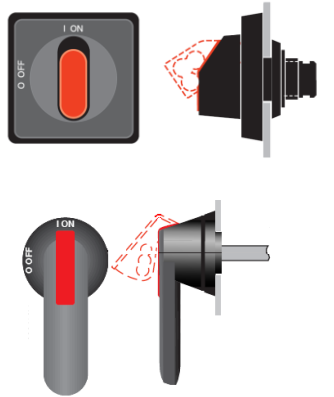
- Fusible
 - Type OS 30-400A

HVAC/R Application



- Accessories
 - Auxiliary Contacts
 - Early Make/Late Break to alert the control system that the motor has been turned off
 - Allows systems behind the motor to react so product or processes do not become backed-up behind the area being serviced or encountering a problem
 - Snap-on, Field Installable
 - Normally Open
 - Normally Closed

HVAC/R Application



- Accessories
 - Handles
 - Pistol and Selector
 - Black and Red/Yellow
 - Optional Direct Mount Handles
 - Provides a solution to NFPA79/UL508A Industrial Machinery Operating Handle requirement

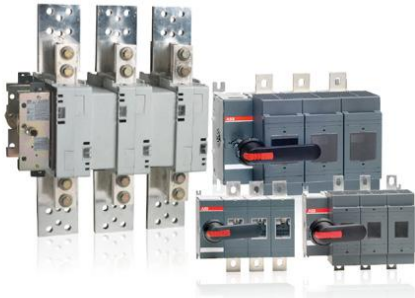
HVAC/R Application



- Enclosed Switches
 - UL Type 3R/12
 - Non-fusible
 - Type EOT 16-80A
 - Type NF 16-400A
 - Fusible
 - Type FJ 30-400A

HVAC/R

Key Facts and Benefits



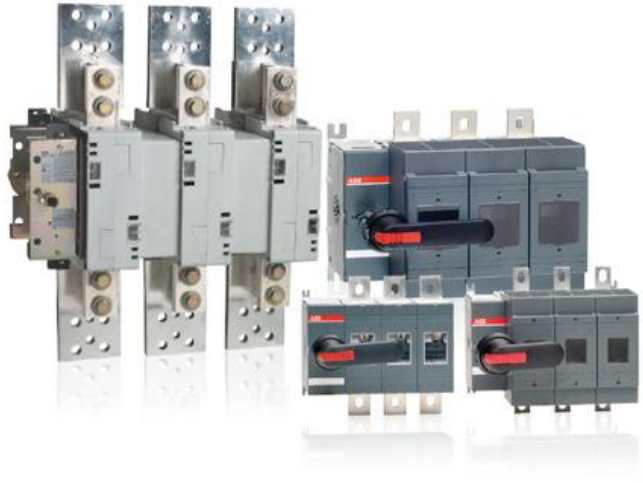
Application

- ✓ Unitary and Centralized Plants
- ✓ 16-400A Fused and Non-fused open switches
- ✓ Switches used primarily for motor disconnects
- ✓ Typically UL Type 3R for enclosed

Benefits

- ✓ Compact solution (open and enclosed)
- ✓ Bulk Packs for inventory and manufacturing efficiency
- ✓ Broad range of handles and field installable accessories

Overview



We will cover...

- HVAC/R
- Material Handling
- Food and Beverage
- Solar
- Summary

Material Handling Definitions

- ❖ **Material Handling** – Transportation of material from one of several locations to a final destination. Material handling applications are typically comprised of moveable items of machinery such as conveyor belts, stackers, loaders, hoppers, industrial trucks, and elevators
- ❖ **MHIA**- Material Handling Industry of America
- ❖ **MHEM** - Material Handling Equipment Manufacturers
- ❖ **NAICS Code** - The North American Industry Classification System. The standard used by Federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy

Material Handling Market Overview

- Material Handling Industry of America - Market Overview
 - 5th largest market in the world
 - 700,000 employees dedicated to material handling solutions (US)
 - US market consumption of material handling equipment & systems greater than \$156 billion

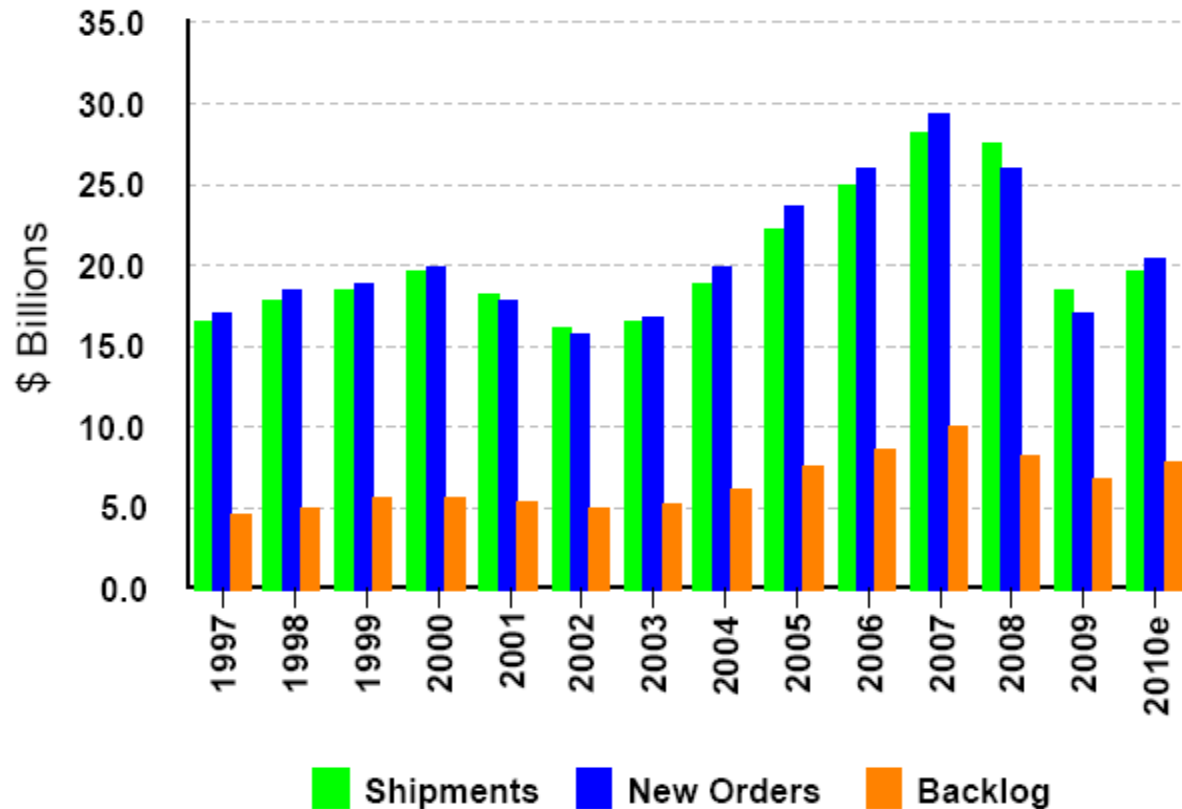


Material Handling Market Overview

- Material Handling Equipment Manufacturers (MHEM)
 - Represents 20 – 30% of the US material handling consumption
 - 2010 statistics:
 - New Orders for the year ending December 2010 grew 18.2%
 - Shipments over the same period grew 6.2%.
 - Unfilled Orders grew 12.3% and represented the equivalent of 4.6 months' of Shipments.

Material Handling Market Overview

U.S. Domestic Production



Note: Shipments, New Orders, and Backlog shown at Annual Rates
Source: USDOC

Material Handling Market Overview

- Trends

- Increasing consumer demand for convenience, quality, and affordability becoming more strategic than a tactical solution
- Mass customization & Electronic Commerce
- Activity based costing and outsourcing operations
- Just In Time Inventory – minimizes costs associated with storage & inventory

- Goals

- Improving productivity & efficiency in material flow
- Developing & maintaining effective logistical processes
- Improving Safety
- Minimizing downtime & human error – emphasis on accuracy
- Improving overall operational, production, & inventory costs

Material Handling Applications



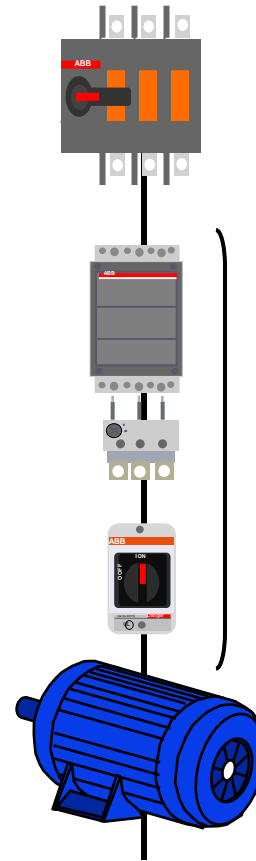
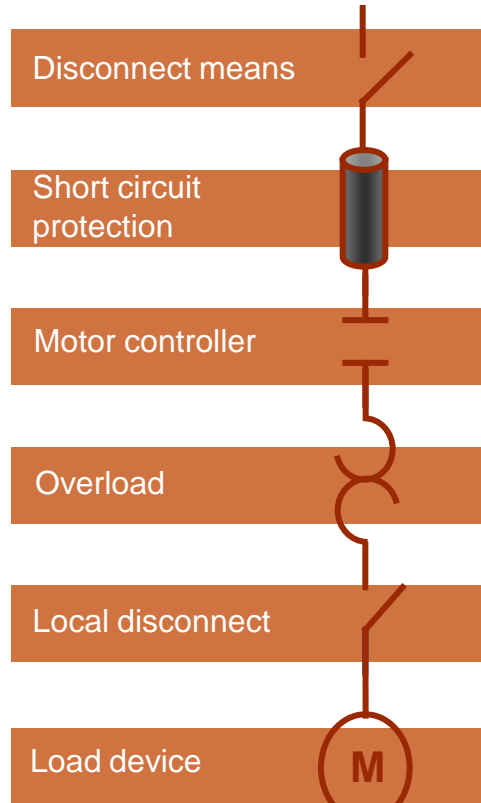
- Conveyors & Conveying Equipment
- Elevators & Moving Stairways
- Industrial Trucks, Tractors, Stacker Machinery
- Overhead Traveling Cranes, Hoists & Monorail Systems

Material Handling Applications



- Material Handling technologies are utilized in a variety of industries, applications, and processes.
 - Manufacturing & Production
 - Warehousing
 - Distribution
 - Packaging
 - Automation
 - Logistics

Material Handling – Switch Applications

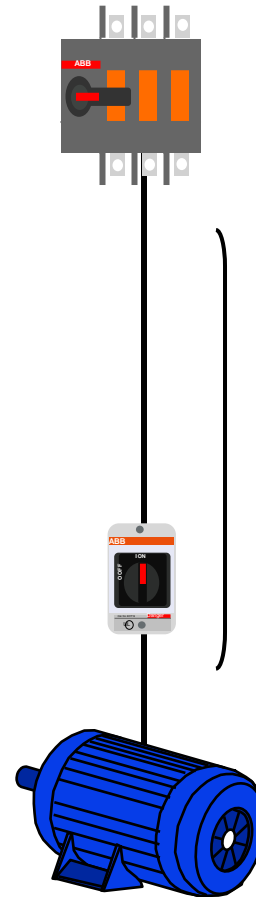
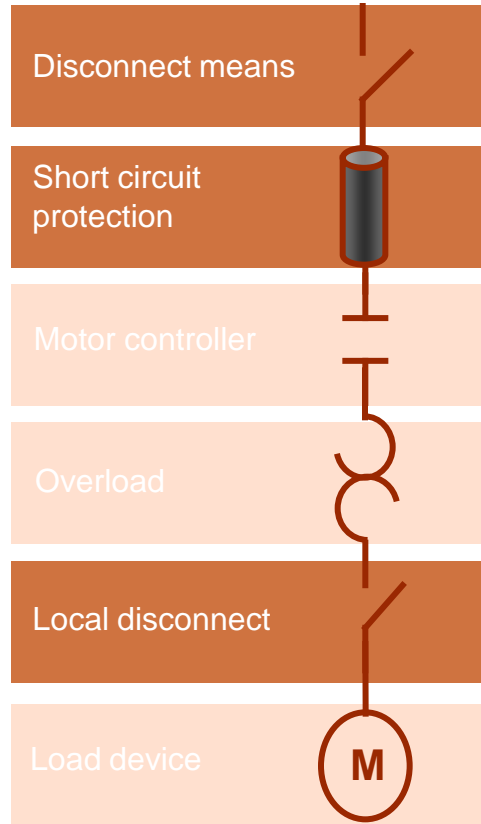
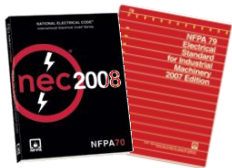


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OSHA Lockout / Tagout
(NEC 430.31-430.44)

Material Handling – Switch Applications

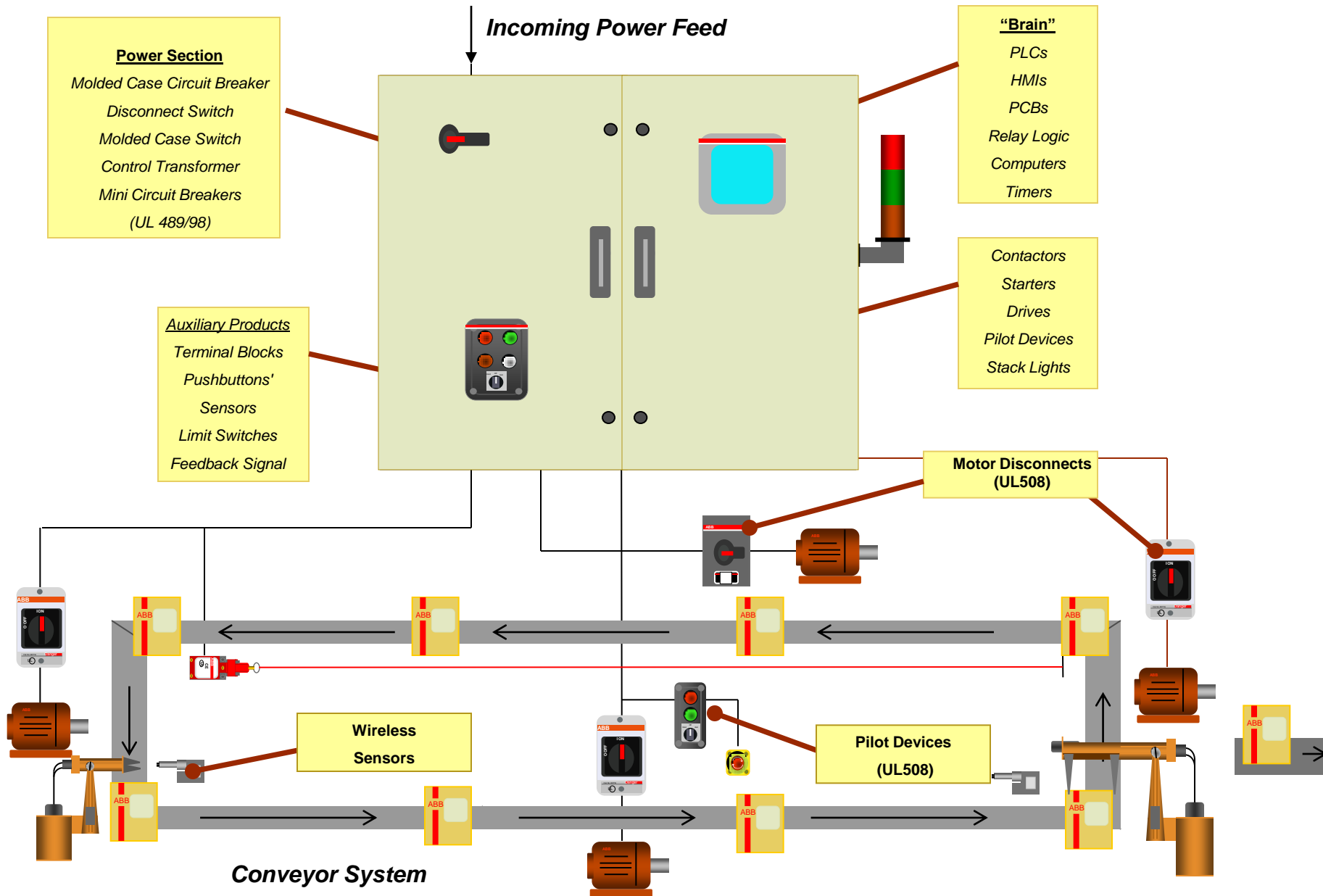


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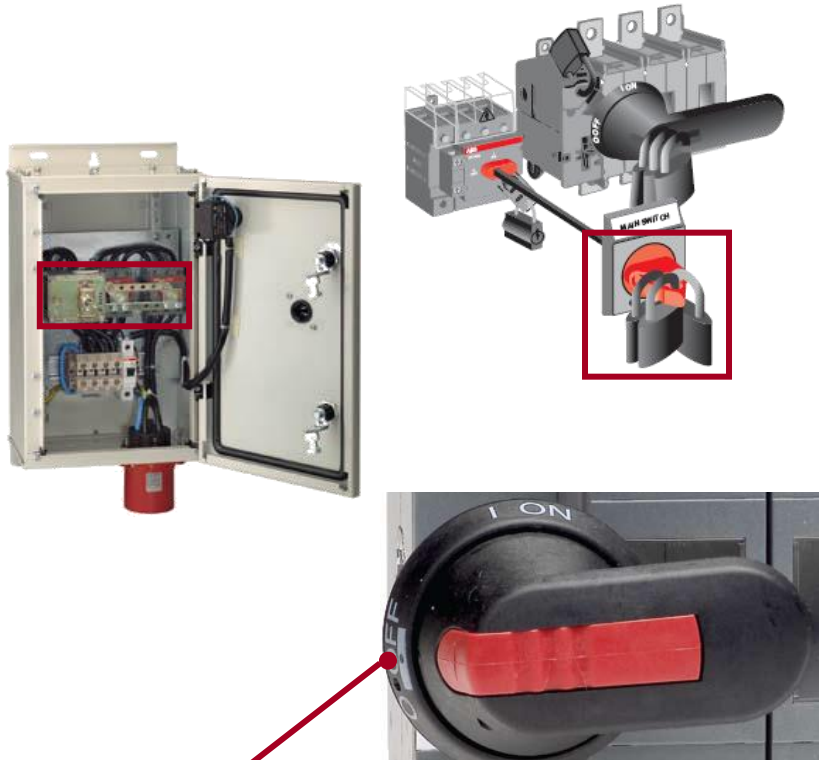
**OSHA Lockout / Tagout
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Material Handling – Switch Applications



Material Handling – Switch Applications

- NFPA79/UL508A Industrial Machinery Operating Handles
 - Material handling machines are classified as Industrial Machinery
 - Code Requirements



- Padlockable in OFF position, independent of door position
- Operable independent of door position without use of tool
- Accessible with door open or closed
- Door interlocked when in ON position
- Door interlock defeatable in ON position
- Deliberate action required to operate switch with door open



Defeatable
(per NFPA 79 requirements)

Material Handling Application

- Open Style Switches
 - Non-fusible
 - Type OT 16-200A



- Fusible
 - Type OS 30-200A



Material Handling Application



- **Enclosed Switches**
- **UL Type 1**
 - Non-fusible
 - Type EOT 16-80A



Material Handling Application



- Accessories
 - Auxiliary Contacts
 - Early Make/Late Break to alert the control system that the motor has been turned off
 - Allows systems behind the motor to react so product or processes do not become backed-up behind the area being serviced or encountering a problem
 - Snap-on, Field Installable
 - Normally Open
 - Normally Closed

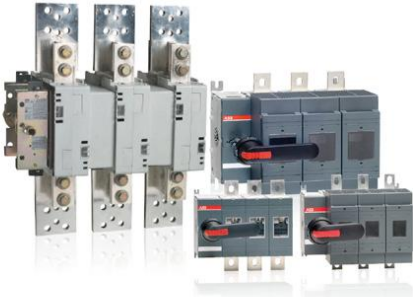
Material Handling – ABB Switch Solutions



- Accessories
 - Flange Handles
 - Provides a solution to NFPA79/UL508A Industrial Machinery Operating Handle requirement
 - Cable & Shaft operated
 - Optional Direct Mount Handles
 - Provides a solution to NFPA79/UL508A Industrial Machinery Operating Handle requirement

Material Handling

Key Facts and Benefits



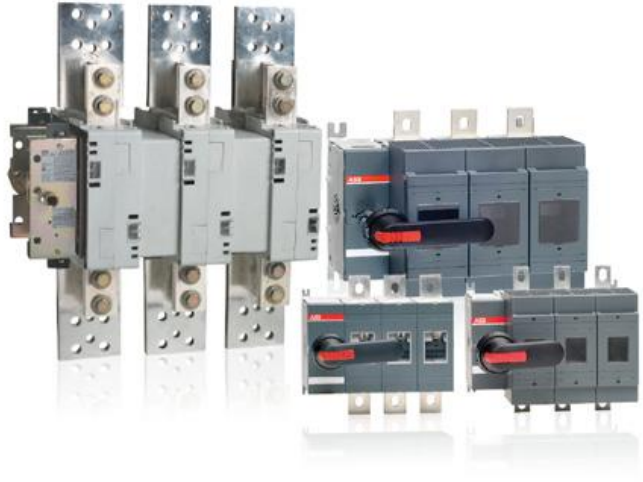
Application

- ✓ Conveyors, Conveying Equipment, Elevators & Cranes
- ✓ 16-200A Fused and Non-fused open switches
- ✓ Typically UL Type 1 and 12 for enclosed

Benefits

- ✓ Compact solution (open and enclosed)
- ✓ Meets OSHA Lockout/Tagout and NEC requirements
- ✓ Enclosed environmental ratings

Overview



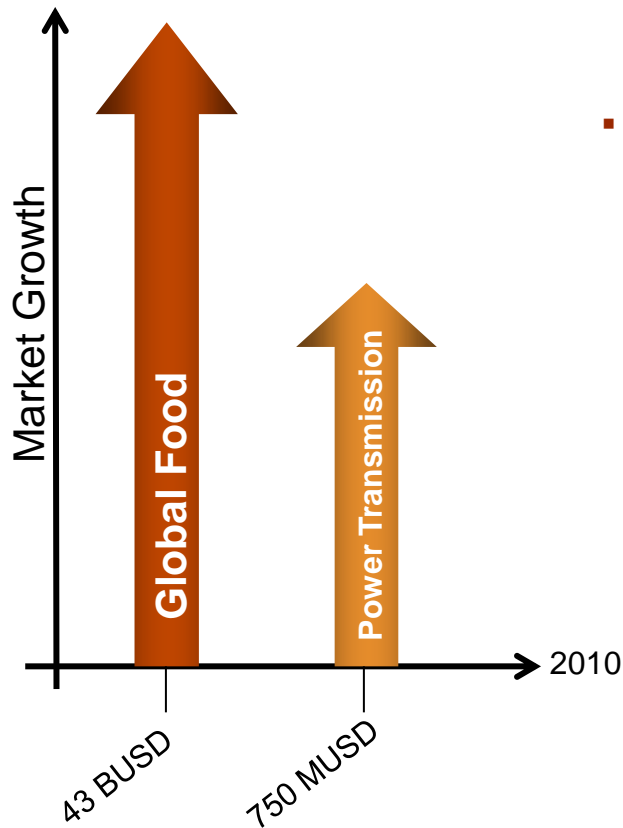
We will cover...

- HVAC/R
- Material Handling
- Food and Beverage
- Solar
- Summary

Food and Beverage Definitions

◆ **Food Processing** – processes and techniques used to transform raw ingredients into marketable food for consumption by humans or animals.

Food Processing – Market Overview



- Food Processing Equipment Market
 - **Global food** processing equipment market worth \$43 billion by 2010
 - US is 3rd largest market worldwide at approx \$10 billion
 - Marketplace is shared among large multinationals with diversified businesses, narrowly focused specialists and a large number of small firms serving local markets.
 - **Power transmission** industry provides \$750 million in products to food & beverage producers in the US annually.



Food and Beverage Market Overview

- Trends

- Health and Safety
 - Personnel
 - Food
- Hygiene
- Efficiency

- Goals

- Improving productivity & efficiency in material flow
- Improving overall operational, production, & inventory costs
- Improving Safety
- Developing & maintaining effective logistical processes
- Minimizing downtime & human error – emphasis on accuracy

Food and Beverage Market Overview

- **Conditions to Consider**
 - Extreme Environment Conditions
 - Caustic Wash Down
 - Chemical Based Cleaners
 - Sanitation
 - Non-contaminated product
- **Requirements**
 - UL/NEMA Type 4X
 - Stainless Material required

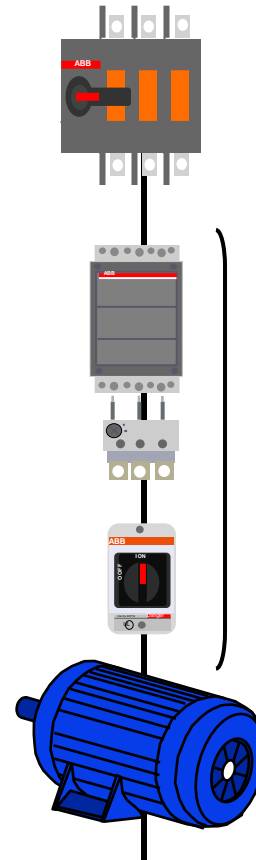
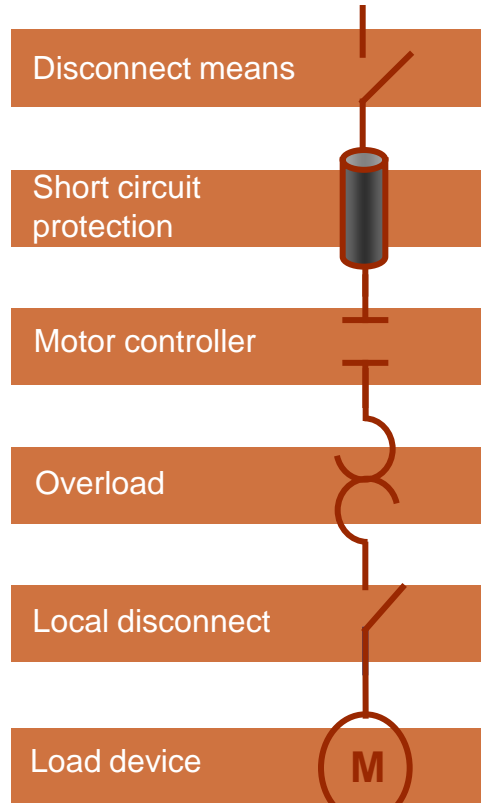
Food and Beverage Applications



- Packaging & Weighing Equipment
 - Bottlers
 - Shrink wrappers, sealers, etc.
 - Labelers
- Processing Equipment
 - Heating & Cooling Machinery
 - Mincers, Grinders, Slicers, Peelers
 - Mixers, Tumblers
 - Washing & Dewatering Equipment
- Material Handling Equipment
 - Conveyors
 - Elevators
 - Loaders & Unloaders



Food and Beverage – Switch Applications

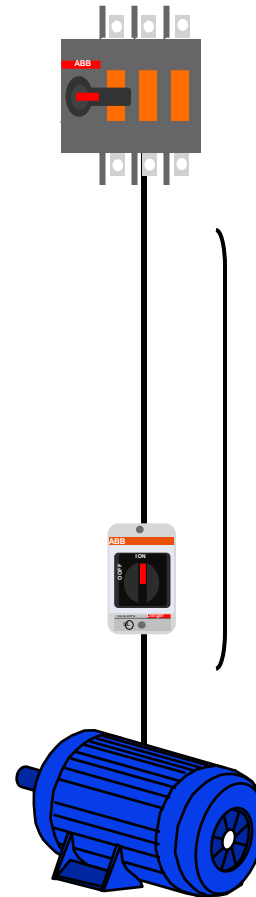
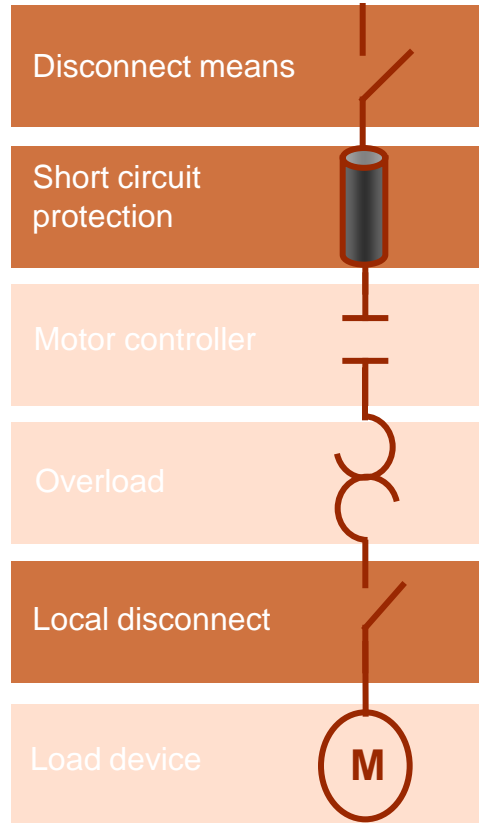
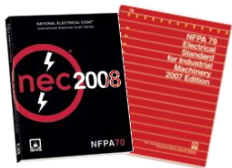


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Food and Beverage – Switch Applications

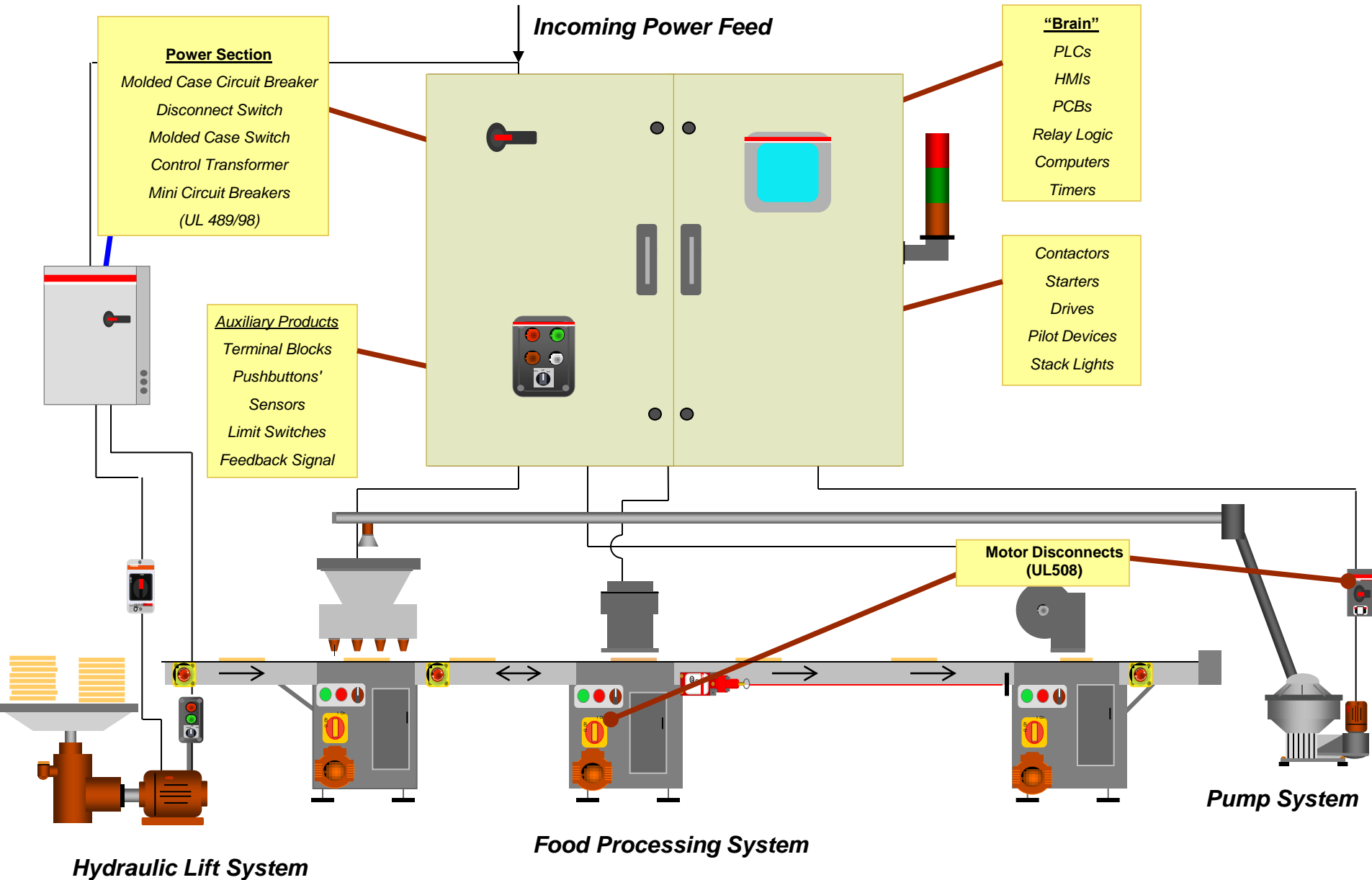


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Food and Beverage – Switch Applications



Food and Beverage Application



- **Open Style Switches**

- Non-fusible
 - Type OT 16-200A



- Fusible
 - Type OS 30-200A

Food and Beverage Application



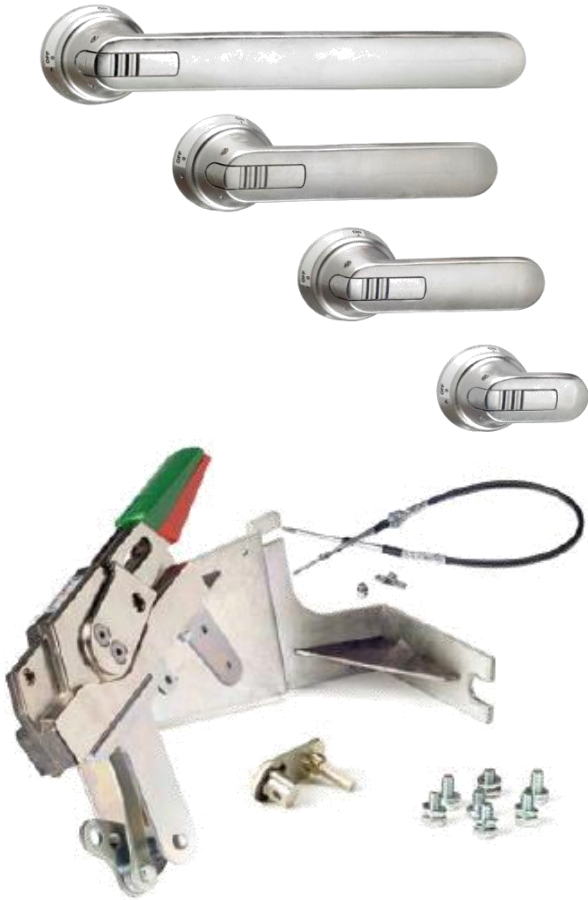
- Enclosed Switches
 - UL Type 4X SS and plastic
- Non-fusible
 - Type EOT 16-80A
 - Type NF 16-100A

Food and Beverage Application



- Accessories
 - Auxiliary Contacts
 - Early Make/Late Break to alert the control system that the motor has been turned off
 - Allows systems behind the motor to react so product or processes do not become backed-up behind the area being serviced or encountering a problem
 - Snap-on, Field Installable
 - Normally Open
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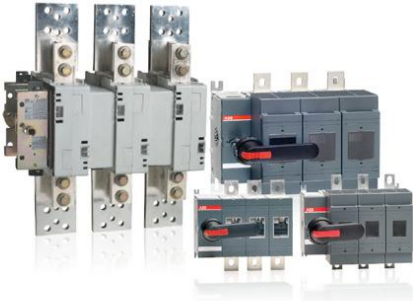
Food and Beverage– ABB Switch Solutions



- Accessories
 - Stainless Steel Handles & Hasps
 - Industry Exclusive!
 - Type 316L SS – Nema 4x
 - 45 to 175 mm lengths
 - Flange handles
 - Nema 4X

Food and Beverage

Key Facts and Benefits



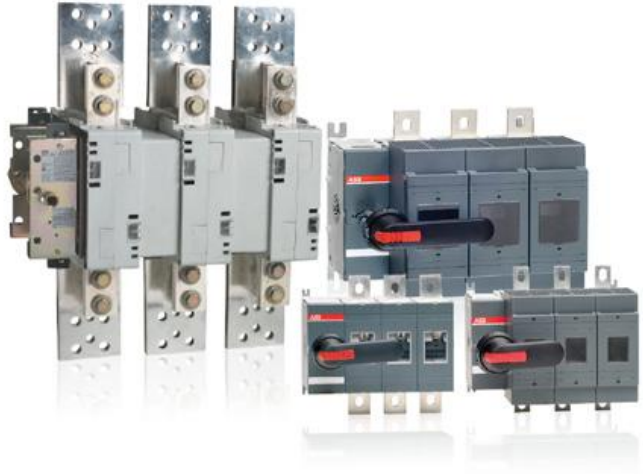
Application

- ✓ Mixers, Mincers, Grinders, Packaging, & Conveyors
- ✓ 16-200A Fused and Non-fused open switches
- ✓ Typically UL Type 4X stainless

Benefits

- ✓ Compact solution (open and enclosed)
- ✓ Meets OSHA Lockout/Tagout and NEC requirements
- ✓ UL Type 4X Washdown in stainless and plastic

Overview



We will cover...

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- Solar
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Solar Definitions

- ❖ **Solar Energy** - the thermal and electrical energy produced by directly exploiting the energy irradiated to the earth.
- ❖ **Photovoltaic Cell** – semiconductor devices that converts light energy into electricity in the form of DC current.
- ❖ **Photovoltaic Module** – packaged interconnection assembly of PV cells.
- ❖ **Strings** - A number of modules or panels interconnected electrically in series to produce the operating voltage required by the load.

Solar Definitions

- ❖ **Combiner Box** – device used to combine the inputs from multiple strings of solar modules.
- ❖ **Inverter** - In a PV system, an inverter converts dc power from the PV array/battery to ac power compatible with the utility and ac loads.
- ❖ **BOS (Balance of System)** – all of the PV system components except the PV modules. Example structures, enclosures, wiring, switch gear, fuses, disconnects, combiner boxes, inverters,

Solar Market Overview

- Total Size of US Solar Market in 2010 is estimated to be \$6 BUSD †
- Grid-connected PV installations grew 102% in 2010 to reach 878 MW, up from 435 MW in 2009, bringing cumulative installed PV capacity in the U.S. to 2.1 GW †
- US has 5% Global market share of PV installations in 2010 †

† US Market Insight "2010 Year in Review™" by Solar Energy Industries Associations®

Solar Market Overview

- Trends

- 600 and 1000VDC ratings
- IEC and UL acceptance (UL98B)
- Safety
- Efficiency

- Goals

- Single product to meet UL and IEC standards
- Improving Safety
- Improve costs and efficiencies

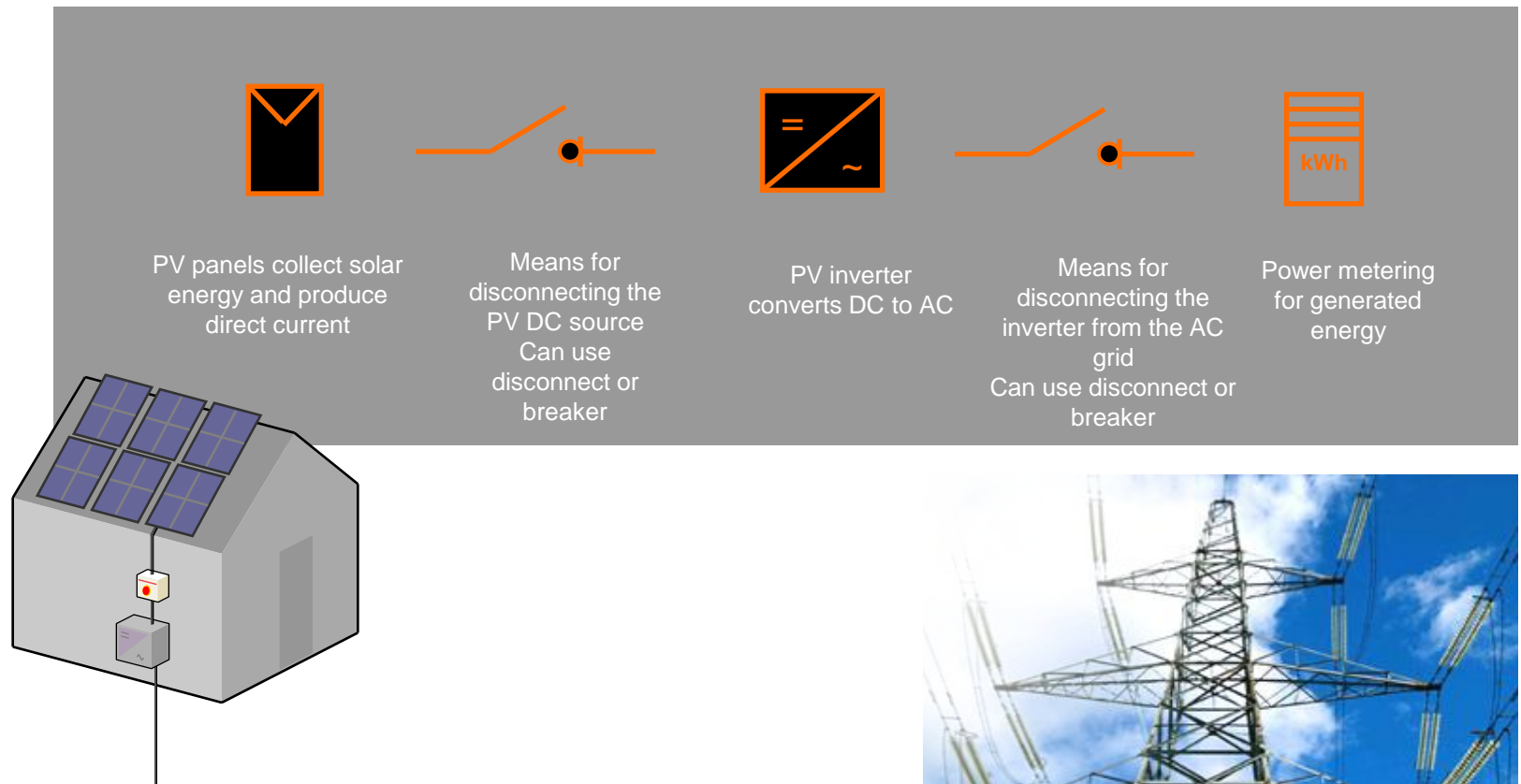
Solar Applications



- Combiner Boxes
 - Source Combiners
 - Field Combiners
- Inverters
 - DC input
 - AC output
- Tracker systems

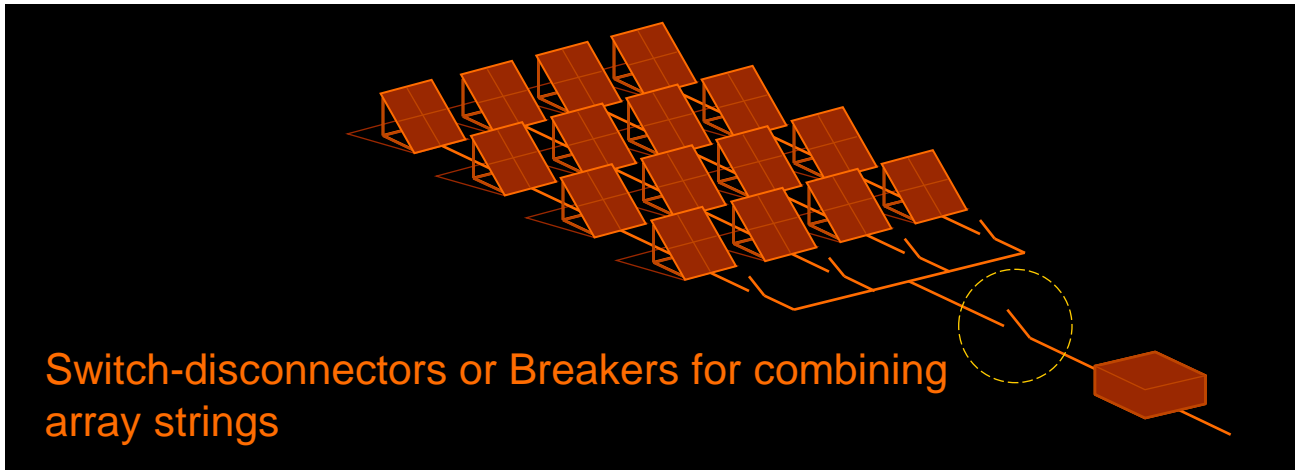
Photovoltaic Applications & Equipment

Distributed systems



Photovoltaic Applications & Equipment

Centralized systems



- String disconnects for combiner boxes
 - maintenance on individual PV-strings
- Switches in combiner boxes:
 - fuse replacement and
 - maintenance on individual sub-arrays
- Inverter disconnects or breakers:
 - Provide means for disconnecting the inverter from DC side

Code Requirements

Related standards



- **IEC 60364-7-712** Requirements for PV power supply systems
 - 536.2.1.1: “To allow maintenance of the PV inverter, **means of isolating** the PV inverter from the DC side and the AC side shall be provided.”
 - 536.2.2.5: “**A switch disconnector** shall be provided on the DC side of the PV inverter.”



- **Article 690** of the National Electrical Code
 - 690.13: “Means shall be provided to **disconnect** all current-carrying conductors of a photovoltaic power source from all other conductors in a building or other structure.”
 - 690.15: “Means shall be provided to **disconnect** equipment, such as inverters, batteries, charge controllers, and the like, from all ungrounded conductors of all sources.”

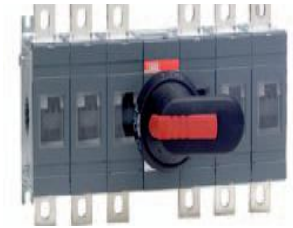
Disconnect Switches for PV Solar Applications

IEC 60947-3



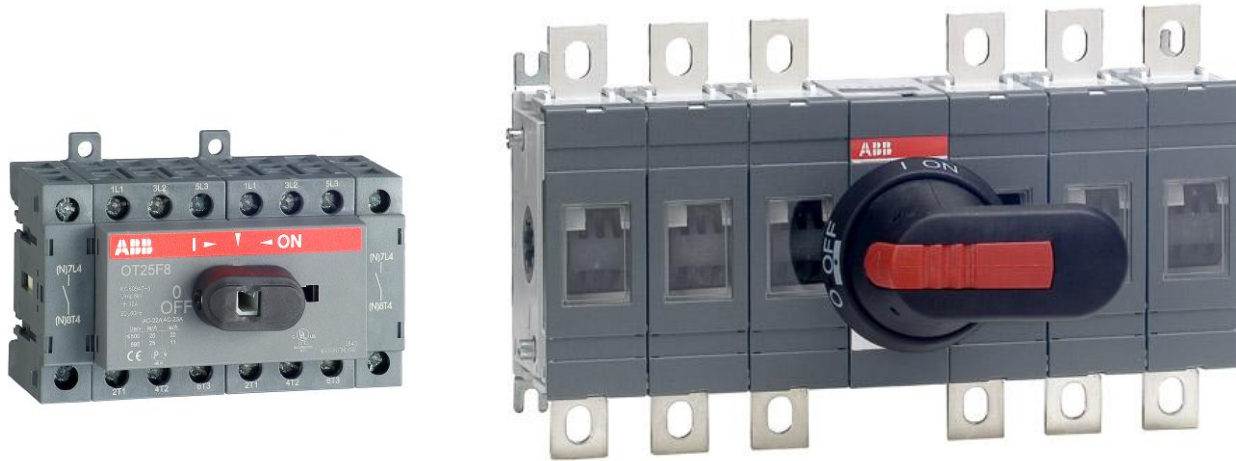
NEMA 3R, NEMA 4X Enclosures

UL 98/508



- Complete switching solutions for your PV applications
 - **Combiner Boxes:** Main DC Disconnecting means up to 1000VDC 630amp
 - **Inverters/Converters:** DC input isolation up to 1000VDC 630amp, AC output isolation up to 600VAC 3000amp
 - **Tracker Systems:** Enclosed disconnect used as motor disconnect. NEMA 1 through NEMA 4X up to 600VDC 200amp
 - **Main Electrical Panels/Switchboards/Switchgear:** Used as main power disconnecting means

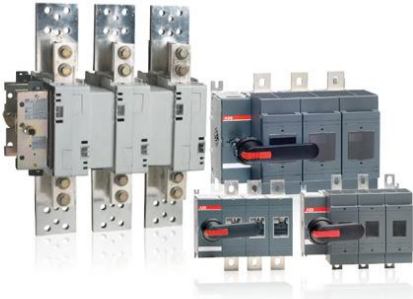
Solar OT Solar Disconnects



- Series-connected poles for increased DC breaking capacity
- OT models for DC applications:
 - OT28...OT200 up to 600 V UL
 - OT16...40F8, OT160E4 up to 750 V IEC
 - OT16F8, OT200...630E23 up to 800 V IEC
 - OT200...630E33 up to 1000 V IEC

Solar

Key Facts and Benefits



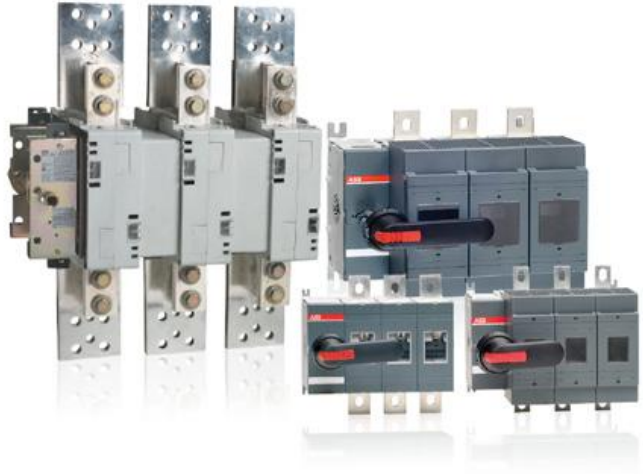
Application

- ✓ Combiner boxes, Inverter isolation, and trackers
- ✓ 28-630A Non-fused open switches
- ✓ Typically 3R or 4X enclosed.

Benefits

- ✓ Compact solution
- ✓ Pre-jumpered switches
- ✓ Integration into existing equipment
- ✓ UL and IEC ratings

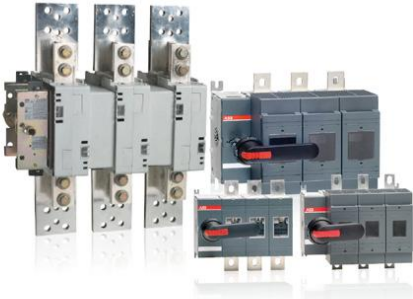
Overview



We will cover...

- HVAC/R
- Material Handling
- Food and Beverage
- Solar
- Summary

Summary



- ✓ HVAC/R
 - ✓ Unitary and Centralized Plants
 - ✓ 16-400A Fused and Non-fused open switches
 - ✓ Typically UL Type 3R for enclosed
- ✓ Material Handling
 - ✓ Conveyors, Conveying Equipment, Elevators & Cranes
 - ✓ 16-200A Fused and Non-fused open switches
 - ✓ Typically UL Type 1 for enclosed
- ✓ Food & Beverage
 - ✓ Mixers, Mincers, Grinders, Packaging, & Conveyors
 - ✓ 16-200A Fused and Non-fused open switches
 - ✓ Typically UL Type 4X stainless
- ✓ Solar
 - ✓ Combiner boxes, Inverter isolation, and trackers
 - ✓ 28-630A Non-fused open switches
 - ✓ Typically 3R or 4X enclosed.

Reminders

Automation & Power World 2011

- Please be sure to complete the workshop evaluation
- Professional Development Hours (PDHs) and Continuing Education Credits (CEUs):
 - You will receive a link via e-mail to print certificates for all the workshops you have attended during Automation & Power World 2011.
 - **BE SURE YOU HAVE YOUR BADGE SCANNED** for each workshop you attend. If you do not have your badge scanned you will not be able to obtain PDHs or CEUs.

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