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# A River of Energy Solutions

## Interconnection Control Issues for Connecting Large Scale Utility Systems to the Grid

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# Session Intent

Gain in-depth insight into utility renewable system planning, construction, and operations and maintenance. Topics include typical stakeholder and facility design, performance and interconnectivity challenges, overcoming design and interconnection challenges and solutions, and lessons learned.

# Interconnection Control Issues for Connecting Large Scale Utility Systems to the Grid

- Interconnection considerations
- Best practice design
- Code Requirements
- Scheduling
- Safety
- Monitoring
- O&M

# Interconnection Considerations

## Utility Perspective

- Customer willing to lease roof top
- Size of the system
  - Regulators
  - Relays
  - Voltage issues
- Distribution infrastructure
  - Existing
  - Cost for any additional infrastructure

# Portion of the roof before installation



# Conduits coming down the side of the building



# Interconnection Considerations

## Utility Perspective

- Customer willing to lease roof top
- Size of the system
  - Regulators
  - Relays
  - Voltage issues
- Distribution infrastructure
  - Existing
  - Cost for any additional infrastructure

# Interconnection Considerations

## Installer Perspective

- Existing distribution tie in location and voltage
  - Interconnection study
- Net metering vs. buy all / sell all
  - Electrical service upgrades
  - Line side tap
  - New service transformer
- Equipment location

# Interconnection Considerations

## Installer Perspective

- Future building plans
- Client restrictions
  - Site access
  - Roof access
  - Hours of operation
  - Lay down area

# Lay down area



# Lay down area



# Roof access



# Highway for moving materials



# Highway at work, moving panels



# Best Practice Design Utility Perspective

- No grid reliability issues
- Maximize roof space
- Minimize impacts to customer
- No roof penetrations

# Best Practice Design Utility Perspective

- Co-generation standards
- Transformer loading
- Metering
- UL 1741

# Transformer Bus Bar



# Best Practice Design Utility Perspective

- Co-generation standards
- Transformer loading
- Metering
- UL 1741

# Best Practice Design Installer Perspective

- Roof warranty
- Structural consideration
  - Weight restrictions
- Choosing equipment and technology
  - Modules and racking
  - Disconnects and inverters
- Layout

# Module racking providing roof access



# Inverters and switchboard layout



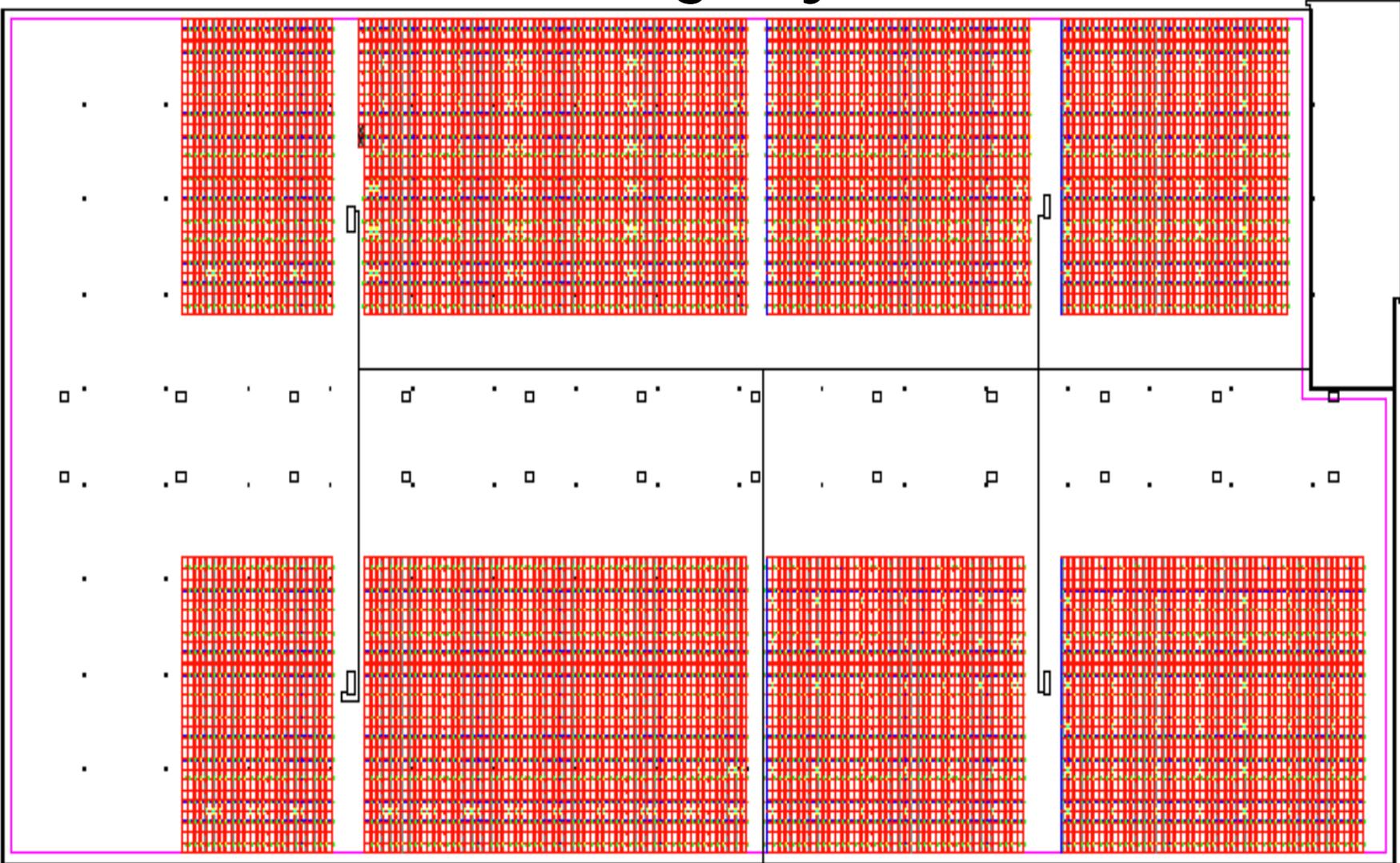
# Best Practice Design Installer Perspective

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# Disconnecting Combiner Box



# Building Layout



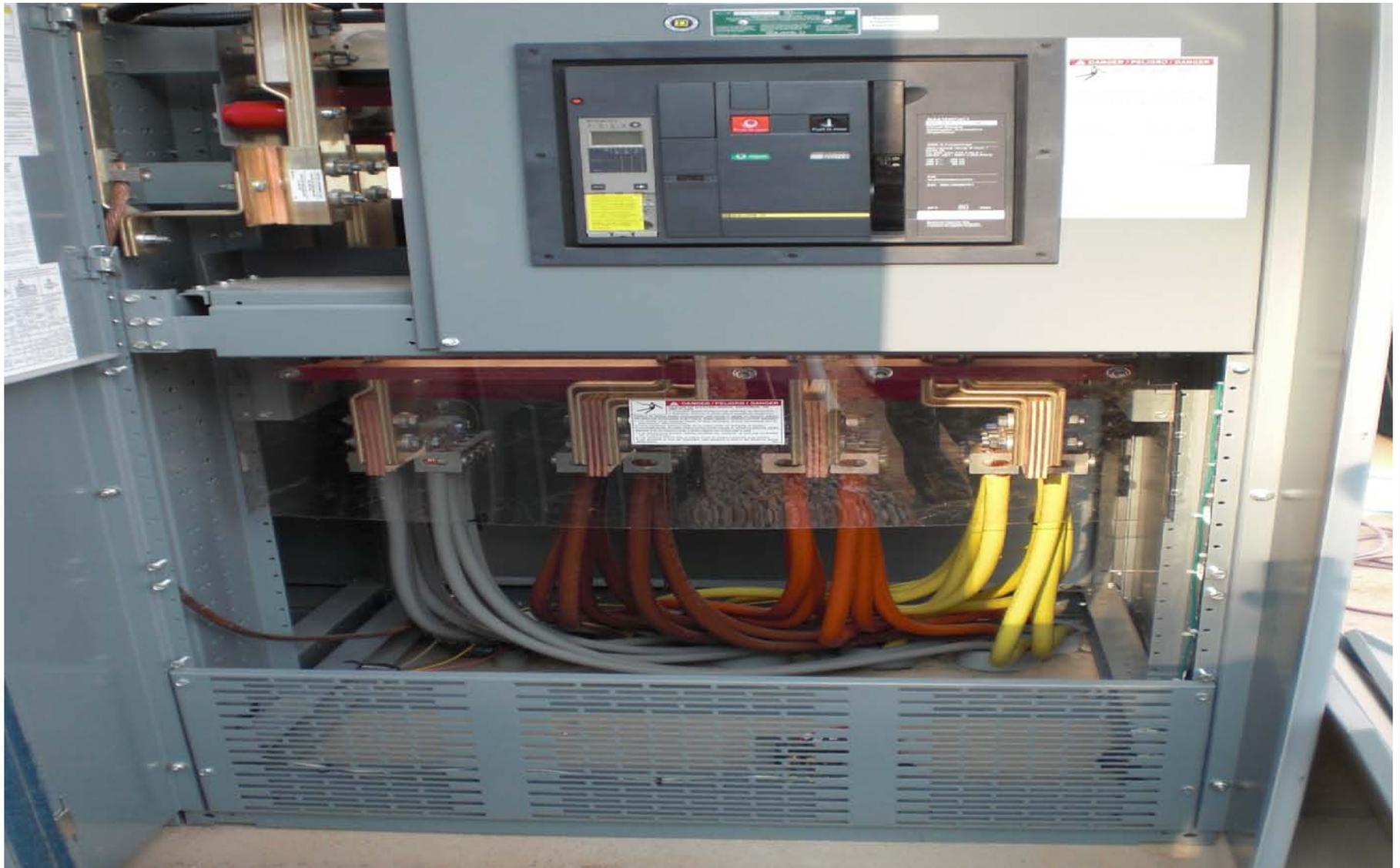
# Best Practice Design Installer Perspective

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- Layout

# Code Requirements Utility Perspective

- Visible lockable disconnect
- UL 1741
- NEC 2008 Article 690
- NABCEP Certification
- General contractor license
- Local inspection / third party verification

# Breaker



# Code Requirements Utility Perspective

- Visible lockable disconnect
- UL 1741
- NEC 2008 Article 690
- NABCEP Certification
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- Local inspection / third party verification

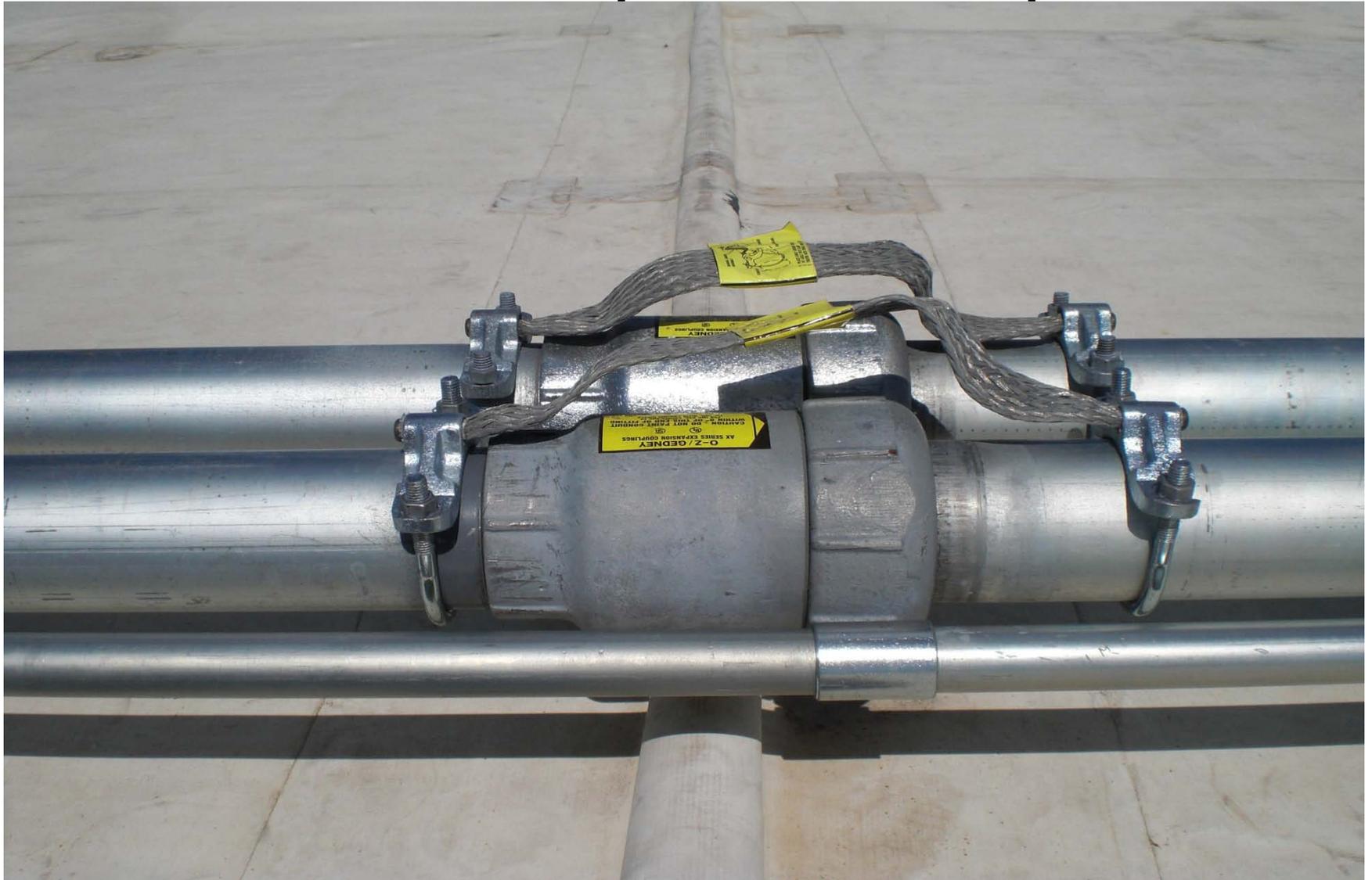
# Code Requirements Installer Perspective

- (Beyond) NEC 2008 Article 690
  - Threaded conduit
  - Additional conduit supports
  - Oversized wire for voltage drop
  - Disconnecting/ contactor combiner boxes
  - Residual Current Monitor System
  - Performance monitoring system
  - Third party verification

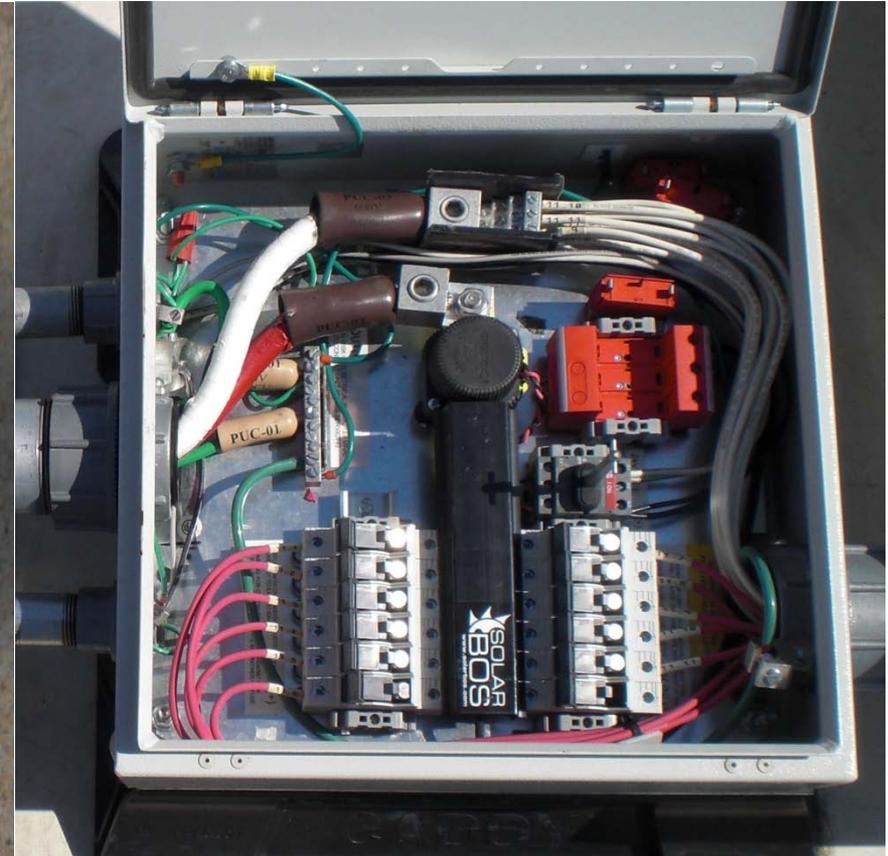
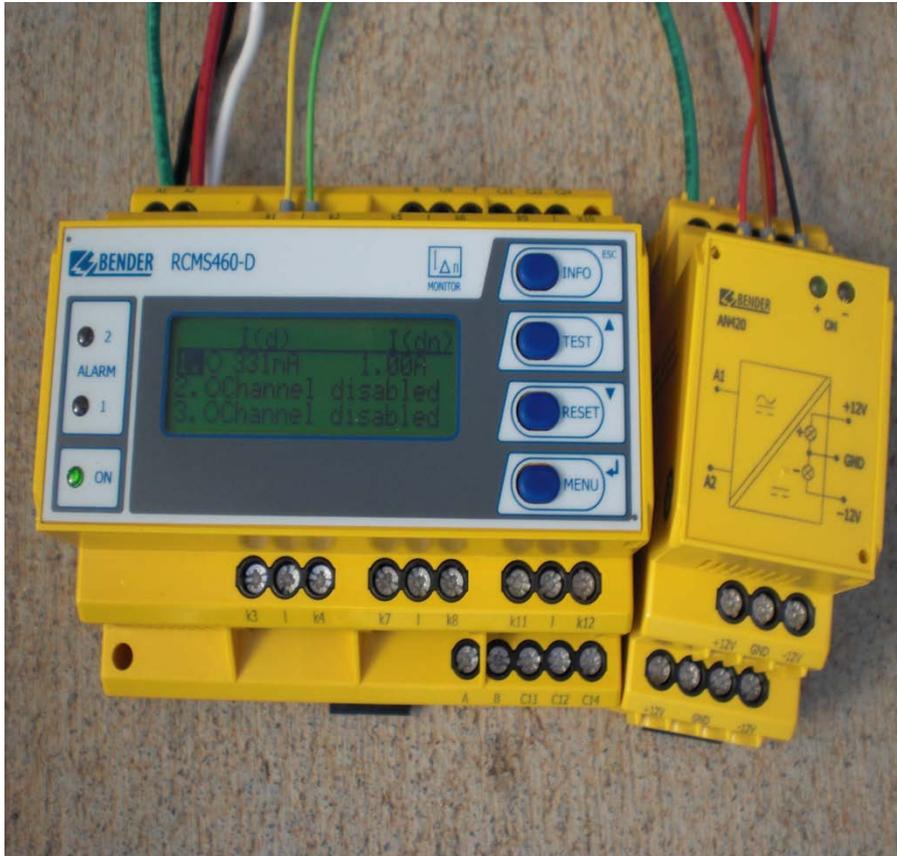
# Conduit raceway to inverters



# Conduit expansion fittings



# RCMS and contactor combiner box



# Code Requirements Installer Perspective

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# Scheduling Utility Perspective

- Customer expectations / requirements
- Ordering materials
- Regulatory requirement
- Distribution installation

# Scheduling

## Installer Perspective

- Design timelines
- Permitting lead times
- Equipment lead times
  - Modules, racking, inverters
- Installation milestones
  - Equipment in place
  - System commissioning

# Scheduling Installer Perspective

- August 1, 2010
- Labor
- Weather delays
- Utility controlled deliverables

# Labor



# Scheduling Installer Perspective

- August 1, 2010
- Labor
- Weather delays
- Utility controlled deliverables

# Safety

## Utility Perspective

- ZERO INJURY / ZERO ILLNESS
- PPE
- Co-generation standards
- Safety audits

# Safety

## Installer Perspective

- Safety training
- Fall protection and PPE
- Safety meetings
- Building and occupant safety
- PV modules are always “hot”

# Safety Requirements



# Monitoring Utility Perspective

- Real time production data
  - kW
  - kWh
  - Voltage
  - Current
  - VARS
- Weather data

# Monitoring Installer Perspective

- Power source required
- Cellular modem or network access
- Good quality system
  - Expected performance vs. actual performance
  - Email alerts
- Utility grade monitoring vs. performance monitoring

# Metering vs. Monitoring



# O&M

## Utility Perspective

- Annual preventative maintenance
  - Testing the system not just visual
- Response time
- Finding a qualified O&M contractor

# O&M

## Installer Perspective

- Good commissioning procedures and documentation
- Daily performance monitoring
- Semi-annual inspections
- Annual preventative maintenance
  - Wire insulation testing
  - Equipment maintenance

# Portion of finished roof



# Additional view of finished roof



# Questions?

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