Advances in Medium and Low Voltage Power Distribution

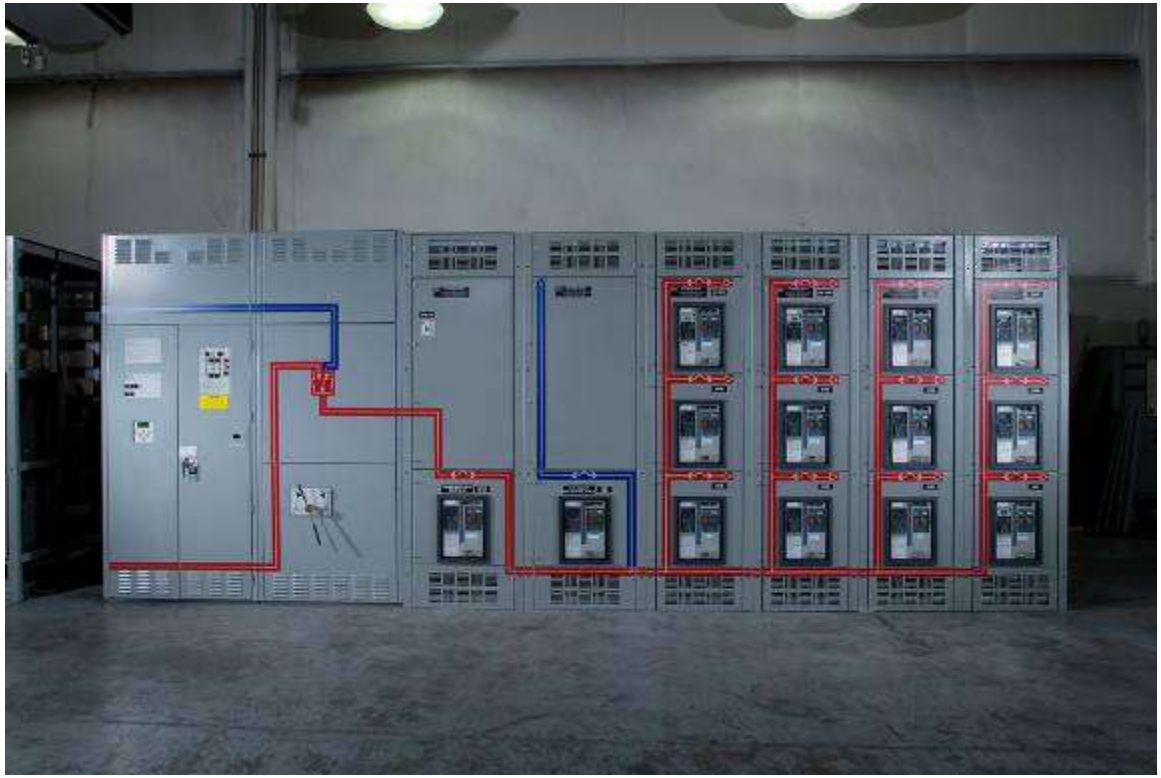
ESS Metron Expo and Technical Seminars

Presented By:
Greg Pelster & Robert Schmid

FFI
Ferrie, Franzmann Industries

LOW VOLTAGE SWITCHGEAR &

LOW VOLTAGE SWITCHBOARDS



Low Voltage Switchboard and Switchgear Application Possibilities

- Stationary or drawout power breakers
- Front or rear accessible
- Steel or stainless steel construction
  - Coastal environments to ANSI C57.12.29
- Custom protective relaying schemes
- Custom controls including
  - Main/Tie/Main throw-over
  - PLC based SCADA monitoring and breaker control
  - Generator paralleling
- Energy management

What Is The Definition of Switchboard

- A wall or floor mounted electrical power distribution device intended for industrial and commercial applications
- Provides over current protection for power circuits to direct power from one source to another
- Designed in accordance to UL891 standards for deadfront switchboards non compartmentalized with density rated bus
- May contain fused switches, or circuit breakers – molded case, group mounted, insulated case fixed or drawout
- Typical ratings up to 600 volts, 6000 Amps, 200kAIC, 50/60Hz, 3 cycle short circuit, indoor type 1 and outdoor type 3R

What Is The Definition of Switchgear

- A robust electrical power distribution device intended for industrial applications
- Rear connected only, metal enclosed compartmentalized, isolated bus compartments
- More reliable over current protection for power circuits to direct power from one source to another ie UL1066 power circuit breakers
- Designed in accordance to ANSI C37.20.1 and UL1558 standards for metal enclosed compartmentalized gear with heat rated bus
- Utilizes insulated case drawout circuit breakers
- Typical ratings to up to 635 volts, 6000 Amps, 150kAIC & 200kAIC 4 cycle short circuit, 100kAIC 60 cycle short time, 50/60Hz, indoor type 1 and outdoor type 3R

UL 1558 Switchgear

- **UL1558 reference standards ANSI C37.20.1 and C37.51-2003 conformance test procedures**
  - UL witnessing and file generation
  - Heat rise – How heat dissipation is affected by different manufacturers breakers – OEM advantages
  - Importance of breaker placements in feeder stacks – cross/riser bus ratings for cumulative and additive loading
  - Short circuit testing – Short circuit withstand vs. short time withstand ratings
  - Differences in withstand capabilities and testing up to 100kAIC, 150kAIC and 200kAIC
  - Utilization of UL1066 power breakers – for low voltage metal enclosed switchgear assemblies
  - Rain testing for 65 mph wind driven rain – challenges
  - Type 3R walk-in and non walk-in
  - Fuse limiters in high kAIC and marine applications
  - Prevalent in heavy industrial, mining, oil & gas, data centers, and some commercial power distribution

Breaker Trip Units and SCADA

- LSIG – Long Time, Short Time, Instantaneous and Ground Fault trip functions
- Zone Selective Interlocking options
- Power Metering Functions –
  - Voltage, Current, Power, Energy, Power Factor, Frequency, Alarm Setpoints, Waveform Capture, Harmonic analysis – C20 Accuracy
- Breaker Status Monitoring/Control including –
  - Device identification – Comm address, trip unit identification, comm status
  - Remote control commands – Open, close, trip reset
  - Breaker status – Opened, closed, charged, tripped, position, temperature, contact erosion, number of operations, number and type of trips, event history
- Communicate to PLC with protocols such as Modbus or Profibus via Serial or Ethernet

Power Monitoring and Management

- **Remotely monitor and manage energy usage over local SCADA system or the internet**

Low Voltage Switchboard and Switchgear Application Possibilities

Operator Safety and Protection

Arc Flash Statistics

- 5th leading cause of workplace injuries in the US
- Electrical shock is 2nd leading cause of lost time on the job
- 97% of electricians have been shocked or injured on the job
- Every 30 minutes a worker experiences an electric shock on the job that required time off for injury
- 46,000 workers injured in the last 10 years due to electrical shock on the job
- More accidents occur on low voltage equipment than medium voltage equipment
- Incident energy in low voltage equipment is higher due to increased current and slower clearing times

- Per Bureau of Labor Statistics and NFPA70E

Arc Resistant Switchgear

- Channel energy released during an internal fault through plenum
- Minimize potential for injury to personnel or damage to nearby equipment
- Breakers interlocked with gear doors to prevent open/close and racking operation with doors open

Arc Flash Mitigation – Preventative Measures

- Arc flash maintenance reduction features on low voltage breaker trip units – ARMS, Arc Sentry, RELT
  - Activation methods
- Feeder protection relays with light and current sensing
  - Utilizes fiber or point sensors
  - Typical 5 cycle clearing time
  - Cost effective in comparison to arc resistant switchgear

Arc Flash Mitigation – Preventative Measures

- Insulating and booting bus bars, joints, and cable lug connections
- Isolated/Insulated bus practices
- These methods can help reduce the risk of arc flash or electrocution
- Service entrance rating

Arc Flash Mitigation – Preventative Measures

- Remote breaker racking mechanisms
  - Most low voltage arc flash incidents occur during the rack-in/rack-out process
  - Rack in a drawout breaker from a safe distance – 30 to 50 feet typical
  - Stand outside the arc flash boundary

Arc Flash Mitigation – Preventative Measures

- Remote breaker operating/status panels
  - Various location possibilities
  - Eliminate danger from closing a breaker on a fault by not standing in front of the gear
  - Local remote, auto manual, electrical and mechanical interlocking
  - Hard wired or PLC controlled
  - Does not apply to manually operated breakers

Arc Flash Mitigation – Preventative Measures

- High resistance grounding systems
  - Limit ground fault current to just a few amps
  - Allow operation to continue while ground fault is located – reduce down time
  - Saves time, money, and potential damage to equipment and switchgear
  - Features include:
    - Resistor path monitoring
    - Pulsing system
    - Data logging
    - Communications via Serial and Ethernet
  - Type 1 stand alone and OEM version for installation into switchgear

UL1558 Switchgear

UL1558 Switchgear

Standard Features:

- UL listed to UL1558
  - NEMA 1, NEMA 3R walk-in, or NEMA 3R non walk-in construction
- Short Circuit ratings up to 200kAIC at 6000 amps.
  - Short Time ratings up to 100kAIC at 60 cycles
- Maximum horizontal bus at 6000 amps
- Maximum vertical bus at 5000 amps
- Built and tested per ANSI C37.20.1 and C37.51.
- Applications up to 635 volts, 50/60Hz, 3 phase 3wire and 3 phase 4 wire.
- Rugged corner post construction and standard powder coated structures for industrial, commercial, and utility applications.
- Exterior paint processes meet ANSI C57.12.29 for Coastal Environments.
- Robust Steel or Stainless steel construction.
- Easily accessible wiring channels.
- Available in standard 22” and 32” widths. Custom depths starting at 60” deep.
- UL1066/ANSI fused and no-fused power circuit breakers from various manufactures, both electrically and manually operated.
- Isolated breaker cubicles, bus compartment, and rear cabling compartments.

Optional Features:

- Custom transition sections for transformer connections.
- Insulated bus bar.
- Remote breaker racking.
- Sectional heaters with thermostat or humidistat.
- Power monitoring.
- Integrated TVSS.
- Harmonic mitigation devices.
- Power factor correction devices.
- Keyed Interlocks.
- Top mounted traveling breaker lifting hoist.
- Integrated high resistance grounding/neutral systems.
- Automatic throw over (ATO) schemes – open & closed transition.
- Custom integrated PLC controls.
- Integration with building management and SCADA systems.
- Custom metering and protective relaying.
- Collective bus for multiple utility or generator feeds.
- Paralleling/load shedding controls
  - Emergency or standby
  - Prime power
  - Co-gen
  - Controls for all types of generators
  - Load sharing for multiple generators
  - Speed and voltage control components
- Rear accessible.

UL891 Switchboards

UL891 Switchboards

Standard Features:

- UL listed to UL891
  - NEMA 1, NEMA 3R walk-in, or NEMA 3R non walk-in construction
- Short Circuit withstand ratings up to 100kAIC.
- Available in amperage ratings from 800 to 6000 amps.
- Applications up to 600 volts, 50/60Hz, 3 phase 3wire and 3 phase 4 wire.
- Rugged corner post construction and standard powder coated structures for industrial, commercial, and utility applications
- Exterior paint processes meet ANSI C57.12.29 for Coastal Environments.
- Steel or Stainless steel construction.
- Thru-the-door circuit breaker operation.
- UL/ANSI circuit breakers/protection devices from various manufactures, both electrically and manually operated.
- Front access to control and communications devices and wire connections.

Optional Features:

- Custom transition sections for transformer connections.
- Insulated bus bar.
- Remote breaker racking.
- Sectional heaters with thermostat or humidistat.
- Power monitoring.
- Integrated TVSS.
- Harmonic mitigation devices.
- Power factor correction devices.
- Keyed Interlocks.
- Top mounted traveling breaker lifting hoist.
- Integrated high resistance grounding/neutral systems.
- Automatic throw over (ATO) schemes – open & closed transition.
- Custom integrated PLC controls.
- Integration with building management and SCADA systems.
- Custom metering and protective relaying.
- Collective bus for multiple utility or generator feeds.
- Paralleling/load shedding controls
  - Emergency or standby
  - Prime power
  - Co-gen
  - Controls for all types of generators
  - Load sharing for multiple generators
  - Speed and voltage control components
- Front/Rear accessible.

UL50 Custom UL Switchboards

- Standard Features:

- UL listed to UL50
  - NEMA 1, NEMA 3R, NEMA 4, and NEMA 4X stainless steel construction.
- Can be applied to non-standard locations such as corrosive environments requiring closed loop cooling or classified areas requiring purge air.
- Exterior paint processes meet ANSI C57.12.29 for Coastal Environments.
- Steel or Stainless steel construction.
- Control and automation options are available.