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 i.e. 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 3 wire 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.