**Basis of Design**

This section applies to the design of design and installation of automatic transfer switches.

**Design Criteria**

Clearly indicate in the drawings and specifications whether the programmed neutral position (PNP), non-programmed neutral position (NPNP), and/or bypass isolation switch (BIS) style switches are required. Eliminate the appropriate sections of the attached guide specification if the PNP and/or the BIS features are not required.

1. Specify NPNP for National Electrical Code (NEC) 517 and NEC 700 emergency systems.
2. Specify PNP for NEC 701 and NEC 702 legally required and optional standby systems and for systems that contain significant motor loads that would benefit from the neutral position for motor rundown prior to restart.
3. Specify BIS for all laboratories and other applications that cannot tolerate prolonged shutdowns of the emergency system for maintenance. BIS is typically required where critical client equipment and systems are connected to the emergency system. Examples include freezers; bio-safety cabinets; life-sustaining processes such as pumped water to fish tanks; systems providing protection of facilities and personnel from environmental hazards; and equipment protecting facilities from damage, e.g., sanitary lift stations and sump pumps.

**Design Evaluation**

The following information is required to evaluate the design:

- **Programming Phase**
  - Statement of design intent, including identification of transfer switch styles (BIS, PNP, or NPNP and Central Management Control System [CMCS] accessories)
  - Preliminary watt/square foot value for loads anticipated

- **Schematic Design Phase**
  - Description of transfer switch requirements
  - Outline specifications
**Design Development Phase**
- Preliminary riser diagrams
- Draft specifications

**Construction Documents Phase**
- Complete automatic transfer switch design, final riser, and one-line diagrams
- Installation details
- Control signal connection details, including generator start (if required), fire alarm, and elevator control interfaces
- Complete specifications

**Submittals**
- Provide industry standard submittal requirements.
- Refer to the attached guide specification.

**Products, Materials, and Equipment**
Acceptable manufacturers include Russelectric, Onan, and others pre-approved by UC CM.
For each project, transfer switches shall be of the same manufacturer.
Circuit-breaker-style transfer switches are not acceptable.

**Installation, Fabrication, and Construction**
Refer to the attached guide specification.

**END OF DESIGN INFORMATION SECTION**
GUIDE SPECIFICATION

The following specification is intended as a guide only. The Engineer shall write the specifications to meet the project needs in consultation with University of Cincinnati Construction Management (CM) and in accordance with the attached design information section.

IMPORTANT: The Engineer shall clearly indicate in the drawings and specifications whether the PNP, NPNP, and/or BIS style switches are required. Eliminate the appropriate sections of this specification if the PNP and/or the BIS features are not required.

ELECTRICAL: AUTOMATIC TRANSFER SWITCHES

PART 1 GENERAL

1.01 DESCRIPTION

A. Automatic transfer switches (ATSs):
   1. Styles and features.

   Engineer shall indicate PNP, NPNP, and BIS requirements here. See the guidelines listed above.

1.02 QUALIFICATIONS

A. Pre-approved transfer switches

   Engineer shall specify the approved manufacturers based on the criteria defined in the introduction to this guide specification.

   1. Approved manufacturers listed here.
   2. For each project, transfer switches shall be of the same manufacturer.
   3. Pre-approval subject to the manufacturer’s ability to meet ALL of the specification requirements.

B. Pre-approved accessories

   1. Selector switches shall be Electro-Switch, Series 24 or approved equal.

   Engineer shall eliminate the following requirement when CMCS monitoring is not required:

   2. Watt/Var transducers shall be Rochester Instrument Systems Tranducer (e.g., #WV30P2EOC5XAWO) available through Branom Instruments Co., (206) 762-6050.

1.03 REFERENCES

A. Applicable codes, standards, and references

5. State and local codes and ordinances.

1.04 COORDINATION
A. Coordinate operation and maintenance training times with UC CM.

1.05 SUBMITTALS
A. General
1. Submittals shall be in accordance with Conditions of the Contract and the General Requirements specification sections.
2. Submit detailed maintenance manuals and drawings, which include wiring diagrams, dimensions, front and side views, and catalog information indicating complete electrical and mechanical characteristics.

1.06 OPERATION AND MAINTENANCE MANUALS
A. Operation and Maintenance (O&M) manuals shall be in accordance with Conditions of the Contract and the General Requirements specification sections.
B. Operation and Maintenance manuals shall include but not be limited to wiring diagrams, bus layout drawings, dimensions, front and side views, and catalog information indicating complete electrical and mechanical characteristics and start-up and testing reports.

1.07 MEETINGS
A. Attend meetings with UC CM and/or UC CM’s representative as required to resolve any installation or functional problems.

PART 2 PRODUCTS
2.01 AUTOMATIC TRANSFER SWITCH AND BYPASS ISOLATION SWITCH
A. General
1. Each transfer switch shall be enclosed in a NEMA-1 general-purpose enclosure with front-opening, lockable doors. Access into enclosure shall be from the front.
2. All components of the assembly except those identified in these specifications by the manufacturer shall be a regularly manufactured product of the supplier.
3. Nameplates: Identify all equipment, operating handles, and devices on structure (exterior and interior) with engraved plastic laminated nameplates (red background with white lettering). Engraving shall identify equipment, emergency classification, and supply sources to match nomenclature identification shown on equipment schematic and wiring diagrams.
4. All relays, timers, control circuitry, and accessories shall be visible and traceable from the front of the enclosure, and all control devices, which change position, shall be mounted such that their state can be visually determined without the aid of instruments.

5. Identify all control wire terminations by tubular sleeve-type markers to agree with wire marking identification on manufacturer's equipment drawings.

6. Indicating lamps shall light-emitting diode (LED).

B. Automatic transfer switch ratings and performance

1. Transfer to emergency and re-transfer to normal source shall be automatic. Once initiated, NPNP transfer time shall not exceed 1/20th of one second. See UL 1008 listed meeting tables 21.1, 23.1, and 23.2.

2. The transfer switch shall be capable of transferring successfully in either direction with 70 percent rated voltage applied to the switch terminals.

3. Each automatic transfer switch shall be rated at 480 volts, 3-phase, 4-pole, for 60 Hertz, normal and emergency sources.

4. All current-carrying parts shall have full 600-volt insulation.

5. The automatic transfer switch and bypass/isolation switch shall have 42,000 amps minimum root mean square (rms) short circuit withstand and closing rating when connected to the load side of standard circuit breakers (not current limiting).

C. Construction

1. For NPNP applications, the transfer switch actuator shall be double throw, single electrical operator, momentarily energized; connected to the transfer mechanisms by a simple over-center-type linkage.

2. The transfer switch shall be equipped with a permanently attached safe manual operator design to prevent injury to operating personnel. The manual operator shall provide the same contact–contact transfer speed as the electrical operator to prevent switching the main contacts slowly, and shall allow for manual transfer under full load.

3. The normal and emergency contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing.

4. Main contacts shall be mechanically locked in position in both the normal and emergency positions.

5. Main contacts: Silver–tungsten alloy. Separate arcing contacts, with magnetic blowouts. Interlocked molded case circuit breakers or contactors are not acceptable.

D. Automatic transfer switch features and accessories

1. All contacts shall be Form-C dry contacts and wire to a dedicated terminal strip for easy access and connection to remote system.

2. Number the terminals clearly and sequentially with labels indicating which function each terminal block represents.
3. Acceptable nomenclature is “Normal Position (N.O.)” or “Normal Position (Common)” where (N.O.) is the normally open contact and common is common with both (N.O.) and (N.C.).

4. Required remote monitoring contacts and signals
   a. Normal position: four auxiliary contacts closed in normal position (Russelectric #14ax).
   b. Emergency position: four auxiliary contacts closed in emergency position (Russelectric #14bx).

5. Adjustable close differential 3-phase sensing relay energized from the normal source, factory set to pick up at 90 percent and drop out at 80 percent of rated voltage. Potential transformers shall be multi-tap for either 208 V or 480 V sensing (Russelectric #VSN).

6. Time delay to override momentary normal source power outage, to delay transfer switch operation; adjustable 0.5–3 seconds, factory set at 3 seconds (Russelectric #1d).

7. Time delay on transfer to emergency; pneumatic type, adjustable 1–300 seconds, factory set at 3 seconds (Russelectric #2b).

8. Time delay on re-transfer to normal while in emergency position. Motor driven type, adjustable 0–30 minutes, factory set at 5 minutes. This time delay shall be overridden upon failure of the emergency source (Russelectric #3a).

   a. Manual: Permits pushbutton transfer to normal or emergency.
   b. Off: Overrides to bypass the automatic transfer switch controls so that the transferred switch remains indefinitely connected to the power source (emergency, normal, or neutral) regardless of the condition of the power sources.
   c. Automatic: All control features ready for automatic sensing and transfer (exception: remote control has priority over this switch position) (Russelectric #12a).
   d. Test: Simulates normal power failure with the load test relay (Russelectric #5c).

10. Pushbutton re-transfer to normal, operable only when the four-position selector switch (Russelectric #6f) is in the manual position.

11. Pushbutton transfer to emergency, operable only when four-position selector switch is in the manual position (Russelectric #6g).

12. Green LED pilot light to indicate the switch is in the normal position (Russelectric #9a).

13. Red LED pilot light to indicate the switch is in the emergency position (Russelectric #9b).

14. Ammeter with four-position selector switch marked "Off," "1," "2," and "3" to read current in all three phases of load circuit. Provide shorting block and terminals for connection of 5-amp transducer to the current transformers (Russelectric #18b).
15. Voltmeter with seven-position selector switch marked “3-1,” “2-3,” “1-2,” “Off,” “1,” “2,” “3.” Three-phase type to read phase-to-phase and phase-to-neutral voltage of the load for 4-pole ATSs. (Russelectric #18b).

16. Adjustable relay to prevent transfer to emergency until voltage and frequency of generating plant have reached acceptable limits. Factory set at 90 percent of rated value (Russelectric #21).

E. Sequence of operation

1. Contacts shall be provided to initiate an emergency operation (i.e., elevator or HVAC equipment shutdown) should the voltage of the normal source drop on any phase after an adjustable time delay of 0.5–3 seconds to allow for momentary dips.

2. The transfer switch shall transfer to emergency when rated voltage and frequency have been reached.

3. After restoration of normal power on all phases, an adjustable time delay period of 0 to 30 minutes shall delay the automatic re-transfer to allow stabilization of normal power. Should the emergency power source fail during this time delay period, the switch shall automatically and immediately return to the normal source or neutral position.

4. A maintained contact test switch shall be included to simulate normal power failure, and pilot lights shall be mounted on the cabinet door to indicate the switch position. Operation of the test switch shall cause a derangement signal.

►► Engineer shall include the next section for PNP-style transfer switches.

F. PNP switches

1. PNP applications: The transfer switch actuator shall be dual electrical operators, momentarily energized, and connected to the transfer mechanisms by a simple over-center-type linkage, with a total transfer time that is adjustable between 0 and 300 seconds.

2. PNP transfer switch styles: Provide time delay relays to control contact transition time by suspending the contact mechanism in the neutral (off) position on transfer to either source, adjustable 1–300 seconds, factory set at 3 seconds. Timing shall start upon failure of old source. Provide terminals for remote contact control (3 amp, 120 Volt from the CMCS by others) to override relay and force the ATS to assume the neutral (off) position, regardless of time delay relay status; for use in load shedding (Russelectric #2dx).

3. PNP transfer switch styles: Provide an LED pilot light with a flashing lamp which indicates when either the load shed or block transfer relays are energized (Russelectric LSBTR).

4. PNP transfer switch styles: Provide a maintained two-position selector switch for load shed or block transfer enable/disable. This switch shall be capable of being sealed in either position with a lead or plastic tamper-indicating seal. Provide contacts for remote monitoring when this switch is placed in the disable position.
5. PNP applications: Provide adjustable time delays for transferring from the normal to the neutral position and from the neutral to the emergency position. A Load Shed signal shall initiate action that removes the load from the emergency source.

6. Each PNP transfer switch shall have a Load Shed Enable/Disable switch. This switch determines whether the Central Management Control System (CMCS) has control.

7. PNP transfer switch styles: The CMCS shall have the ability to control loads on the campus emergency feeder system. Load Shed control takes (predetermined) prioritized loads off the system. Block transfer control permits the proper loading of the system when the generators come on line. This control shall be combined into one output signal from the CMCS.

8. Required PNP monitoring and control equipment, contacts and signals:
   a. Neutral position; four auxiliary contacts closed in neutral position.
   b. Load Shed Keyswitch; closed when keyswitch enabled.
   c. Load Shed keyswitch; enables/disables remote load shed control.

►► Engineer shall include the next section for BIS-style transfer switches.

G. Bypass/isolation switch

1. The automatic transfer switch and its associated bypass/isolation switch shall be mounted in a freestanding enclosure and bused together with copper bus to provide a complete and pre-tested factory assembly. Construction shall be such that the installation contractor needs only to make the incoming power and control wiring connections.

2. Bypass/isolation switches (both normal to load and emergency to load) shall provide a safe and convenient means for manually bypassing and isolating the ATS, regardless of the position or condition of the ATS, with the ability to be used as an emergency back-up system should the transfer switch fail. In addition, the BIS shall be utilized to facilitate removal of the automatic transfer switch for maintenance and repair.

3. The ATS shall be completely isolated from the BIS by means of insulating barriers and separate access doors to positively prevent hazard to operating personnel while servicing or removing the automatic transfer switch.

4. Provide feeder entrance compartment at the top of the switch.

5. Transfer switch removal: Provide drawout-type transfer switch that when withdrawn from its operational position is supported on a rail assembly for ease of maintenance.

6. Operation of the BIS to either normal or emergency shall be possible without changing and regardless of the position of the automatic transfer switch. Overlapping contact bypass/isolation switches that are dependent on the position of the ATS for proper operation are not acceptable.

7. Provide indicating lights to show the bypass/isolation switch in the bypass position and in the fully isolated position, and to indicate source availability. Derangement signal shall indicate only the fully isolated position (drawn out of the cubicle).
8. Accomplish positive sequencing of all contacts, with mechanical linkage that prevents delay in the intermediate position, through the manual operators from a dead front location.

9. Electrical testing and maintenance of the automatic transfer switch shall be possible in the bypass position.

10. Inherent double-throw (break-before-make) operation shall provide positive assurance against accidental interconnection of the normal and emergency power sources. Arrangements utilizing interlocking of single-throw devices are not acceptable.

11. The operating speed of the contacts shall be independent of the speed at which the handle is moved.

12. The BIS switch shall be fully manually operable and shall not be dependent on electrical interlock, operators, or relays for operation.

13. All main contacts and operating linkages of the BIS shall be identical to the ATS except that the operation shall be manual, and the switch shall give the same electrical ratings of ampacity, voltage, short-circuit withstand, and temperature rise capability as the associated ATS. The bypass and emergency switch shall be mechanically locked in both the normal bypass and emergency bypass positions without the use of hooks, latches, magnets, or springs and shall be silver–tungsten alloy, protected by arcing contacts with magnetic blowouts on each pole.

14. The primary buswork of the drawout automatic transfer switch shall be connected to the stationary bus stabs in the freestanding cubicle by silver-plated, segmented, self-aligning, primary disconnect stabs to facilitate proper alignment between the removable drawout element and the stationary cubicle. The ATS stab assemblies shall be drawn out when the ATS is withdrawn and shall be available for inspection without disturbing or de-energizing the main bus.

15. Similarly, the secondary control disconnect contacts mounted on the ATS shall be self-aligning and shall plug into the stationary elements mounted on the freestanding cubicle. Separate, manual, secondary control disconnect plugs are not acceptable.

16. Provide the ATS with self-contained extension rails, rollers, or casters to allow it to be rolled from its enclosure by one person.

17. Provide positive mechanical interlocks to ensure that the drawout functions can be accomplished without the danger of a short circuit.

18. Required BIS monitoring contacts and signals
   a. Bypassed to emergency position.
   b. Bypassed to normal position.

►► Engineer shall eliminate the following requirements when CMCS monitoring is not required.

H. Central monitoring and control system
   1. The transfer switches shall have the capability of being supervised by the Central Monitoring and Control System (CMCS).
2. KW and KVAR: Monitor on the load side of the transfer switch with Watt/Var transducers and related hardware. Transducer outputs shall be 4–20 ma corresponding to the actual load. Hardware provided should be isolated from all other normal switch operational wiring. Include P.T. and C.T. fuse protection, facilities for portable testing equipment (e.g., G.E. type "PK-2" testblocks), and C.T. shorting blocks.

3. Loss of normal power: Six auxiliary contacts to close on failure of normal source. When applicable, these contacts shall initiate building emergency power procedures: engine generator start contacts; heating, ventilation, and air conditioning (HVAC) control; elevator shutdown; fire alarm annunciation; and so forth (Russelectric #7).

4. Contacts operated from voltage sensing network (VSN) to open on failure and close on restoration of normal source (to CMCS signal) (Russelectric #VSN).

5. Loss of emergency power: Terminals and contacts (3-amp, 125 VAC) for remote monitoring of emergency source status (within voltage and frequency limits; not within voltage and frequency limits) (Russelectric #21x).

6. Derangement: Interconnect the following contacts (normally closed) such that any open contact indicates "off normal" condition, including the following:
   a. Manual/Off/Auto/Test selector switch (acc. 12) is in manual, off, or test position.
   b. Automatic mechanism of switch is fully isolated (drawn out of the cubicle).
   c. Enclosure intrusion has occurred.

PART 3  EXECUTION

3.01 REQUIREMENTS

A. Installation, mounting, and electrical connections
   1. Installation, mounting, and electrical connections must be in accordance with manufacturer's installation instructions and Seismic Zone 3 requirements.
   2. Install floor-mounted transfer switches on housekeeping pads.
   3. Coordinate remote monitor and control signal connections with UC CM.

B. Training
   1. Provide operation and maintenance training by a factory-trained instructor for two 2-hour sessions of on-site training for a total of six maintenance personnel.
   2. Include troubleshooting, repair, and maintenance manuals for each participant.

C. Testing
   1. Provide factory field start-up and testing services to assist the electrical testing contractor (ETC).

END OF GUIDE SPECIFICATION SECTION