
USACE / NAVFAC / AFCEA UFGS-16410A (July 2001)

Preparing Activity: USACE Superseding
UFGS-16410A (May 1999)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 25 June 2004

Latest change indicated by CHG tags

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DIVISION 16 - ELECTRICAL

SECTION 16410A

AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH

07/01

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SECTION 16410A

AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH 07/01

NOTE: This guide specification covers the requirements for low voltage applications of automatic transfer switches (ATS) and ATS with by-pass/isolation switches.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

PART 1 GENERAL

NOTE: This guide specification is for use when the nature of electrical loads indicates a need for automatic transfer between two power sources. Terminology used depends on the application. "Preferred" and "alternate" should be used when this specification applies to a stand-by generator system as defined in NFPA 70. The same terminology should be used when switching between different sets of service entrance conductors or between feeders supplied by different transformers. "Normal" and "emergency" should be used for the emergency system application described in NFPA 70.

This specification covers conventional, standard,

commercially available equipment appropriate for most Department of Army/Air Force applications. Special applications may require synchronized, closed-transition transfer, or withdrawal features to facilitate rapid maintenance or repair. Manufacturers of standard ATS may be able to provide ATS for special applications. The cost must be compared with the cost of conventional synchronizing equipment and circuit breakers with withdrawal features, as applicable. The decision should be based on life-cycle costs.

1.1 REFERENCES

NOTE: Issue (date) of references included in project specifications need not be more current than provided by the latest guide specification. Use of SpecsIntact automated reference checking is recommended for projects based on older guide specifications.

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B 117 (2002) Operating Salt Spray (Fog) Apparatus

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.13 (1990; R 1995) Low-Voltage AC Power Circuit Breakers Used in Enclosures

IEEE C37.90.1 (2002) Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus

IEEE C62.41 (1991) Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits

IEEE Std 602 (1996) Recommended Practice for Electric Systems in Health Care Facilities - White Book

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1 (2000) Industrial Control and Systems: General Requirements

NEMA ICS 10 (1999; R 2000) Industrial Control and Systems: AC Transfer Switch Equipment

NEMA ICS 2 (2000) Industrial Controls and Systems: Controllers, Contactors, and Overload Relays Rated Not More than 2000 Volts AC

or 750 Volts DC

NEMA ICS 4 (2000) Industrial Control and Systems:
Terminal Blocks

NEMA ICS 6 (1993; R 2001) Industrial Control and
Systems: Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 110 (2002) Emergency and Standby Power Systems

NFPA 70 (2002) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1008 (1996; Rev thru Aug 2003) Transfer Switch
Equipment

UL 1066 (1997) Low-Voltage AC and DC Power Circuit
Breakers Used in Enclosures

1.2 SUBMITTALS

NOTE: Submittals must be limited to those necessary
for adequate quality control. The importance of an
item in the project should be one of the primary
factors in determining if a submittal for the item
should be required.

A "G" following a submittal item indicates that the
submittal requires Government approval. Some
submittals are already marked with a "G". Only
delete an existing "G" if the submittal item is not
complex and can be reviewed through the Contractor's
Quality Control system. Only add a "G" if the
submittal is sufficiently important or complex in
context of the project.

For submittals requiring Government approval on Army
projects, a code of up to three characters within
the submittal tags may be used following the "G"
designation to indicate the approving authority.
Codes for Army projects using the Resident
Management System (RMS) are: "AE" for
Architect-Engineer; "DO" for District Office
(Engineering Division or other organization in the
District Office); "AO" for Area Office; "RO" for
Resident Office; and "PO" for Project Office. Codes
following the "G" typically are not used for Navy
projects.

Submittal items not designated with a "G" are
considered as being for information only for Army
projects and for Contractor Quality Control approval
for Navy projects.

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Switches

Schematic, external connection, one-line schematic and wiring diagram of each ATS assembly. Interface equipment connection diagram showing conduit and wiring between ATS and related equipment. Device, nameplate, and item numbers shown in list of equipment and material shall appear on drawings wherever that item appears. Diagrams shall show interlocking provisions and cautionary notes, if any. Operating instructions shall be shown either on one-line diagram or separately. Unless otherwise approved, one-line and elementary or schematic diagrams shall appear on same drawing.

Equipment Installation

Dimensioned plans, sections and elevations showing minimum clearances, weights, and conduit entry provisions for each ATS.

SD-03 Product Data

Material Equipment

List of proposed equipment and material, containing a description of each separate item.

SD-06 Test Reports

Testing[; G][; G, [____]]

A description of proposed field test procedures, including proposed date and steps describing each test, its duration and expected results, not less than [____] weeks prior to test date.

Certified factory and field test reports, within 14 days following completion of tests. Reports shall be certified and dated and shall demonstrate that tests were successfully completed prior to shipment of equipment.

SD-07 Certificates

Equipment Material

Certificates of compliance showing evidence of UL listing and conformance with applicable NEMA standards. Such certificates are not required if manufacturer's published data, submitted and approved, reflect UL listing or conformance with applicable NEMA standards.

Switching Equipment

Evidence that ATS withstand current rating (WCR) has been coordinated with upstream protective devices as required by UL 1008.

Upon request, manufacturer shall also provide notarized letter certifying compliance with requirements of this specification, including withstand current rating.

SD-10 Operation and Maintenance Data

Switching Equipment Instructions

[Six] [_____] copies of operating manual outlining step-by-step procedures for system startup, operation, and shutdown. Manual shall include manufacturer's name, model number, service manual, parts list, and brief description of equipment and basic operating features. Manufacturer's spare parts data shall be included with supply source and current cost of recommended spare parts. [Six] [_____] copies of maintenance manual listing routine maintenance, possible breakdowns, repairs, and troubleshooting guide. Manual shall include simplified wiring and control diagrams for system as installed.

1.3 GENERAL REQUIREMENTS

1.3.1 Standard Product

Material and equipment shall be standard products of a manufacturer regularly engaged in manufacturing the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. The experience use shall include applications in similar circumstances and of same design and rating as specified ATS. Equipment shall be capable of being serviced by a manufacturer-authorized and trained organization that is, in the Contracting Officer's opinion, reasonably convenient to the site.

1.3.2 Nameplate

Nameplate showing manufacturer's name and equipment ratings shall be made of corrosion-resistant material with not less than 3 mm 1/8 inch tall characters. Nameplate shall be mounted to front of enclosure and shall comply with nameplate requirements of NEMA ICS 2.

1.4 SERVICE CONDITIONS

NOTE: Provide seismic requirements, if a Government designer (Corps office or A/E) is the Engineer of Record, and show on the drawings. Delete the bracketed phrase if seismic details are not provided. Sections 13080, 15070A and 16070A, properly edited, must be included with the contract documents.

Seismic requirements shall be as specified in Sections 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT, 15070A SEISMIC PROTECTION FOR

MECHANICAL EQUIPMENT and 16070A SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT [as indicated]. ATS shall be suitable for prolonged performance under following service conditions:

- a. Altitude: [_____] m feet above mean sea level.
- b. Relative Humidity: [_____] percent maximum, continuous.
- c. Temperature: Minus [_____] to [_____] degrees C. F.
- d. Seismic Parameters: [_____] .

PART 2 PRODUCTS

NOTE: Normally, switched poles should be limited to three for three-phase, three- or four-wire systems.

Switching of neutral (fourth pole) should only be considered where emergency/alternate power source is a separately derived system; where ground potential at the two voltage sources differs significantly; or where NFPA 70 requires ground fault protection for equipment.

Sizing of neutral bus, pole, contacts, and terminations should consider harmonic currents. Nonlinear loads such as switch mode power supplies, electronic ballasts, personal computers, laser printers, variable frequency motor drives, static uninterruptible power supplies, and other equipment described in IEEE 519 and 1100 will produce harmonic currents with high zero phase sequence components which are additive in neutral circuit. Neutral ampere rating may need to be higher than phase contacts (200 percent is typical for 100% harmonic load).

2.1 AUTOMATIC TRANSFER SWITCH (ATS)

NOTE: Calculate short-circuit current available at ATS supply terminals. Caution: emergency source may be capable of supplying larger amount of short-circuit current. Ampere interrupting capacity (AIC) rating of circuit protective devices on ATS supply side should equal or exceed available short-circuit current. Since ATS WCR should be equal to or greater than AIC rating of upstream circuit protective devices, care should be used in determining available AIC to avoid high costs of over-rated ATS. WCRs listed in UL 1008 should be used when fault currents are less than WCR listed. However, in no case should WCR be less than 10,000 amperes.

Where closed-transition transfer is required, coordinate system design requirements with power supplier.

Delete BP/IS requirements if not applicable. Delete
reference to IEEE Std 602 if not applicable.

ATS shall be electrically operated and mechanically held in both operating positions. ATS shall be suitable for use in [emergency systems] [standby systems] described in NFPA 70. ATS shall be UL listed. ATS shall be manufactured and tested in accordance with applicable requirements of IEEE C37.90.1, IEEE C37.13, IEEE C62.41, IEEE Std 602, NEMA ICS 1, NEMA ICS 2, NEMA ICS 10, UL 1008 and UL 1066. ATS shall conform to NFPA 110. To facilitate maintenance, manufacturer's instruction manual shall provide typical maximum contact voltage drop readings under specified conditions for use during periodic maintenance. Manufacturer shall provide instructions for determination of contact integrity. ATS shall be rated for continuous duty at specified continuous current rating. ATS shall be fully compatible and approved for use with BP/IS specified. BP/IS shall be considered part of ATS system. ATS shall have following characteristics:

- a. Voltage: [_____] volts [dc] [ac].
- b. Number of Phases: [One] [Two] [Three].
- c. Number of Wires: [Two] [Three] [Four].
- d. Frequency: [25] [50] [60] [400] Hz.
- e. Poles: [Two switched] [Three switched] [and solid neutral] [and switched neutral] [_____] .
- f. ATS WCR: Rated to withstand short-circuit current of [_____] amperes, RMS symmetrical.
- g. Nonwelding Contacts: Rated for nonwelding of contacts when used with upstream feeder overcurrent devices shown and with available fault current specified.
- h. [Main] [Main and Neutral] Contacts: Contacts shall have silver alloy composition. [Neutral contacts shall have same continuous current rating as main or phase contacts] [Neutral contact continuous current rating shall be not less than twice the rating of main or phase contacts].

2.1.1.1 Override Time Delay

NOTE: Consult ATS manufacturers' literature for feature availability, timing interval range, and pickup and dropout settings. Insert proper values.

Recommended values for normal applications are shown in brackets but may be changed for other design conditions. Where values are not shown or different settings are required, specify values and settings.

ATS operation should not be initiated during low voltage conditions attributed to a fault or to momentary dips or excursions (transients) in normal or preferred power source. Time delay before

monitored source override should exceed associated circuit breaker tripping time and normal system voltage instability periods. Minimum of 1 second is recommended. Where utility type power source is used and application is standard, monitoring devices should drop out at 85 percent of nominal value and pick up at 90 percent. Where precise power is monitored, protection should be specified with monitoring devices set to pick up at 95 and drop out at 90 percent of nominal. In applications requiring closer regulation, solid state or microprocessor arrangement may be used with pickup and dropout response adjusted as close as 2 percent differential. However, for these applications a redundant uninterruptible power supply should be considered.

Delete generator reference if not required.

Time delay to override monitored source deviation shall be adjustable from [0.5] [_____] to [6] [_____] seconds and factory set at [1] [_____] second[s]. ATS shall monitor phase conductors to detect and respond to sustained voltage drop of [25] [15] [_____] percent of nominal between any two [normal] [preferred] source conductors and initiate transfer action to [alternate] [emergency] source and start engine driven generator after set time period. Pickup voltage shall be adjustable from [85] [_____] to 100 percent of nominal and factory set at [90] [_____] percent. Dropout voltage shall be adjustable from [75] [_____] to [98] [_____] percent of pickup value and factory set at [85] [_____] percent of nominal.

2.1.2 Transfer Time Delay

NOTE: Use nonzero setting where multiple ATS require staggered application of load steps to alternate or emergency source.

Time delay before transfer to [alternate] [emergency] power source shall be adjustable from [0] [_____] to [5] [_____] minutes and factory set at [0] [_____] minutes. ATS shall monitor frequency and voltage of [alternate] [emergency] power source and transfer when frequency and voltage are stabilized. Pickup voltage shall be adjustable from [85] [_____] to 100 percent of nominal and factory set at [90] [_____] percent. Pickup frequency shall be adjustable from [90] [_____] to 100 percent of nominal and factory set at [90] [_____] percent.

2.1.3 Return Time Delay

Time delay before return transfer to [normal] [preferred] power source shall be adjustable from [0] [_____] to [30] [_____] minutes and factory set at [30] [_____] minutes. Time delay shall be automatically defeated upon loss or sustained undervoltage of [alternate] [emergency] power source, provided that [normal] [preferred] supply has been restored.

2.1.4 Engine Shutdown Time Delay

NOTE: Omit this paragraph if there is no generator in transfer scheme. Consult ATS manufacturers' literature for feature availability, timing interval range, and pickup and dropout settings. Insert proper values. Recommended values for normal applications are shown in brackets but may be changed for other design conditions. Where values are not shown or different settings are required, specify values and settings.

Time delay shall be adjustable from [0] [_____] to [30] [_____] minutes and shall be factory set at 10 [_____] minutes.

2.1.5 Exerciser

NOTE: Use this paragraph when automatic system exercising is required by nature of loads and desired reliability. Automatic system exerciser is recommended when diesel engine driven generator set is used, but only if automatic feature is manually initiated and can be manually overridden during exercise period to return ATS to normal or preferred source. Omit this paragraph if there is no generator in transfer scheme.

Consult ATS manufacturers' literature for feature availability, timing interval range, and pickup and dropout settings. Insert proper values for application.

Provide a generator exerciser timer. Run times shall be user programmable.

The generator exerciser shall be selectable between load transfer and engine run only, and shall have a fail-safe feature that will retransfer the ATS to [normal] [preferred] during the exercise period.

2.1.6 Auxiliary Contacts

[Two] [_____] normally open and [two] [_____] normally closed auxiliary contacts rated at [10] [15] [_____] amperes at [120] [480] [_____] volts shall operate when ATS is connected to [normal] [preferred] power source, and [two] [_____] normally open and [two] [_____] normally closed contacts shall operate when ATS is connected to [alternate] [emergency] source.

2.1.7 Supplemental Features

NOTE: Delete features when not required. Delete in-phase monitor unless required to eliminate or reduce transients during switching of large inductive loads while limiting time delays associated with ATS transfer in both directions.

ATS shall be furnished with the following:

- a. Engine start contact.

- b. [Alternate] [Emergency] source monitor.
- c. Test switch to simulate normal power outage.
- d. Voltage sensing. Pickup voltage adjustable from 85 to 100 percent of nominal; dropout adjustable from 75 to 98 percent of pickup.
- e. Time delay bypass switch to override return time delay to normal.
- f. Manual return-to-normal switch.
- g. Means shall be provided in the ATS to insure that motor/transformer load inrush currents do not exceed normal starting currents. This shall be accomplished with either in-phase monitoring, time-delay transition, or load voltage decay sensing methods. If manufacturer supplies an in-phase monitoring system, the manufacturer shall indicate under what conditions a transfer cannot be accomplished. If the manufacturer supplies a time-delay transition system, the manufacturer shall supply recommendations for establishing time delay. If load voltage decay sensing is supplied, the load voltage setting shall be user programmable.

2.1.8 Operator

Manual operator conforming to UL 1008 shall be provided, and shall incorporate features to prevent operation by unauthorized personnel. ATS shall be designed for safe manual operation under full load conditions. If manual operation is accomplished by opening the door, then a dead-front shall be supplied for operator safety.

2.1.9 Override Switch

NOTE: Override switch allows operator to switch load from primary source to alternate or emergency source and keep it connected to that source. It is useful for users who prefer alternate or emergency source under certain operating conditions, such as lightning storms or during maintenance on primary source. Override switch will be specified only when nature of mission and operators' expertise make it desirable to control power source. User must ensure that adequate administrative and operational controls exist to prevent load from being inadvertently left in alternate or emergency mode. This paragraph should be omitted for ordinary applications since override switch significantly alters ATS function.

Override switch shall bypass automatic transfer controls so ATS will transfer and remain connected to [alternate] [emergency] power source, regardless of condition of [normal] [preferred] source. [If [alternate] [emergency] source fails and [normal] [preferred] source is available, ATS shall automatically retransfer to [normal] [preferred] source.]

2.1.10 Green Indicating Light

A green indicating light shall supervise/provide [normal] [preferred] power source switch position indication and shall have a nameplate engraved [NORMAL] [PREFERRED].

2.1.11 Red Indicating Light

A red indicating light shall supervise/provide [alternate] [emergency] power source switch position indication and shall have a nameplate engraved [ALTERNATE] [EMERGENCY].

2.2 BY-PASS/ISOLATION SWITCH (BP/IS)

NOTE: Omit this section if no by-pass/isolation switch is required. Delete reference to generator starting where a generator is not used as alternate source.

2.2.1 Design

Bypass/isolation switch (BP/IS) shall permit load by-pass to either [normal] [preferred] or [alternate] [emergency] power source and complete isolation of associated ATS, independent of ATS operating position. BP/IS and associated ATS shall be products of same manufacturer and shall be completely interconnected and tested at factory and at project site as specified. BP/IS shall be manufactured, listed, and tested in accordance with paragraph AUTOMATIC TRANSFER SWITCH (ATS) and shall have electrical ratings that exceed or equal comparable ratings specified for ATS. Operating handles shall be externally operated and arranged so that one person can perform the bypass and isolation functions through the operation of a maximum of two handles within 5 seconds. The ATS shall have provisions for locking in the isolation position. Handle for manual operation shall be permanently attached to operating mechanism. BP/IS operation shall be accomplished without disconnecting switch load terminal conductors. Isolation handle positions shall be marked with engraved plates or other approved means to indicate position or operating condition of associated ATS, as follows:

- a. Indication shall be provided to show that ATS section is providing power to the load.
- b. Indication shall be provided of ATS isolation. The ATS controls shall remain functional with the ATS isolated or in bypass mode to permit monitoring of the normal power source [and automatic starting of the generator in the event of a loss of the normal power source]. In the isolated mode, the bypass section shall be capable of functioning as a manual transfer switch to transfer the load to either power source. The ATS shall be capable of undergoing functional operation testing without service interruption. The ATS may also be completely removed from the enclosure, if required for maintenance or repair, while the bypass section continues to power the load.

2.2.2 Switch Construction

Bypass/isolation switch shall be constructed for convenient removal of

parts from front of switch enclosure without removal of other parts or disconnection of external power conductors. Contacts shall be as specified for associated ATS, including provisions for inspection of contacts without disassembly of BP/IS or removal of entire contact enclosure. To facilitate maintenance, manufacturer shall provide instructions for determination of contact integrity. BP/IS and associated ATS shall be interconnected with suitably sized copper bus bars silver-plated at each connection point, and braced to withstand magnetic and thermal forces created at WCR specified for associated ATS.

2.3 ENCLOSURE

**NOTE: Designer must provide normal power source to
ATS when specifying enclosure heater.**

If ATS assembly is provided, equipment should be installed in free-standing, floor-mounted enclosure as specified, except when manufacturer incorporates switch specified in wall-mounted enclosure as standard construction. However, in some applications it is advisable to specify that ATS or BP/IS components be mounted in separate switchboard, switchgear, motor control center, or other enclosure. Designer shall investigate conditions and options and specify accordingly.

ATS and accessories shall be installed in [wall-mounted] [free-standing, floor-mounted], [ventilated] [unventilated] NEMA ICS 6, Type [1] [3R] [4] [12], smooth sheet metal enclosure constructed in accordance with applicable requirements of UL 1066 and/or UL 1008. [Intake vent shall be screened and filtered. Exhaust vent shall be screened.] [Door shall have suitable hinges, locking handle latch, and gasketed jamb.] [Thermostatically controlled heater shall be provided within enclosure to prevent condensation over temperature range stipulated in paragraph SERVICE CONDITIONS.] Metal gauge shall be not less than No. 14. Enclosure shall be equipped with at least two approved grounding lugs for grounding enclosure to facility ground system using No. [4] [_____] AWG copper conductors. Factory wiring within enclosure and field wiring terminating within enclosure shall comply with NFPA 70. If wiring is not color coded, wire shall be permanently tagged or marked near terminal at each end with wire number shown on approved detail drawing. Terminal block shall conform to NEMA ICS 4. Terminals shall be arranged for entrance of external conductors from [top] [bottom] [top and bottom] of enclosure as shown. Main switch terminals, including neutral terminal if used, shall be pressure type suitable for termination of external [copper] [aluminum] conductors shown.

2.3.1 Construction

Enclosure shall be constructed for ease of removal and replacement of ATS components and control devices from front without disconnection of external power conductors or removal or disassembly of major components. Enclosure of ATS with BP/IS shall be constructed to protect personnel from energized BP/IS components during ATS maintenance.

2.3.2 Cleaning and Painting

Both the inside and outside surfaces of an enclosure, including means for fastening, shall be protected against corrosion by enameling, galvanizing, plating, powder coating, or other equivalent means. Protection is not required for metal parts that are inherently resistant to corrosion, bearings, sliding surfaces of hinges, or other parts where such protection is impractical. Finish shall be manufacturer's standard material, process, and color and shall be free from runs, sags, peeling, or other defects. An enclosure marked Type 1, 3R, 4 or 12 shall be acceptable if there is no visible rust at the conclusion of a salt spray (fog) test using the test method in ASTM B 117, employing a 5 percent by weight, salt solution for 24 hours. Type 4X enclosures are acceptable following performance of the above test with an exposure time of 200 hours.

2.4 TESTING

2.4.1 Factory Testing

A prototype of specified ATS shall be factory tested in accordance with UL 1008. In addition, factory tests shall be performed on each ATS as follows:

- a. Insulation resistance test to ensure integrity and continuity of entire system.
- b. Main switch contact resistance test.
- c. Visual inspection to verify that each ATS is as specified.
- d. Mechanical test to verify that ATS sections are free of mechanical hindrances.
- e. Electrical tests to verify complete system electrical operation and to set up time delays and voltage sensing settings.

2.4.2 Factory Test Reports

Manufacturer shall provide three certified copies of factory test reports.

2.5 FACTORY TESTING (MEDICAL FACILITIES)

**NOTE: The factory tests sequence listed below is
required for Medical Facilities only.**

The factory tests for ATS and By-Pass/Isolation switches used in medical facilities shall be conducted in the following sequence:

- a. General
- b. Normal
- c. Overvoltage
- d. Undervoltage
- e. Overload
- f. Endurance
- g. Temperature Rise
- h. Dielectric Voltage-Withstand
- i. Contact Opening
- j. Dielectric Voltage-Withstand (Repeated)

- k. Withstand
- l. Instrumentation and Calibration of High Capacity
- m. Closing
- n. Dielectric Voltage-Withstand (Repeated)
- o. Strength of Insulating Base and Support

2.5.1 Viewing Ports

ATS and BP/IS switches shall be of draw-out construction. Viewing ports to inspect the contacts without requiring disassembly shall be provided.

2.5.2 Operating Handles

The operating handles shall be externally operated, and designed and constructed not to stop in an intermediate or neutral position during operation, but shall permit load by-pass and transfer switch isolation in no more than two manual operations which can be performed by one person in 5 seconds or less. The transfer speed will be independent of the operational speed of the switch handle or handles.

PART 3 EXECUTION

3.1 INSTALLATION

ATS shall be installed as shown and in accordance with approved manufacturer's instructions.

3.2 INSTRUCTIONS

Manufacturer's approved operating instructions shall be permanently secured to cabinet where operator can see them. One-line and elementary or schematic diagram shall be permanently secured to inside of front enclosure door.

3.3 SITE TESTING

NOTE: Design should incorporate ATS testing in overall test of complete emergency system under load, including ATS and generators. Delete BP/IS reference if not required.

Following completion of ATS installation and after making proper adjustments and settings, site tests shall be performed in accordance with manufacturer's written instructions to demonstrate that each ATS functions satisfactorily and as specified. Contractor shall advise Contracting Officer not less than 5 working days prior to scheduled date for site testing, and shall provide certified field test reports within 2 calendar weeks following successful completion of site tests. Test reports shall describe adjustments and settings made and site tests performed. Minimum operational tests shall include the following:

- a. Insulation resistance shall be tested, both phase-to-phase and phase-to-ground.
- b. Power failure of normal source shall be simulated by opening upstream protective device. This test shall be performed a minimum of five times.

- c. Power failure of emergency source with normal source available shall be simulated by opening upstream protective device for emergency source. This test shall be performed a minimum of five times.
- d. Low phase-to-ground voltage shall be simulated for each phase of normal source.
- e. Operation and settings shall be verified for specified ATS features, such as override time delay, transfer time delay, return time delay, engine shutdown time delay, exerciser, auxiliary contacts, and supplemental features.
- f. Manual and automatic ATS and BP/IS functions shall be verified.

-- End of Section --