Application Guide

- for -

Fire Pump Power Transfer Switches

- for use with -

Electric Motor Driven Fire Pumps

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This document attempts to outline the salient requirements for the selection co-ordination and application of fire pump transfer switches upstream of fire pump controllers in order to meet the requirements of NFPA-20 *Standard for the Installation of Stationary Pumps for Fire Protection*.

Power Transfer Switches "Arrangement I" - Combined Tranfer Switch & Fire Pump Controller

Listed Combination Fire Pump Controller and Power Transfer Switch" units eliminate the majority of the required coordination since it is accomplished by the manufacturers of these combination units. Moreover, this coordination is examined, verified, and documented by both Underwriters Laboratories, Inc. and by Factory Mutual Laboratories. This is the simplest and most verifiable way to meet NFPA-20.

Power Transfer Switches "Arrangement II" - Separate Transfer Switch & Fire Pump Controller

This arrangement consists of a listed Single Power Source (non-transfer switch) Fire Pump Controller and a listed "Fire Pump Power Transfer Switch". NFPA-20 section 7-1.2.1 makes it clear that a transfer switch used for supplying power to a fire pump must be *listed for the service*. To wit: “All controllers and transfer switches shall be specifically listed for electric motor-driven fire pump service”. Section 7-8.3.1 states the same requirement. Most U.L. listed transfer switches are listed under U.L. Standard UL-1008 and are not listed as Fire Pump equipment. A listed transfer switch is not a listed Fire Pump transfer Switch unless the *U.L.* and the *F.M.* label so states. It is important to note that there are around 45 manufacturers of U.L. listed "Transfer Switches" in a number of different categories. As of this writing, there are only four (4) Listed manufacturers of "Transfer Switches for Use in Fire Pump Motor Circuits" -- U.L. Category Control Number (Guide) "XNVE". The U.L. label must give the category of the listing, and either the name of the category or it's U.L. "Guide" number. Any other transfer switch, listed or otherwise, is not suitable for use in a fire pump circuit. The safest course is to consult the U.L. "Brown Book" (*Fire Protection Equipment* listing book) or the *Factory Mutual Approval Guide* or contact the agency directly. The U.L. listings are available on the Web at: http://www.ul.com/database/. If the transfer switch is not in both the U.L. "Brown Book" and the F.M. "Approval Guide", then it is *not* a listed and approved "Fire Pump Transfer Switch".

Location: NFPA-20, Section 6-6.4 specifically requires that "Transfer of power to the fire pump controller between the normal supply and one alternate supply shall take place within the pump room". Hence, the Fire Pump Transfer Switch must be installed in the same pump room or pump house as the fire pump controller to which it is connected.

Number Required: When the requirement for alternate power for one or more fire pumps exists, each fire pump controller requires its own *dedicated* transfer switch (NFPA-02, Section 7-8.2.3). It is not permissible for more than one fire pump (controller) to be fed from a transfer switch.

Coordinating Withstand (Short Circuit Current) Ratings: The same considerations for both of the WIC (short circuit) ratings of the transfer switch apply the same as they do to a combination Power Transfer Switch and Fire Pump Controller. With a separate transfer switch, however, the coordination is not done by manufacturer of either the controller or the transfer switch. It is up to "others" to do so.

Section 7-8.2.2(b) requires that "An isolating switch, or service disconnect where required, ahead of the normal input terminals of the transfer switch" be supplied. This will be the case for any currently listed transfer switch unless the service device (a circuit breaker, usually) is supplied as part of the transfer switch. Note, however, that this is usually an *option* and not standard equipment. In any event, this device must meet the 600% rule that requires that any such overcurrent protective device "shall be selected or set to carry indefinitely the sum of the *locked rotor current* of the fire pump motor" plus any additional connected loads. See NFPA-20, section 6-3.2.2.3(a) and section 7-8.2.2(c). See also NFPA-70 (the NEC) section 695-4(b)(1), section 695-5(b) and section 695-5(c)(2). These all require nothing short of locked rotor sizing of any upstream protection.

This is a very important limitation to the transfer switch WIC rating since the size of the upstream protection must not exceed the maximum upstream device size qualification for the transfer switch WIC rating. With separate transfer switches, this applies to *both* incoming sides, Normal and Emergency, unless circuit breakers are supplied with as part of the transfer switch. This is often *not* the case for economic reasons. As a result, the coordination is many times missing or incorrect. A dangerous and unreliable situation then ensues.

Section 7-8.3.4 requires that the transfer switch be sized at only 115% of the motor FLA current. However, the transfer switch will almost always have to be *larger* in order to meet the maximum size rating of the upstream circuit breaker (or fuses). Case in point: A 100 Hp motor at 460 Vac having a FLA of 120 amperes. The upstream overcurrent (on the normal side, at least) is 120 x 600% or 720 amps, which requires an 800 amp device. The 120 FLA x 115% = 138 amperes which would seem to require a transfer switch rated at only 150 amps. While this may satisfy the *Thermal* sizing requirements, it likely would *not* satisfy the WIC coordination requirements.

Coordinating Withstand (Short Circuit Current) Ratings - cont'd:
For a hypothetical example, consider a manufacturer "X" who qualifies his WIC rating with a maximum upstream breaker size of 250 amps. It can *not* be used here, since this is *smaller* than the 800 amp upstream breaker. The transfer switch must be *up-sized* until the required maximum upstream breaker size equals or exceeds the required 600% breaker. In this case, the transfer switch may have to be a 400 amp transfer switch in order to meet the above requirement. In most installations, the transfer switch size will be determined by the withstand ratings, not the 115% thermal requirement. A summary of this example follows.

Transfer Switch Sizing Example for 100 Hp at 460 Vac

Motor Hp	Motor FLA	X 115% Thermal	Thermal Sizing	X 600% Upstream	Breaker Size	WIC Coord. Switch Size
100 Hp	124 amps	143 amps	150 amp	744 amp	800 amp	400 amp

The matter is further complicated by the fact that the listed transfer switch manufacturers typically have two or three different WIC -versus- upstream rating charts. One is called the "any breaker" or the "any molded case" breaker, meaning any U.L. listed molded case circuit breaker ratings. This will be the lower of the transfer switch WIC ratings. Again, the Interrupting Capacity of the circuit breaker is neither sufficient nor always relevant in this coordination. It does need to exceed the available fault current; but, it is not the WIC rating of *any* downstream device nor does it directly establish those ratings. The second category is the "Specific Breaker or Coordinated Breaker" ratings. These will also have maximum allowed upstream breaker sizes. The third category is the "Fuse" category, which will also have maximum allowed sizes. Using current limiting breakers or fuses may allow the use of a smaller switch, but at the expense of a costlier upstream device(s).

Coordinating Phase Reversal Switching: The transfer switch is required to switch to Emergency upon reversal of the normal source power. This may be supplied as standard with some; but not all transfer switches. The phase reversal contacts in the fire pump controller may already be used for the required remote alarm circuit. Thus, either the controller or the transfer switch will need to be modified.

Coordinating Alternate Source Isolating Switch: When the alternate source is a second utility, another upstream service and overcurrent device like the one described above is required and must also meet the 600% sizing rules in accordance with NFPA-20 section 7-8.2.2(c). Otherwise, for the more typical gen-set alternate power source installations, an emergency side isolating switch is required. See NFPA-20 section 7-8.2.2(d). Again, due to cost, such a switch is *not* standard equipment on all listed fire pump transfer switches. It must either be ordered as an option with the switch, or purchased and installed separately. In any case, it must meet the following requirements:

Coordinating Alternate Source Isolating Switch - cont'd:

(1) It shall be lockable in the "ON" position[1].
(2) A placard with large (1.0", 25.4 mm) lettering must be affixed to the outside of this switch reading: "Fire Pump Isolating Switch".
(3) Another placard must be mounted in the pump room "adjacent to the fire pump controller" stating the location of this switch and the location of the key for unlocking it.
(4) The isolating switch must be supervised to indicate when it is "not closed". Four methods are allowed and listed in the standard.
(5) The supervision shall operate an audible and visual (alarm light) on the transfer switch and also at a remote point where required. This is a new requirement added to the 1999 edition of NFPA-20. This matches the similar requirement for listed combination (Arrangement "I") units. This will require extra circuitry within the transfer switch and wired to supervisory contacts within the isolating switch. One or the other will also need to have the extra contacts for the remote alarm circuit.

Required Alarm Circuits: The transfer switch will usually have at least one set of "position indicating" remote alarm contacts as standard. It may or may not have the position indicating lights (most will) as standard. It won't likely have the isolating switch alarm light and contacts unless it is ordered with an isolating switch as part of the transfer switch.

Generator Start Circuit Over-ride: The transfer switch will normally have the engine start contacts as standard equipment. However, it won't normally have the engine start over-ride (lock-out) means unless it is ordered with an isolating switch option. See NFPA-20 section 7-8.3.13(3). This is to prevent undesired and/or unexpected starting of the engine generator set by this transfer switch when the isolating switch (wherever it is located) is opened. Note that other transfer switches can and will start the gen-set when a power failure or phase loss occurs.

Higher-than-Normal In-rush Currents: Section 7-8.3.10 of NFPA-20 requires that "Means shall be provided to prevent higher-than-normal in-rush currents when transferring the fire pump motor from one source to the other. As discussed in the above section on combination units, there are currently three methods used for the purpose, two of which must be part of this transfer switch. It must either be of the "Program Neutral" type or it must have signaling circuitry (contacts) to momentarily shut-down the fire pump motor. Neither one is normally standard equipment. In addition, in order to use the second (momentary motor shut-down) the fire pump controller must be equipped with remote motor (pump) lock-out circuitry, also not always standard equipment. This too requires coordination.

In summary, here's what is usually included with a listed fire pump transfer switch[2]:

1) NEMA 2, drip proof only, enclosure,
2) The Manual (mechanical) transfer means,
3) The normal side three voltage sensors,
4) The alternate side single phase voltage and frequency sensor (for gen-set applications),
5) The Manual (mechanical) transfer means,
6) The two Position Indicator lights, maybe,
7) The Engine Start delay timer and the Re-Transfer delay timer,
8) The Engine Start contacts,
9) The Test (Transfer) switch (pushbutton), maybe.

Here's what is usually not supplied as standard equipment:

a) Three phase voltage sensing on the alternate source side for Dual (Second) Utility jobs,
b) The Normal Side Service Disconnect and overcurrent protection fuses or breaker,
c) A second service entrance device for dual utility jobs,
d) Otherwise, the required emergency side Isolating Switch which is:
    1) Lockable "ON"
    2) Having an external Fire Pump Isolating Switch" placard,
    3) A placard next to the controller giving the location of this isolating switch
    4) Supervision of the isolating switch by one of the four means given
e) Audible and visible alarm to indicate Isolating Switch Open,
f) Isolating Switch contacts for remote alarm,
g) Means to prevent Higher-than-Normal motor in-rush currents,
h) Phase reversal sensing and transfer circuitry.
i) Although not required, the Bypass switch may or may not be standard equipment.

Finally, the coordination of both the Normal Source side and the Alternate Source side *Short Circuit Withstand* coordination must be performed by someone. This coordination must include: 1) any upstream protective device(s), 2) the transfer switch, 3) the fire pump controller, and 4) the power circuit Available Short Circuit Current. Unfortunately, miscoordination is often not discovered until it uncovered during an inspection. Worse yet, it isn't always discovered even then. Installations that aren't coordinated for Withstand factors are prone to be both unreliable and unsafe from a personnel and fire hazard standpoint.

The alternative "Arrangement I" Listed Combination Fire Pump Controller and Power Transfer Switch" units eliminate the majority of the required coordination since it is accomplished by the manufacturers of these combination units. Moreover, this coordination is examined, verified, and documented by both Underwriters Laboratories, Inc. and by Factory Mutual Laboratories.

Notes:

1) All listed enclosed isolating or safety switches can be locked in the "OFF" position; but, not all of them are capable of being locked in the "ON" position. Check before ordering or specifying.
2) Disclaimer: This is best information at time of writing. In any case, all of this must be verified for each installation.