4.4 Essential Electrical System Requirements - Type 1.

4.4.1 Sources (Type 1 EES).

4.4.1.1 On-Site Generator Set.

4.4.1.1.1\* Design Considerations. Dual sources of normal

power shall be considered but shall not constitute an alternate

source of power as described in this chapter.

4.4.1.1.1.1 Distri bution system arrangemen Ls shall be designed

t.o minimize interntptions to the electrical systems clue

to internal failures by the use of adequately rated equipment.

4.4.1.1.1.2 The following factors shall be considered in the

design of the distribution system:

(1) Abnormal voltages such as single phasing of three-phase

utilization equipment, switching and/ or lightning surges,

voltage reductiom, and so forth

(2) Capability of achieving the fastest possible restoration of

any given circuit(s) af'ter clearing a hult

(3) Ellens of future changes, such as increased loading and/or

supply capacity

(4) Stability and power capability of the prime mover during

and after abnormal conditions

(5) "Sequence reconnection of loads to avoid large current

inrushes that trip overcurrent devices or overload the

generator(s)

(6) Bypass arrangements La permit testing and maintenance

of system components that could not otherwise be maintained

without disruption of important hospital functions

(7) Effects of any harmonic currents on neutral conductors

and equipment

4.4.1.1.2 Current-sensing devices, phase and ground, shall be

selected to minimize the extent of intelTuption to the eleco-ical

system due to abnormal current caused by overload

and/ or short circuits.

4.4.1.1.3 Generator load-shed circuits designed f~)r the pUl~

pose of load reduction or for load priority systems shall not

shed life safet.v branch loads, critical branch loads serving critical

care are~s, medical air compressors, medical-sl~rgical

vacuulll pumps, pressure maintenance (jockey) pump(s) for

water-based tire protection systems, generator fuel pumps, or

other generator accessories.

4.4.1.1.4 Essential electrical systcms shall have a minimum of

two independent sources of power: a normal source generally

supplying the entire electrical system and one or more alternate

sources for use when the normal source is interrupted. •

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4.4.1.1.5 Where the normal source consists of generating

units on the premises, the alternate source shall be either another

generating set or an external utility service.

4.4.1.1.6 General. Generator sets installed as an alternate

source of power ti)r essential electrical systems shall be designed

to meet the reguirements of such service.

4.4.1.1.6.1 Type I and Type 2 essential electrical system

power sources shall be classified as Type 10, Class X, Levell

generator sets per NFPA 110, Stmularri jin' bnclgnu:y and

Standby POWN Systems.

4.4.1.1.6.2 Type 3 essential electrical system power sources

shall be classified as Type 10, Class X, Level 2 generator sets

per NFPA 110, StrmrLardjin'/:'lIlelgenr:y and Standby Power Systr!flls.

4.4.1.1.7 Uses for Essential Electrical System.

4.4.1.1.7.1 The generating eguipment used shall be either

reserved exclusively for sllch service or normally used for

other purposes of peak dernand control, internal voltage control,

load relief for the external utility, or cogeneration. If normally

used for the other purposes listed above, two or more

sets shall be installed, such that the maximum actual demand

likely to be produced by the connected load of the emergency

system as well as medical air compressors, medical-surgical

vacuum pumps, electrically operated fire pumps, jockey

pumps, fuel pumps, and generator accessories shall be met

with the largest single generator set out-of~service, The alternate

source of emergency power for illumination and identiIication

of means of egress shall be the essential electrical system,

The alternate power source for fire protection signaling

systems shall he the essen tial electrical systems,

4.4.1.1.7.2 A single generator set thelt operates the essential

electrical system shall be permitted to be part of the system

supplying the other purposes as listed in 4.4.1.1,7.1, provided

any such use will not decrease the mean period between service

overhauls to less than three years.

4.4.1.1.7.3\* Optional loads shall be permitted to be setved by

the essential electrical system generating eguipmenL Optional

loads shall be served by their own transfer means, such that these

loads shall not be transferred onto the generating eguipment if

the transf(~r will overload the generating equipment and shall be

shed upon a generating equipment overload, Use of the generating

eguipme11t to serve optional loads shall not constitute "other

purposes" as described in 4,4, I, I ,7.1 and therefore shall not require

multiple generator seLs.

4.4.1.1. 7.4 Where optional loads include cotltiguous or samesite

facilities not covered in Chapters 12 thr()llgh 20, provisiolls

shall be made to meet the reguiremenl'; ofNFPA 101, fJjr! Sapty

Cor/e, Article 700 of NFPA 70, National/~Ii!(:tTir:rtl Corle, and other

applicable NFPA requirements for emergency egress under loadshed

conditions,

4.4.1.1.8 Work Space or Room.

4.4.1.1.8.1 The EPS shall be installed in a separate room for

Levell installations. EPSS equipment shall be permitted to be

installed in this room. [110:7.2.1]

(A) The room shall have a minimum 2-hour fire rating or be

located in an adequate enclosure located ollL~ide the building

capable of resisting the ent.rance of snow or rain at a maximum

wind velocity required by local building codes, [110:7.2.1,1]

4.4.1.1.8.2 The rooms, shelters, or separate buildings housing

Level I or Level 2 EPSS equipment shall be designed and

located to minimize the damage from floodittg, ittcluding th:lt

caused by the fi)llowing: .

(I) Flooding resulting frum fire lighting

(2) Sewer water backup

(3) Similar disasters or occurrences [110:7.2.:\J

4.4.1.1.8.3 The EPS equipment shall be installed in ,I IOCItion

that permits ready accessibility attd a minimum of 76 CIlI

(30 in,) from the skid rails' outermost point in the direction of

access for inspection, repair, maintenance, cleaning, or replacement.

This requirement shall not apply to units in outdoor

housings, [110:7,25J

4.4.1.1.9\* Capacity and Rating. The generator set(s) shall

have sufficient capacity and proper rating to meet the maximum

actual demand likely to he produced by the connected

load of the essential electrical system(s) at anyone time.

4.4.1.1.10 Load Pickup. The energy converters shall have the

required capacity and response to pick lip :mel carry the load

within the time specilied in Table 4.1 (b) ulNFPA 110, .\/rlllriauljil{

HrruCI;I!,,;nI)' and Standby PUlIIrI'SYS/{!IIIS, after I, )Ss ()f I )ri III a ry P' )wcr.

4.4.1.1.11 Maintenance of Temperature. The EPS shall he

heated as necessary to maintain the w:lterjacket temperatttre

determined by the EPS manuLlcturer for cold start and load

acceptance for the type of EPSS. [110:[,.3, II

4.4.1.1.12 Heating, Cooling, and Ventilating.

4.4.1.1.12.1\* With the EPS running at rateelload, ventilation

airflow shall be provided to limit the tllaximutll air tCIllIWLIture

in the EPS room to the maximum :unbient air telllpcr:lture

reguired by the EPS manuLlcturer. [110:7,7, I]

(A) Consideration shall be given to :tli the heat rejected to

the EPS equipment room by thc energy cotl\'crLer, IIninSIllated

or insulated exhaust pipes, and other heat-prodllcing

equipment. [110:7.7, I.l]

4.4.1.1.12.2 Air shall be supplied to the EPS eqllipmcnt f,lt'

combustion, [110:7.7.2]

(A) For EPS supplying Levell EPSS, ventilatioll air shall be

supplied directly [i'om a source outside of the bllilciing by an

exterior wall opening or from a source outside the bllilding by

a 2-hour fire-rated air transfer system. [llO:7,7,2.1]

(B) For EI'S supplying Level I EPSS, discharge air shall be

directed outside of the huilding by ,m exterior wall opening or

to an exterior opening by a 2-hour lire-rated air translCr system,

[110:7.7.2,2]

(C) Fire dampers, shlltters, or other self~cl()sing devices shall

not be permitted in ventilation openings or ductwork fi)r supply

or return/discharge air to EPS equipment It)r Level I

EPSS, [110:7, 7.25[

4.4.1.1.12.3 Ventilation air supply sh:t11 be from outdoors or

from a source outside of the building by an exterior wall opening

or from a source outside the building bv a 2-hollr firc-rated

ail~ transfer system. [110:7,7,3] "

4.4.1.1.12.4 Ventilation air shall be provided to sltpply ,md

discharge cooling air for racliator cooling of the EPS when

running at rated load, [110:7,7.4J

(A) Ventilation air supply anc! discharge 1,)1' radiator cooled

EPS shall have a maximllm static restriction of 120 Pa (0,;') in.)

of water column in the discharge dllct at the raciiator outlet.

[110:7.7.4.IJ

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(B) Radiator air discharge shall be ducted outdoors or to an

exterior opening by a 2-hour lire-rated air transfer switch.

[110:7.7.4.2]

4.4.1.1.12.5 Motor operated dampers, when used, shall be

spring-operated to open and motor-closed. Fire dampers, shutters,

or other selfdosing devices shall not be permitted in ventilation

openings or ductwork for supply or return/discharge air

to EPS equipment for Levell EPSS, [110:7.7.5]

4.4.1.1.12.6 The ambient air temperature in the EPS equipment

room or outdoor housing containing Level 1 rotating

equipment shall be not less than 4.5"C (40°F). [110:7.7.6]

4.4.1.1.12.7 Units housed Olltdoors shall be heated as specified

in 5.3.3 of NFPA 110, StandaTdjiJr ErneJgency and Standby

Power Systems. [110:7.7.7J

4.4.1.1.12.8 Design of the heating, cooling, and ventilation

system for the EPS equipment room shall include provision

for ClCtors including, but not limited to, the following:

(I) Heat

(2) Cold

(3) Dust

(4) Humidity

(5) Snow and ice accumulatjons around housings

(b) Louvers

(7) Remote l'adiator Ems

(8) Prevailing winds blowing against radiator fan discharge

air [110:7.7.8]

4.4.1.1.13 Cranking Batteries. Internal combustion engine

cranking batteries shall be in accordance with the battery requirements

of NFPA 110, ,,,'tmulardjilT Hrnergeru) and Standby

Pow!''!' System.s.

4.4.1.1.14 Compressed Air Starting Devices. Other types of

stored energy starting systems (except pyrotechnic) shall be

permitted to be useel where recommended by the manufacturer

of the prime mover and subject to approval of the authority

having.iurisdiction, ullder the following conditions:

(I) Where two complete periods of cranking cycles are completed

without replacement of the srored energy

(2) Where a means for automatic restoration from the emergency

SOlll'ce of the stored energy is provided

(3) Where the stored eners,), system has the cranking capacity

specified in 5.6.4.2.] of NFPA 110, Standard .for Emergent)

and Standby Power Systems

(4) Where the stored energy system has a "black start" capability

in addition to normal discharge capability [110:5.6.4.1.2]

4.4.1.1.15 Fuel Supply. The fuel supply for the generator set

shall comply with Sections .').5 and 7.9 of NFPA 110, Standard

.lin !,'mer:e:eruJ' and Standby Power Systems.

4.4.1.1.16 Requirements for Safety Devices.

4.4.1.1.16.1 Internal Combustion Engines. Internal combustion

engines serving generator sets shall be equipped with the

following:

(I) A sensor device plus visual warning device to indicate a

water,:jacket temperature below those required in 4.4.1.1.11

(2) Sensor devices plus visual prealarm warning device to indicate

the following:

(a) High engine temperature (above manufacturer's recommended

safe operating temperature range)

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(b) Low lubricating oil pressure (below manufacturer's

recommended safe operating range)

(c) Low water coolan t level

(3) An automatic engine shutdown device plus visual device to

indicate that a shutdown took place due to the following:

(a) Overcrank (failed to start)

(b) Overspeed

(c) Low lubricating oil pressure

(d) Excessive engine temperature

(4) A common audible alarm device to warn that anyone or

more of the prealarm or alarm conditions exist

4.4.1.1.16.2 Safety indications and shutdowns shall be in accordance

with Table 4.4.1.1.16.2.

4.4.1.1.17 Alarm Annunciator. A remote annunciat.or, storage

battery-powered, shall be provided to operate outside of the

generating room in a location readily observed by operating

personnel at a regular work station (see Section 700. ] 2 of

NFPA 70, National E/ec/'rical Code). The annunciator shall be

hard-wired to indicate alarm conditions of the emergency or

auxiliary power source as follows:

(1) Individual visual signals shall indicate the following:

(a) When the emergency or auxiliary power source is operating

to supply power to load

(b) When the battery charger is malfunctioning

(2) Individual visual signals plus a common audible signal to

warn of an engine-generator alarm condition shall indicate

the following:

(a) Low lubricating oil pressure

(b) Low water temperature (below those required in

4.4.1.1.11)

(c) Excessive water temperature

(el) Low fuel- when the main fuel storage tank contains

less than a 4-hour operating supply

(e) Overcrank (failed to start)

(f) Overspeed

4.4.1.1.17.1 \* A remote, common audible alarm shall be provided

as specified in 4.4.J .1.17.4 that is powered by the storage

battery and located outside of the EPS service room at a work

site obser-vable by personnel. [110:5.6.6)

4.4.1.1.17.2 An alarm-silencing means shall be provided, and

the panel shall include repetitive alarm circuitry so that, after

the audible alarm has been silenced, it reactivates after the

fault condition has been cleared anci has to be restored to its

normal position to be silenced again. [110:5.6.6.1]

4.4.1.1.17.3 In lieu of the requirement of5.6.6.1 ofNFPA 1 10, a

manual alarm-silencing means shall be permitted that silences

the audible alarm aher the occurrence of the alarm condition,

provided slich means do not inhibit any subsequent alarms from

sounding the audible alarm again withoutfi.lrther manual action.

[110:5.6.6.2]

4.4.1.1.17.4 Individual alarm indication to annunciate any of

the conditions listed in Table 4.4.1.1.16.2 shall have the following

characteristics:

( I) Battery-powered

(2) Visually indicated

(3) Have additional contacts or circuits for a common audible

alarm that signals locally and remotely when any of

the itemized conditions occurs

(4) Have a lamp test switch(es) to test the operation of all

alarm lamps ELECTRICAL SYSTEMS 99-29

I Table 4.4.1.1.16.2 Safety Indications and Shutdowns

Indicator Function (at Battery Voltage)

(a) Overcrank

(b) Low water temperature

(c) High engine temperature prealann

(d) High engine temperature

(e) Low lube oil pressure prealarrn

(f) Low lube oil pressure

(g) Overs peed

(h) Low fuel main tank

(i) Low coolant level

U) EPS supplying load

(k) Control switch not in automatic position

(I) High battery voltage

(m) Low cranking voltage

(n) Low voltage in battery

(0) Battery charger <lC l~lilLlre

(p) Lamp test

(q) Contacts fr)]' local and relllote comlllon alarm

(r) Audible alarm silencing switch

(s) Low starting air pressure

(t) Low starting hydraulic pressure

(u) Air shutdown damper when used

(v) Remote emergency stop

C.V.

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

Levell

S.

X

X

X

X

0

X

X

R.A.

X

X

X

X

X

X

X

X

X

X

X

X

X

X

CV: Control panel-mounted visual. S.: Shutdown of EPS indication. R.A.: Remote audible. X: Re'luired.

0: Optional.

Notes:

I. Item (p) shall be provided, hut <l separate remote audible signal shall not be required when the regular

work site in :1.(;.6 of NFPA 110 is staffed 24 hours d day.

2. Item (b) is not required for combustion turbines.

'>. Item (r) or (s) sh'lll apply only where used as a starting method.

4. Itern (j): EPS ac ammder shall bt; permitted fi)!' t.his function.

S. All required c.v. fUllctions shall be visually annunciated by a remote, common visual indicator.

6. All required functions indicated in the R.A. column shall be annunciated by a rcmote, common audible

alarm as required in S.I1.5.2( 4) of NFPA II n.

7. Item (i) on gaseous systerns shall require a low gas pressure alarm.

8. item (b) shall be set. at II "C (200F) below t.he reg'ulatcc!tcrnperature determined by the EPS manuLlcturer

as required in 5.'>.1 of NFPA [10.

4.4.1.2 Battery. Battery systems shall meet all requirements of

Article 700 of NFPA 70. National L'/f!fbiml Corle.

4.4.2\* Distribution (Type 1 EES).

4.4.2.1 General Requirements.

4.4.2.1.1 Electrical characteristics of the t.ransfer switches

shall be suitable for the operation of all hmct.ions and equiprnent

they are int.ended to supply.

4.4.2.1.2 Switch Rating. The rating of the transfer switches

shall be adequate for switching all classes onoads to be served

and for withst.anding t.he effects of available fattlt currents

without. contact welding.

4.4.2.1.3 Automatic Transfer Switch. Transfer of all loads

shall be accomplished using automat.ic transfer switch (es).

Each automatic transfer switch 600 volts or below shall be

listed for the purpose and approved for emergency elect.rical

service (see lvFPA 70, Nationall:'lectrical Corie, Artir:le 700.3) as a

complete assembly.

•

4.4.2.1.4 Automatic Transfer Switch Features.

4.4.2.1.4.1 Source Monitoring.

(A)\* Undervoltage-sensing devices shall be provided to rnonitor

all ungrounded lines of the prirnalY source of power as 1()llows:

(I) When the voltage on any phase 1~t1ls below the minimulYl

operating voltage of any load to be served, the transfer

swit.ch shall automatically initiate engine st.art and the

process of transfer to the emergency power supply (El'S).

(2) \*When the voltage on all phases of t.he primary source returns

to within specified limit.s lor a designated period of

time, the process of transfer back to primary power shall

be initiated. [110:6.2.2.1)

(B) Both volt.age-sensing and frequency-sensing equipment

shall be provided to monitor one ungrounded line of the EI'S

power. [110:6.2.2.2]

(C) Transfer to the EPS shall be inhibited until the voltage

and frequency are within a specified range to handle loads to

be served. [110:6.2.2.3]

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(D) Sensing eqllipmcllt shall not be required in the transfer

switch, provided it is included with the engine cOl1trol panel.

[110:fi.'2.'2.3(A)J

(E) Freqllellcy-sensing eqlliprnent shall not bc required for

Illonitoring the public utility source where used as an IPS, as

permilled by ~'.I.4 of NFPA 110, StmuiaTd .fiJI" /,'mergeuIY and

.'ifill/lfl)' t>rIl(ln.~).\{(:IIiS. [1l0:(i.'2.2.?>(B)]

4.4.2.1.4.2 Interlocking. Mechanical interlocking or an approved

,t1temate method shall prevent the inadvertent interconnection

of the primary power supply and the E1'S, or any

two sep,ILlte sources of power. [110:6.2.3]

4.4.2.1.4.3\* Manual Operation.

(A) Instruction and equipment shall be provided for safe

manual nonelectric transfer in the event the transfer switch

malfunctions. [llO:G.'2.4.I]

(B) All ,lutOII1Cltic transfer switch shall visually annunciate

when "not-ill-automatic." [110:(i.'2.4.'2]

4.4.2.1.4.4\* Time Delay on Starting of EPS. A time-delay device

shall be provided to delay starting of the EPS. The timel'

sh,t11 prevent nuisance st,lrting of the EPS and possible subsequen

t load tr,ll1sfcr in the event or harmless momentary power

dips and interruptions or the primary source. [110:(j.'2.5]

4.4.2.1.4.5 Time Delay at Engine Control Panel. Time delays

shall be permitted to be located at the engine control panel in

lieu or in the transrcr switches. [110:(i.2.6]

4.4.2.1.4.6 Time Delay on Transfer to EPS. An adjustable timedelay

device sll,11I be provided to delay transfer and sequence

load transfer to the EPS to avoid excessive voltage drop when the

transrcr switch is installed l()r Level I usc. [110:6.2.7.1

(A) Time Delay Commencement. The time delay shall COIllmence

when proper EI'S vollilge and Frequency are achieved.

[110:6.'2.7.1.1

(B) Time Delay at Engine Control Panel. Time delays shall be

permitted to be IOGltccl at the enginc control panel in lieu of

ill the tr'lnsli.T switches. [UO:6.2.7.2J

4.4.2.1.4.7\* Time Delay on Retransfer to Primary Source. An

adjustable timc-deby device with automatic bypass shall be

provided to del'l)' rdranskr from the EPS to the primary

source of powcr, and allow the primary source to stabilize beFore

retranskr of the load. 1110:6.'2.8]

4.4.2.1.4.8 Time Delay Bypass If EPS Fails. The time delay

shall be autolllatictlly bypassed if the EPS bils. [110:6.2.9]

(A) The trallsfer switch shall be permitted to be programmed

I(lr ,l 11I,1l1udlly illitiated rctransl'er to the primary source to

provide I(lr a planned nloment,u-y interruption of the load.

[11 0:6.2.9.1.1

(B) II used, the arrangement in 6.2.9.1 orNFPA 110, Standlmi

.fiJI' /,'/lIn;i!,'I'Tuy and S/alldhy Power Systems, shall be provided with a

byp,lSs ['c:;llure to allow automatic retransler in the event that

the EI'S 1~lils and the primary source is available. [110:6.2.9.2]

4.4.2.1.4.9 Time Delay on Engine Shutdown. A minimum

Lime deby or Ij minutes shall be provided for unloaded running

or t.he EPS prior to slllltdown to allow for engine

coolclown. [1l0:b.'2.IO.l

(A) The l1linill1l1111 5-lllinute delay shall not be required on

slllall (15 k '''' or less) ,lir-cooled prime movers. [1l0:(:i.2.1 0.1]

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(B) A time-delay device shall not be required, provided it is

included ,yith the engine contl'Ol panel, or if a utility I,,:eder is

used as an EPS. [110:(:i.2.10.2]

4.4.2.1.4.10 Engine Generator Exercising Timer. A program

timing' device shall be provided to exercise the EPS as describecl

in Chapter 8 of NFPA 110, Stanr/lrrri PH l;IIli!~i!:(!ncy and

Stlrnrluy Power Systems. [llO:(i.'2.II]

(A) Transfer switches for Levelland Level '2 shall transkr the

connected load to the EPS and immediatel), return to primary

power automatically in case or the EPS failure. [11 0:6.2.11.1]

(B) Exercising timers shall be permitted to be located at the

engine control panel in lieu of in the transfer switches.

[110:(:i.'2.11.2]

(C) A program timing device shall not be required in health

care facilities that provide scheduled testing in accordance

with NF1'A 99, S/anriard[or /-fealth Cam /<fuTilities. [110:6.2.11.')]

4.4.2.1.4.11 Test Switch. A test means shall be provided on

each automatic transfer switch (ATS) that simulates f~lilure of

the primary power source and then transfers the load to the

EPS. [110:6.2.12]

4.4.2.1.4.12\* Indication of Switch Position. C[\vo pilot lights

with identification nameplates or other approved position indicators

shall be provided to indicate the transfer switch position.

[1l0:b.2.13]

4.4.2.1.4.13 Motor Load Transfer. Provisions shall be included

to reduce currents resulting II'om Illotor load transter if such

currents could damage EPSS equipment or cause nuisance tripping

of EPSS overcurrent protective devices. [110:6.'2.14]

4.4.2.1.4.14\* Isolation of Neutral Conductors. Provisions shall

be included f()f ensuring continuity, transfer, anc! isolation of the

primary and the EPS neutral conductors wherever they are separately

grounded to achieve ground-fault sensing. [110:6.'2.15]

4.4.2.1.4.15\* Nonautomatic Transfer Switch Features. Switching

devices shall be mechanicallv held and shall be operated bv

di;'ect manual or electrical remo'te manual control. [110:6,2.16]'

(A) Interlocking. Reliable mechanical interlocking, or an approved

alternate method, shall prevent the inadvertent interconnection

of the primary power source and the EPS. [110:6.2.16.1]

(B) Indication of Switch Position. Two pilot lights with identiliGltion

nameplates, or other approved position indicators, shall

be provided to indicate the switch posit jon. [110:6.2.16.2]

4.4.2.1.5 Nonautomatic Transfer Device Classification. Nonautomatic

transfer devices 600 volts or below shall be listed for

the purpose and approved.

4.4.2.1.6 Nonautomatic Transfer Device Features.

4.4.2.1.6.1 General. Switching devices shall be mechanically

helel and shall be operated by direct manual or electrical remote

manllal control. [110:6.2. Hi]

4.4.2.1.6.2 Interlocking. Reliable mechanical interlocking, or

an approved alternate method, shall prevent the inadvertent

interconnection of the primary power source and the E1'S.

[1l0:6.2.1b.l]

4.4.2.1.6.3 Indication of Switch Position. Two pilot lights with

identification nameplates, or other approved position indicators,

shall be provided to indicate the switch position. [110:6.2.16.2] ELECTRICAL SYSTEMS 99-31

4.4.2.1.7 Bypass-Isolation Switches. Bypass-isolation switches

shall be permitted for bypassing and isolating the transfer

switch and installed in accordance with 4.4.2.1.7.1 through

4.4.2.1.7.4. [110:6.4.1]

4.4.2.1. 7.1 Bypass-Isolation Switch Rating. The bypass-isolation

switch shall have a continuous current rating and a current

rating compatible with that of the associated transfer switch.

[11 0:6.4.2]

4.4.2.1. 7.2 Bypass-Isolation Switch Classification. Each bypassisolation

switch shall be listed for emergency electrical service

as a completely factory-assembled and factory-tested apparatus.

[110:6.4.3]

4.4.2.1.7.3\* Operation. With the transfer switch isolated or

disconnected, the bypass-isolation switch shall be designed so

it can function as an independent nonautomatic transfer

switch and allow the load to be connected to either power

source. [110:6.4.4]

4.4.2.1.7.4 Reconnection of Transfer Switch. Reconnection

of the transfer switch shall be possible without a load interruption

greater than the maximum time, in seconds, specified by

the type of system. [110:6.4.5]

4.4.2.2 Specific Requirements.

4.4.2.2.1 \* General.

4.4.2.2.1.1 The emergency system shall be limited to circuits

essential to life safety and critical patient care and al-e designated

the life safety branch and the critical branch.

4.4.2.2.1.2 The equipment system shall supply major electrical

equipment necessary for patient care and basic Type I operation.

4.4.2.2.1.3 Both systems shall be arranged for connection,

within time limits specified in this chapter, to an alternate

source of power following a loss of the normal source.

4.4.2.2.1.4 The number of transfer switches to be used shall be

based upon reliability, design, and load considerations. Each

branch of the emergency system and each equipment system

shall have one or more tl-ansfer switches. One transfer switch

shall be permitted to serve one or more branches or systems in a

facility with a continuous load on the switch ofl50 kVA (120 kW)

or less.

4.4.2.2.2 Emergency System.

4.4.2.2.2.1 General. Those functions of patient care depending

on lighting or appliances that shall be permitted to be

connected to the emergency system are divided into two mandatory

branches, described in 4.4.2.2.2.2 and 4.4.2.2.2.3.

4.4.2.2.2.2 Life Safety Branch. The life safety branch of the

emergency system shall supply power for the following lighting,

receptacles, and equipment:

(1) Illumination of means of egress as required in NFPA J01,

Life Safety Corle

(2) Exit signs and exit direction signs required in NFPA J01,

Life Safety Code

(3) Alarm and alerting systems including the following:

(a) Fire alarms

(b) Alarms required for systems used for the piping of nonflammable

medical gases as specified in Chapter 5, Gas

and Vacuum Systems

(4)\*Hospital communication systems, where used for issuing

instruction during emergency conditions

(5) Generator set location: Task illumination, battery charger

for emergency battery-powered lighting unit.(s), and selected

receptacles at the generator set location and essential

electrical system transfer switch locations

(6) Elevator cab lighting, control, communication, and signal

systems

(7) Automatically operated doors used for building egress

(8) The auxiliary functions of fIre alarm combination systems

complying wi th NFPA 72, National Fire Alarm Code

No function other than those listed in items 4.4.2.2.2.2(1)

through 4.4.2.2.2.2(8) shall be connected to the life safety

branch.

4.4.2.2.2.3\* Critical Branch. The critical branch shall be permitted

to be subdivided into two or more branches. The critical

branch of the emergency system shall supply power lor task

illumination, fixed equipment, selected receptacles, and selected

power circuits serving the following areas and functions

related to patient care:

(1) Critical care areas that utilize anesthetizing gases, task illumination,

selected receptacles, and fixed equipment

(2) The isolated power systems in special environments

(3) Task illumination and selected receptacles in the following:

(a) Patient care areas, including inf~lIlt nurseries, selected

acute nursing areas, psychiatric bed areas (omit receptacles),

and ward treatment rooms

(b) Medication preparation areas

(c) Pharmacy dispensing areas

(d) Nurses' stations (unless adequately lighted by corridor

luminaires)

(4) Additional specialized patient care task illumination and

receptacles, where needed

(5) Nurse call systems

(6) Blood, bone, and tissue banks

(7) \*Telephone equipment rooms and closets

(8) Task illumination, selected receptacles, and selected

power circuits for the following areas:

(a) General care beels with at least one duplex receptacle

per patient bedroom, and task illumination as required

by the governing body of the health care facility

(b) Angiographic labs

(c) Cardiac catheterization labs

(d) Coronary care units

(e) Hemodialysis rooms or areas

(f) Emergency room treatment areas (selected)

(g) Human physiology labs

(h) Intensive care units

(i) Postoperative recovery rooms (selected)

(9) Additional task illumination, receptacles, and selected

power circuits needed for effective f~lcility operation.

Single-phase fractional horsepower motors shall be permitted

to be connected to the critical branch.

4.4.2.2.3 Equipment System.

4.4.2.2.3.1 General. The equipment system shall be connected

to equipment described in 4.4.2.2.3.3 through 4.4.2.2.3.5.

4.4.2.2.3.2 Connection to Altemate Power Source. The equipment

system shall be installed and connected to the alternate

power source, such that equipment described in 4.4.2.2.3.4 is

automatically restored to operation at appropriate time-lag intervals

following the energizing of the emergency system. Its

arrangement shall also provide for the subsequent connection

of equipment described in 4.4.2.2.3.5.

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4.4.2.2.3.3 AC Equipment for Nondelayed Automatic Connection.

Generator accessories, including, but not limited to,

the transfer fuel purnp, electrically operated louvers, and

other generator accessories essential for generator operation,

shall be arranged for automatic connection to the alternate

power source.

4.4.2.2.3.4\* Equipment for Delayed-Automatic Connection.

The following equipment. shall be permitted to be arranged for

delayed-automatic connection to the alternate power source:

(I) Central suctjon systems serving medical and surgical functions,

including controls. It. shall be permitted to place

such suction systems on the critical branch.

(2) Sump pumps and otber equipment required to operate

for the safety of major apparatus, including assoeiated

control systems and alarms.

(3) Compressed air systems serving medical and surgical

functions, including controls. It shall be permitted to

place such air systems on the critical branch.

(4) Smoke control and stair pressurization systems.

(5) Kitchen hood supply and/ or exhaust systems, if required

to operate during a fire in or under the hood.

(6) Supply, return, and exhaust vent.ilating systems for airborne

infectious/isolation rooms, protective environment

rooms, exhaust fans for laboratory fume hoods,

nuclear medicine areas where radioactive material is

used, ethylene oxide evacuation, and anesthetic evaCLlatiun.

\!\There delayed automatic connection is not appropriate,

such ventilation systems shall be permitted to be

placed on the critical branch.

4.4.2.2.3.5\* Equipment for Delayed-Automatic or Manual

Connection. The following equipment shall be permitted to

be arranged fOl' either delayed-automatic or manual connectjon

to the alternate power source (also see A. 4.4. 2. 2.3.4):

(I) Heat.ing equipment to provide heating for operating, delivery,

labor, recovery, intensive care, coronary care, nurseries,

inf:ection/isolat.ion rooms, emergency treatment

spaces, and general patient rooms; and pressure maintenance

(jockey or make-up) pump(s) for water-based fire

protection systems.

(2)\*Heating of general patient. rooms during disruption of

the normal source shall not be requiredllnder any of the

f()llowing conditions:

(a) The olll~ide desigll temperature is higher than -6.7°C

(+200F).

(b) The out.side design temperature is lower than -6.7°C

(+20°F) and a selected room(s) is provided for the

needs of all confined patients [then only such

room(s) need be heated].

(c) The facility is served by a dual source of normal power

as described in 4.3.2.l.

(3) Elevator(s) selected to provide service to patient, sUl'gicaJ.

obstetrical, and ground 11ool"s during interruption of normal

power.

(4) Supply, return, and exhaust ventilating systems for surgical

and obstet.rical delivery suites, int.ensive care, coronary

care, nurseries, and emergency treatment spaces.

(5) Hyperbaric facilities.

(6) Hypobaric bcilities.

(7) Autoclaving equipment shall be permitted to be arranged

for either automatic or manLlal connection to the alternate

source.

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(8) Controls for equipment listed in 4.4.2.2.3.

(9)\*Otber selected equipment shall be permiLLedto be served

by tbe equipment system.

4.4.2.2.4 Wiring Requirements.

4.4.2.2.4.1 \* Separation from Other Circuits. The life safet.y

branch and critical branch of the emergency svstcm shall be

kept entirely independent of all other wiring' a~d equipment.

4.4.2.2.4.2 Receptacles. The requirements for receptacles

shall comply with 4.4.2.2.4.2 (A) and4.4.2.2.4.2(B).

(A) The number of receptacles on a single branch circuit for

areas described in 4.4.2.2.2.3(8) shall be nlinimized to limit the

effects of a branch circuit out."lge. Branch circuit overeurrent devices

shall be readily accessible to authorized personnel.

(B)\* The electrical receptacles or the cover plates for the electrical

receptacles supplied from the emergency systcm shall have a

distinctive color or marking so as to be readily identifiable.

4.4.2.2.4.3 Switches. Switches installed in the lighting circuits

connected to the essential elect.rical system shall comply with

Article 700, Section V, of \!FPA 70, National Elee/rical Corie.

4.4.2.2.4.4 Mechanical Protection of the Emergency System.

The wiring of t.he emergency system shall be mechanically protected

by raceways, as defined in NFPA 70, NationaU';/J!(;trir:a1 Code.

4.4.2.2.4.5 Flexible power cords of appliances 01- ot.her utilization

equipment connected to the emergency system shall

not be required to be enclosed in raceways.

4.4.2.2.4.6 Secondar,), circuits of' transformer-powered communication

or signaling systems shall not be required to be

enclosed in raceways unless otherwise specified by Chapters 7

or 8 of NFPA 70, National Electrical Corle.

4.4.3 Performance Criteria and Testing (Type 1 EES).

4.4.3.1 Source. The branches of the emergency system shall

be installed and connected to the alternate power source

specified in 4.4..1 .1.4 and 4.4.1.15 so that all functions specified

herein for the emergency system shall be aut.omatically

restored to operation within 10 seconds after interruption of

the normal source.

4.4.3.2 Transfer Switches.

4.4.3.2.1 All ac-powered support and accessOl')' equipment

necessalY to the operation of the EPS shall be supplied Ii'om

the load side of the automatic transfer switch(es), or the output

terminals of the EPS, ahead of the main EPS overcurrent

protection, as necessar,)" to ensure continuity of the EPSS operation

and performance. [110:7.125]

4.4.3.2.2 The essential electrical system shall be served by t.he

normal power source except when the normal power source is

interrupted or drops below a predetermined voltage level. Settings

of the sensors shall be determined by careful study of the

voltage requirements of the load.

4.4.3.2.3 Failure of the normal source shall automatically start

the alternate source generator after a short delay as described in

4.4.2.1.4.4. \Nhen the alternate power source has attained a voltage

and frequency that satisfies minimurn operating requirements

of t.he essential electrical system, the load shall be connected

automatically to the alternate power source.

4.4.3.2.4 Upon connection of the alternate power source,

the loads comprising the emergency system shall be automatically

re-energized. The load comprising the equipment

system shall be connected either automatically after a time ELECTRICAL ~'YSTEMS 99-33

delay as described in 4.4.2.1 .4.6 or nonautomaticaJly and in

such a sequcntial manncr as not. to overload the generator.

4.4.3.2.5 When the normal power source is restored, and af~

tel' a time delay as described in 4.4.2.1.4.7, the automatic transfer

switches shall disconnect the alternate sonrce of power and

connect the loads to the normal power source. The alternate

power source generator set shall continue to run unloaded for

a preset time delay as described in 4.4.2.1.4.9.

4.4.3.2.6 If the emergency power source fails and the normal

power source has been restored, retransfer to the normal

source of power shall be immediate, bypassing the retransfer

delay timer.

4.4.3.2.7 If the emergency power source hils during a test,

provisions shall be made to immediately retransfer to the normal

source.

4.4.3.2.8 Nonautomatic transfer switching devices shall be

restored to the normal power source as soon as possible after

the return of the norrnal source or at the discretjon of the

operator.

4.4.4 Administration (Type 1 EES).

4.4.4.1 Maintenance and Testing of Essential Electrical System.

4.4.4.1.1 Maintenance and Testing of Alternate Power Source

and Transfer Switches.

4.4.4.1.1.1 Maintenance of Alternate Power Source. The generator

set or other al ternate power source and associated

equipment, including all appurtenant parts, shall be so maintained

as to be capable of supplying service within the shortest

time practicable and within the lO-second intel-val specified in

4.4.1.1.10 and 4.4.3.1. Maintenance shall be performed in accordance

with NFPA 110, Standard Fir l~'mr;rgertl)' and Standby

Power Systems, Chapter 8.

4.4.4.1.1.2 Inspection and Testing. Criteria, conditions, and per~

sonnel requirement'i shall be in accordance with 4.4.4.1.1.2(A)

through 4.4.4.l.1.2(C).

(A) \* Test Criteria. Generator set, shall be tested 12 times a year

with testing intelvals between not less than 20 days or exceeding

40 days. Generator sets serving emergency and equipment systems

shall be tested in accordance with NFPA 110, Starulardfirr

Emergrmr,), and Standby Power Systems, Chapter 8.

(B) Test Conditions. The scheduled test under load conditions

shall include a complete simulated cold start and appropriate

automatic and manual transfer oLdl essential electrical

system loads.

(C) Test Personnel. The scheduled tests shall be conducted by

competent personnel. The tests are needed to keep the machines

ready to function and, in additjon, serve to detect causes

of malfunction and to train personnel in operating procedures.

4.4.4.1.2 Maintenance and Testing of Circuitry.

4.4.4.1.2.1 \* Circuit Breakers. Mai n and feeder circuit breakers

shall be inspected annually and a program for periodically

exercising the components shall be established according to

manufacturer's recommendations.

4.4.4.1.2.2 Insulation Resistance. The resistance readings of

main feeder insulation shall be taken prior to acceptance and

whenever damage is suspected.

4.4.4.1.3 Maintenance of Batteries. Batteries for on-site generators

shall be maintained in accordance with NFPA 110,

Standard/i)T Emetgeney and Standby Power Systems.

4.4.4.2 Recordkeeping. A written record of inspection, perj()rmance,

exercising period, and rep,lirs shall be regularly

maintained and available for inspection by the authority havingjurisdiction.

4.5 Essential Electrical System Requirements - Type 2.

4.5.1 Sources (Type 2 EES). The requirements for sources for

Type 2 essential electrical systems sh,dl conform to those listed

in 4.4.1.