Chapter 21.5 Electrical Guidelines

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21.5.1 Introduction.

21.5.1.1 Purpose. The purpose of Chapter 21.5 is to identify the electrical requirements for the design, construction, operations, and maintenance of Indian Health Service (IHS) and Tribal health care facilities and staff quarters.

21.5.1.2 Applicability. The information found herein is applicable to all IHS new construction, major renovation, joint venture, small ambulatory, maintenance and improvement projects, and facility operations, unless otherwise noted.

21.5.1.3 Background. Reserved.

21.5.1.4 Technical Support. Technical support for the implementation of these requirements may be provided through the following IHS offices:

- IHS Headquarters: Director, Division of Facilities Planning and Construction (DFPC) and Director, Division of Engineering Services (DES)
- The IHS Area Offices: Director, Facility Management

21.5.2 Definitions.

(1) Advanced Meter. An advanced meter records energy or water consumption data hourly or more frequently and provides for daily or more frequent transmittal of measurements over a communication network to a central collection point. Features of advanced meters vary depending on the utility they are serving.

(2) Advanced Metering Device. A separate electronic device coupled to a standard meter or to a building automation system that enables it to function as an advanced meter.

(3) Alternate Power (AP) Source. One or more generator sets or battery systems, where permitted, intended to automatically provide power during the interruption of the normal electrical service.

(4) Emergency Electrical System. An Alternate Power System of circuits and equipment intended to supply alternate power to a limited number of prescribed functions vital to the protection of life and safety. Emergency electrical systems

are required by NFPA 101 and may include installation of an emergency generator.

(5) Building Automation System (BAS). Also referred to as an Energy Management and Control System (EMCS) or a Direct Digital Control system (DDC). A BAS is a system of devices and associated software that together allow for monitoring, controlling, and recording many conditions within a facility. The BAS generally links the devices to modern computer systems. The system can consist of stand alone devices that monitor only critical building elements, such as boilers and chillers, or special spaces, such as operating suite ventilation. Typically, however, a BAS incorporates many such building elements and environments into a larger system that is monitored, controlled, and recorded in a central location.

(6) Standby Electrical System. An Alternate Power System intended to automatically supply power to selected loads (other than those classified as emergency systems) in the event of failure of the normal source (NEC 701.2). Standby Electrical Systems are optional; they are typically sized to meet the entire electrical load of a facility, and they may include installation of a standby generator.

(7) Life Cycle Cost (LCC). The LCC is the sum of all costs over the useful life of a building, system or product. It includes the costs of design, construction, acquisition, operation and maintenance, and the salvage value, if any, using present worth (PW) costs. A comprehensive guideline for conducting LCC analysis is provided in Circular A-94, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs, available online at http://www.whitehouse.gov/omb/circulars/a094/a094.pdf

(8) Harmonic. A component frequency of a harmonic motion (as of an electromagnetic wave) that is an integral multiple of the fundamental frequency. For example, the 3rd harmonic is 60 Hz multiplied by 3, or 180 Hz. The introduction of distortion into the main 60 Hz current (or voltage) sine wave results in additional currents or voltages (harmonics) which are introduced into the electrical system at the multiples of the fundamental 60 Hz current (or voltage). Harmonics are generated in non-linear loads within the facility.

(9) Noise. Electrical noise is constituted of random unwanted electrical signals that produce undesirable effects whenever they get coupled into the circuits of the controls, communication, or power systems.

(10) Power Quality. Degree of the electrical network's or the grid's ability to supply a clean and stable power source. It refers to the voltage, the current and the frequency to stay as close as possible to the nominal values and the desired behavior.

(11) Shielding. Shielding is the use of a conducting barrier between a potentially disturbing noise source and sensitive circuitry. Shields are used to protect cables (data and power) and electronic circuits. They may be in the form of metal barriers, enclosures, or wrapping around source circuits and receiving circuits.

(12) Total Harmonic Distortion (THD). THD is a measure of the effective value of the

harmonic components of a distorted waveform. The waveform can be a voltage or a current in the electrical system.

(13) Transient Voltage Surge Suppression (TVSS). The action of an solid state device which clamps the voltage of the distorted waveform to a safe level and then redirects the potentially enormous current associated with the surge away from sensitive electronic equipment. See ANSI/IEEE C62.41-1980 for location application categories. The UL Standard 1449 is the standard to assure TVSS product safety and uniform performance evaluation.

(14) Voltage Distortion. Any deviation from the nominal sine waveform of the ac line voltage.

21.5.3 Codes and Standards. Electrical systems in IHS facilities shall be designed, constructed, operated and maintained in accordance with the latest published edition of the following codes and standards:

(1) National Fire Protection Association (NFPA) Codes and Standards, including:

- NFPA 70 National Electric Code (NEC)
- NFPA 70E Standard for Electrical Safety in the Workplace
- NFPA 72 National Fire Alarm Code
- NFPA 75 Protection of IT Equipment
- NFPA 99 Standard for Health Care Facilities
- NFPA 101 Life Safety Code (LSC)
- NFPA 110 Standard for Emergency and Standby Power Systems
- NFPA 780 Standard for the Installation of Lightning Protection Systems

(2) American Institute of Architects/Facility Guidelines Institute (AIA/FGI) Guidelines for Design and Construction of Health Care Facilities

(3) Illuminating Engineering Society of North America (IESNA) Lighting Handbook and IESNA RP-29-06 Lighting for Hospitals and Health Care Facilities.

(4) Institute of Electrical and Electronic Engineers (IEEE)

- National Electrical Safety Code
- IEEE Std 1100, IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment
- IEEE Std 446 - IEEE Recommended Practice For Emergency And Standby Power Systems For Industrial And Commercial Applications
- IEEE Std C62.41 - IEEE recommended practice on characterization of surges in low-voltage (1000 V and less) AC power circuits
- IEEE Std C62.45 - IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits

(5) American National Standard Institute (ANSI)

- ANSI C84.1 - Electrical Power Systems and Equipment- Voltage Ratings (60 Hz)

(6) State and municipality local codes and ordinances
(7) Local utility companies rules and regulations
(8) Other applicable standards including:

- National Electrical Manufacturers Association (NEMA)
- Underwriters Laboratories Inc. (UL) Standard 1449 Standard for Surge Protective Devices

21.5.4 General Guidance. Any major generator upgrade will require IHS Headquarters (IHS HQ) approval with Division of Engineering Services (DES) recommendation.

21.5.5 Alternate Power (Emergency Electrical Systems).

21.5.5.1 Purpose. The purpose of this section of Chapter 21.5 is to identify the requirements for Alternate Power (Emergency Electrical Systems) in IHS and Tribal health care facilities and staff quarters. The requirements are based upon NFPA Codes and Standards, the AIA/FGI Guidelines for Design and Construction of Health Care Facilities, and IHS policy.

21.5.5.2 Scope. The listed Alternate Power (AP) requirements are only intended to meet the previously listed reference codes and standards as they relate to the operation of IHS facilities. AP equipment and distribution should be limited to only essential loads so as to improve reliability, and reduce system operation and maintenance costs. The essential AP equipment is not intended to ensure full function of a facility during a power outage, but is intended to meet certain present emergency codes and standards. Minimum AP distribution requirements defined in listed references are listed below as "Basic". Other AP distributions permitted, but not required, are listed below as "Additional". On a case by case basis, as justified due to proven history of unreliable utility power, standby power may be authorized in the Program of Requirements (POR) as outlined in paragraph 21.5.6 to allow the facility to function at or near full functionality during extended power outages, if critical care areas are present in a facility.

21.5.5.3 Alternate Power (Emergency Electrical Systems) Requirements by Facility Type.

(1) **Hospital**
NFPA 99/101 Definition: Hospital
NFPA 101 Occupancy Type: Health Care

a) Basic: Hospitals must have AP providing Type I Essential Electrical System service to life safety branch and critical branch functions requiring Alternate Power (AP) per NFPA 99. These AP sources are classified as Level 1, Type 10, Class 24.

Each patient bed and treatment space shall have access to a minimum of one (1) receptacle on the critical branch of the emergency power system. Furthermore, the AIA/FGI Guidelines for Design and Construction of Health Care Facilities requires the following:

- Where stored fuel is required (for Emergency Electrical Service), storage capacity shall permit continuous operation for at least 24 hours.

  Note: NFPA 110 requires a 96 hour storage capacity for Level 1, Class X Systems in ASCE 7 seismic design categories C, D, E, and F.

  Note: Fuel supply requirements need to be coordinated with the facility's emergency management role in the community.

- Approximately 50 percent of receptacles in critical care areas and emergency departments shall be connected to emergency system power.

b) Additional: AP consideration may be provided for the following:

- Automatic lab bio-analyzers
- Data processing equipment rooms that are designed to meet NEC Article 645
- Selected oral surgery operatory lights, receptacles, and equipment

  NOTE: Dental Scavenger Gas Exhaust will not be on the AP circuit. The presence or absence of AP shall not affect the design decision to install nitrous oxide for dental analgesia.

(2) **Ambulatory Health Care Center**
NFPA 99 Definition: Ambulatory Health Care Center
NFPA 101 Occupancy Type: Ambulatory Health Care

a) Basic: Ambulatory Health Care Centers must have AP providing Type II Essential Electrical System service to life safety branch and critical branch functions that requires AP per NFPA 99. In these facilities Type I Essential Electrical System service with one transfer switch is required to serve one or more branches or systems when the continuous load on the switch is less than 150 kVA.
b) Additional: when a Type I Essential Electrical System is required AP consideration may be provided for the following:

- Automatic lab bio-analyzers
- Data processing equipment rooms which are designed to meet NEC Article 645
- Selected oral surgery operatory lights, receptacles, and equipment

  NOTE: Dental Scavenger Gas Exhaust will not be on AP. The presence or absence of AP shall not effect the design decision to install nitrous oxide for dental analgesia.

(3) **Health Station**

NFPA 99 Definition: Medical/Dental Office
NFPA 101 Occupancy Type: Business

a) Basic: Medical/Dental Offices will be equipped with AP providing Type III Essential Electrical System service to functions that require AP, per NFPA 99 (battery powered)
b) Additional: None

(4) **Intermediate/Skilled Nursing Facility**
NFPA 99 Definition: Nursing Home
NFPA 101 Occupancy Type: Health Care

a) Basic: Nursing Homes will be equipped with AP providing Type II Essential Electrical System service to functions that require AP, per NFPA 99.
b) Additional: None

(5) **Support Facility**
NFPA 99 Definition: Not Applicable
NFPA 101 Occupancy Type: Business

a) Basic: Support Facilities will be equipped with AP (battery powered) emergency service when required by NFPA 101-Chapters 38 and 39.
b) Additional: None

(6) **Staff Residential Building**
NFPA 99 Definition: Not Applicable
NFPA 101 Occupancy Type: One- and Two-Family Dwellings / Apartment Buildings

a) Basic: Multi-Family Staff Residential Buildings (three or more dwelling units) will be equipped with AP (battery powered) emergency service when required by NFPA 101-Chapters 30 and 31. One- and Two-Family Dwellings require no AP.
b) Additional: None

(7) **Youth Treatment Center**
NFPA 99 Definition: Not Applicable
NFPA 101 Occupancy Type: Residential Board and Care

a) Basic: Youth Treatment Centers will be equipped with AP (battery powered) emergency service, per NFPA 101-Chapters 32 and 33.
b) Additional: None

21.5.6 Alternate Power (Standby Electrical Systems).

21.5.6.1 Purpose. The purpose of this section of Chapter 21.5 is to provide a methodology for establishing the circumstances under which a standby electrical system may be justified. Specifically, this chapter focuses on the justification for the provision of alternate power through the use of standby generators. Justification may be achieved whether or not alternate power is specifically required by NFPA 99 or 101.

21.5.6.2 Background. The requirements of NFPA 99 and NFPA 101 as outlined in Section 21.5.5 – Alternate Power (Emergency Electrical Systems), provide the justification for generators for emergency electrical systems in health care facilities. Such generators are designated as "emergency generators." Generators justified using the methodology outlined herein are designated as "standby generators."

Due to the remote nature of most IHS facilities, it is often desirable to provide standby generators for them. When justified, standby generators may be provided in facilities that have emergency generators as well as in those that do not. Justification for standby generators may include a permanently installed generator or installation of wiring and connections for placing and using a portable generator.

There are three means to justify a standby generator: (1) Standby System Risk Calculation (SSRC) Formula Method, (2) Medical/Program Justification Method, and (3) Business Plan Method. Each of these methods is described below.

21.5.6.3 Methodologies for Justification of a Standby Generator.

(1) Standby System Risk Calculation (SSRC) Formula Method

A common criterion used to determine the need for specific facility equipment or systems is the risk factor evaluation. Such evaluations are currently used to provide specific recommendations for facility seismic and lightning arrester systems. For standby power systems, the SSRC formula is such a risk factor evaluation.

The SSRC formula calculates a value for a facility. The SSRC – dsf value is calculated using the Standby System Risk Calculation (SSRC) form (provided in Appendix A – Standby System Risk Calculation (SSRC) Form). This SSRC value determines whether the standby generator system is justified and, if so, whether it should consist of an installed generator or only wiring and connections for placing and using a portable generator. See Table 1, "Standby System Risk Calculation Determination."

Table 1. Standby System Risk Calculation Determination

SSRC Value	Determination
Greater than 8	Standby System Generator Supported
Between 5-8	Portable Standby Generator Connection Only
Less than 5	Standby System Generator is not Justified

The SSRC value is only used to determine whether a standby generator is needed and is not to be used for emergency generator selection. A "risk value" calculation greater than eight demonstrates the need for an on-site standby system generator for facilities where there is no strict code requirement for alternate power using generator(s). The calculations using these criteria do not preclude a generator to address power quality issues, for peak shaving and other energy conservation reasons where the generator meets life cycle costing payback analysis of the federal energy policies using the latest edition of the National Institute of Standards and Technology Building Life-Cycle Cost Program.

(2) <u>Medical/Program Justification Method</u>

New health care facilities that cannot justify a standby generator per the SSRC Formula Method, may still qualify for a standby generator if supported by specific and compelling medical needs. In such cases, these needs shall be documented in a detailed narrative justification describing the medical issue(s) and the need for a standby generator. This justification shall be endorsed by the Area Chief Medical Officer, prior to submission of the POR to the Director, OEHE, for approval.

(3) <u>Business Plan Method</u>

It is recognized that business operating plans at existing IHS health care facilities may require continuous electrical power. To address this need, standby generators may be permanently installed at these locations, subject to review and approval of any plans to do so by the respective Area Facility Engineer. The SSRC formula is not applicable to generators installed at existing facilities to meet the requirements of the operating entity’s business plan.

The generator and related equipment shall be sized, designed, and installed in accordance with the applicable Codes and Standards referenced in Section 21-5.1. The operating entity shall operate and maintain the generator in accordance with NFPA 110. <u>In no case shall appropriated Health Care Facilities Construction, Maintenance and Improvement, Equipment, or Facility and Environmental Health Support funding be used for the purchase or installation of generators and related appurtenances that are justified only to meet the requirements of the operating entity’s business plan.</u>

21.5.6.4 Determination of Appropriate Generator Electrical Loads. The designer, in consultation with the Area Facility Engineer, shall determine the appropriate electrical loads, generator configuration and load growth for the standby power circuit. The entire building load may be used; however, not all building loads must necessarily be carried by the standby generator. Proper protection shall be provided by the use of automatic transfer switches to insure the selected standby load matches the chosen generator. Examples of loads which could potentially be excluded include building chiller equipment (depending on climatic zone), elevators and parking lot lights. In all cases, the basis for the standby generator design shall be documented in the Operation and Maintenance Manuals for the facility.

21.5.6.5 Program Requirements. A facility's Program of Requirements (POR), Project Justification

Document (PJD), or Project Summary Document (PSD) will document whether standby generators are needed based on the SSRC Formula Method, or the Medical/Program Justification Method. As applicable, the "Standby System Risk Calculation (SSRC) Form" will be completed by the Area Facility Engineer, who will then make an initial determination regarding the need for standby generators. Completion of other documentation may require input from facility and Area medical staff. The Director, OEHE, has approval authority for the POR.

21.5.7 Electrical Power Quality.

21.5.7.1 Purpose. The section of Chapter 21.5 provides guidance for design and installation practices which will assure reliable facility electrical power quality for sensitive electronic equipment in Indian Health Service (IHS) and Tribal Facilities. Technologically advanced electronics and communications equipment and devices which are now routinely incorporated in facilities must be operationally dependable and cost effective. This guideline will provide guidance to assure a dependable and cost effective operation of this equipment.

21.5.7.2 Scope. The electrical power and grounding requirements that support the normal and safe operation of sensitive electronic equipment at IHS and Tribal Facilities is detailed in this section. This section provides criteria for power quality at various types of existing and proposed facilities, using as references the Institute of Electrical and Electronic Engineers (IEEE) Recommended Practice for Powering and Grounding Sensitive Electronic Equipment and several other national codes.

21.5.7.3 Facility Electrical Power Quality Requirements.

(1) General Guidance

Successful practices that will ensure reliable facility electrical power quality are a joint effort of the local power company, the facility designers, and the DES electrical engineer. The power company normally provides service that will minimize waveform distortion and outages as a result of lightning, heavy rains, strong winds, ice build-up, heavy snow, and sudden changes in the system load. The designer must verify that the existing service power quality, the site facility conditions, and new project requirements will ensure acceptable power quality. Example of design concerns and considerations include, but are not limited to, site grounding; harmonic currents generated by adjustable speed drives/electronic ballasts and computers etc., distance from electrical panels to electronic loads, lightning activity; and alternate power supply switching transients (generator start-up). An evaluation of utility service and facility power quality elements has resulted in the information detailed in the following paragraph for seven types of IHS/Tribal facilities.

(2) Power Quality Requirements by Facility Type

Basic requirements are mandatory minimums. Additional requirements shall apply as warranted for the installation as a result of the designer verification of existing service/site facility conditions and the review of new project requirements.

21.5.7.4 Facility Electrical Power Quality Requirements by Facility Type

(1) **Hospital**
NFPA 99 Definition: Hospital
NFPA 101 Occupancy Type: Health Care

a) Basic: Install Transient Voltage Surge Suppression at the main electrical service, telephone, data, cctv, and mctv service connection panels. `

Building service ground resistance shall be 10 ohms or less as measured using the fall of potential method. Test results shall be posted adjacent to the main electrical service panel directory.

Electronic equipment specifications shall include a selection factor of low Total Harmonic Distortion (THD). Example: electronic ballast for fluorescent light fixtures shall have less than 20% THD. AC Distribution Systems - Four hundred eighty volts system 3 phase is recommended when economically feasible as opposed to 208 volts 3 phase. Connect electronic loads near the source not at a downstream panel. Do not use 120 volts for the distribution voltage.

b) Additional: Transient voltage surge suppression shall additionally be provided at electrical subpanels and branch circuits when facility conditions indicate this need. An example of a potential application would be to provide surge protection on branch circuits with dedicated fluorescent lighting/electronic ballast loads with localized surge activity.

Isolation transformers with shielded windings should be provided for disturbances on the power system conductors.

K-rated or E-rated transformers should be provided to handle non-linear loads in the hospital power distribution system.

Noise filters should be provided when low energy, high frequency noise is on conductors.

Harmonic filters should be provided to trap harmonic currents from being fed back to line.

Standby power system (battery-inverter type) operating as an Uninterruptible Power Supply (UPS) is required provide power for electronic equipment when utility power fails.

Power factor (PF) correction capacitors will be installed when the PF measured at the main electrical service entrance is less than 0.9.

(2) **Ambulatory Health Care Center**
NFPA 99 Definition: Ambulatory Health Care Center
NFPA 101 Occupancy Type: Ambulatory Health Care

a) Basic: Install Transient Voltage Surge Suppression at the main electrical service, telephone, data, cctv, and mctv service connection panels.

Building service ground shall be 10 ohms or less as measured using the fall of potential method. Test results shall be posted adjacent to the main electrical service panel directory.

Electronic equipment specifications shall include a selection factor of low Total Harmonic Distortion (THD). Example: electronic ballast for fluorescent light fixtures shall have less than 20% THD.

b) Additional: Transient voltage surge suppression shall additionally be provided at electrical subpanels and branch circuits when facility conditions indicate this need. An example of a potential application would be to provide surge protection on branch circuits with dedicated fluorescent lighting/electronic ballast loads with localized surge activity.

Isolation transformers with shielded windings should be provided for disturbances on the power system conductors.

Noise filters may be required when there is low energy, high frequency noise on conductors.

Harmonic filters should be provided to trap harmonic currents from being feed back to line.

Standby power system (battery-inverter type) operating as an Uninterruptible Power Supply (UPS) is required to provide power for electronic equipment when utility power fails.

Power factor (PF) correction capacitors may be installed when the PF measured at the main electrical service is less than 0.9.

K-rated or E-rated transformers to handle non-linear loads in the hospital power distribution system may be provided.

(3) **Health Station**
NFPA 99 Definition: Medical/Dental Office
NFPA 101 Occupancy Type: Business

a) Basic: Install Transient Voltage Surge Suppression at the main electrical service, telephone, data, cctv, and mctv service connection panels.

Building service ground shall be 25 ohms or less as measured using the fall of potential method. Test results shall be posted adjacent to the main electrical service panel directory.

Electronic equipment specifications shall include a selection factor of low Total Harmonic Distortion (THD). Example: electronic ballast for fluorescent light fixtures shall have less than 20% THD.

b) Additional: Transient voltage surge suppression shall additionally be provided at branch circuits when facility conditions indicate this need. An example of a potential application would be to provide surge protection on branch circuits with dedicated fluorescent lighting/electronic ballast loads with localized surge activity.

(4) **Support Facility**
NFPA 99 Definition: Not Applicable
NFPA 101 Occupancy Type: Business

a) Basic: Install Transient Voltage Surge Suppression at main service entrance panel.

Electronic equipment specifications shall include a selection factor of low Total Harmonic Distortion (THD). Example: electronic ballast for fluorescent light fixtures shall have less than 20% THD.

b) Additional: Transient voltage surge suppression shall additionally be provided at branch circuits when facility conditions indicate this need. An example potential application would be to provide surge protection on branch circuits with dedicated fluorescent lighting/electronic ballast loads with localized surge activity.

(5) **Staff Residential Building**
NFPA 99 Definition: Not Applicable
NFPA 101 Occupancy Type: One- and Two-Family Dwellings / Apartment Buildings

a) Basic: Install Transient Voltage Surge Suppression at main service entrance panel. Electronic equipment specifications shall include a selection factor of low Total Harmonic Distortion (THD). Example: electronic ballast for fluorescent light fixtures shall have less than 20% THD.
b) Additional: Transient voltage surge suppression shall additionally be provided at branch circuits when facility conditions indicate this need. An example of a potential application would be to provide surge protection on branch circuits with dedicated fluorescent lighting/electronic ballast loads with localized surge activity.

(6) **Youth Treatment Station**
NFPA 99 Definition: Not Applicable
NFPA 101 Occupancy Type: Residential Board and Care

a) Basic: Install Transient Voltage Surge Suppression at main service entrance panel.

   Electronic equipment specifications shall include a selection factor of low Total Harmonic Distortion (THD). Example: electronic ballast for fluorescent light fixtures shall have less than 20% THD.

b) Additional: Transient voltage surge suppression shall additionally be provided at branch circuits when facility conditions indicate this need. An example of a potential application would be to provide surge protection on branch circuits with dedicated fluorescent lighting/electronic ballast loads with localized surge activity.

21.5.8 Building Automation Systems

21.5.8.1 Purpose. This section of technical handbook chapter 21.5 provides guidelines for selecting building automation systems (BAS) in health care facilities.

21.5.8.2 Background. There is considerable diversity in IHS facility types and locations. This, coupled with the large number of acceptable operational strategies, makes it impossible to absolutely define building automation system architecture or its implementation for each occupancy or building type. A more flexible and reasonable method is to consider general requirements that have led to successful installations. The following information is intended to assist Area Office Project Managers, Engineering Services (ES) Project Managers, and Service Unit representatives to understand and consider an appropriate building automation system for inclusion in project design.

The technological revolution in the computer field has directly affected BAS. The technology now allows for dependable direct digital control of a wide variety of equipment that has traditionally been controlled by pneumatic systems.

This new technology comes at a time when buildings need to become more efficiently operated and dependable. The appropriate use of BAS permits increased monitoring and control of specified environmental conditions, energy consumption, and equipment status and performance within the facility. It encourages increased equipment efficiency and reliability through the use of dynamic feedback and data comparison, which can be used to detect trends and/or changes from the original or normal readings. This information can even be analyzed at locations that are remote from the facility itself. These capabilities allow BAS to also offer significant improvements to the risk management and quality assurance activities of health care facilities.

21.5.8.3 Guidance. Building automation systems can be used to ensure proper environmental conditions within a facility. The Indian Health Service (IHS) will consider installation of BAS in all health facilities being constructed new or undergoing renovation. Where appropriate, IHS will plan projects to include BAS in health care facilities. BAS may also offer cost effective features on small projects.

(1) Applications The users and designers must determine, early in the planning and development phases of projects, the building systems or environments that will be controlled or monitored by the BAS. The Area, ES, and the Service Units will each have a role in determining the degree to which each building system will be controlled or monitored. During the selection of the BAS, The designers must ensure that the selected BAS is integrated with existing and proposed systems so that it operates effectively and efficiently, e.g., it must demonstrate that it saves energy, that complies environmental requirements, that is easy to operate, that may be easily upgraded or expanded, that support services are available nearby; that acquisition, installation and operation and maintenance costs are reasonable, that the system is reliable and meets the facility long term needs, and that it has the capability to interact with the various types of equipment or systems it controls or monitors. The design effort must ensure that the technical specifications clearly define the system's salient features. It should also be compatible with a facilities maintenance management program.

The minimum requirements for installing a BAS for a renovation or expansion project should match those mentioned above. In addition, the new system must be compatible with any existing control or monitoring system that is retained. The design and installation of a BAS on a renovation or expansion project in an existing facility is highly variable, and must be considered on a project specific basis. Items to be considered when determining the extent of the new system include the size of the project, the type and importance of the areas impacted by the project, the type and extent of any existing BAS, the availability of funds, the expertise of the staff maintaining the facility and the BAS, the past performance of the existing control system, and changing regulatory requirements.

The installation of BAS in new construction is highly desirable. A more comprehensive building automation system may be possible for a new facility, where it would not be possible for a renovation project on an existing facility. It should be noted that a building automation system installed in a completely new facility will dictate that the building will not be ready for occupancy until the BAS is operational and the system operators are satisfactorily trained.

(2) Priority Of Application Of BAS

The type, number, and importance of systems and equipment for inpatient health facilities are usually of a higher magnitude than those found at outpatient facilities. From a risk management perspective, the effective use of available resources is to provide

BAS at inpatient health care facilities first before outpatient facilities.

Most Indian Health Service outpatient facilities are located at remote sites and are not usually occupied 24 hours per day. Therefore, the need to assess the status of plant equipment during occupied and unoccupied hours at these facilities will often be justified. The declining cost of BAS allows an appropriate level of control and monitoring for both inpatient and outpatient facilities.

(3) Suggested Systems and Formats

Most problems with the operation of BAS are not caused by failure of the system, but rather from the operator not understanding the system well enough to make it work for the staff. It is expected that a complex building automation system will require considerable resources in staff time as well as operating funds for operator training and development. Adequate training must be included so that staff operating the BAS fully comprehends the theory of operation of the systems being controlled, as well as the operational theory of the BAS itself. From this perspective, it is important that the designer carefully consider the staff's ability to operate the selected building automation system. The designer should work with the staff responsible for maintaining the BAS to ensure that they understand the difference between the two main types of programming for BAS: line-by-line programming and graphic interfacing. Designers of successful systems ensure that the owner has a vested interest in the type of system selected and its operation.

(4) Systems and Points to be Included in the BAS

The following systems and points should be considered for monitoring and controlling by the building automation system. The selected points should be controlled and monitored at a central location, as well as from remote workstations or computers.

a) Air Handling Units

- Damper and valve actuators - control and position
- air and fluid temperatures
- motor status
- motor start-stop
- filter pressure drops
- humidifier control and humidistat alarm conditions relative to specific sequence of operation or application flow rate
- static pressure status
- flow rates

b) Terminal Equipment

- space thermostats
- reheat coil controls
- duct coils
- VAV boxes

- alarm conditions relative to specific sequence of operation or application

c) Perimeter Baseboard Zones

- valve control
- pump start-stop
- pump status
- zone and fluid temperature sensors
- alarm conditions relative to specific sequence of operation or application

d) Fire Alarm and Fire Suppression (components addressable - each with unique address)

- status of all central fire alarm panels
- water flow and pressure switches
- temperature sensors
- smoke detectors
- smoke and fire dampers
- pull stations
- horns
- lights
- valve supervisory switches
- magnetic door holder at fire and smoke doors
- alarm conditions relative to specific sequence of operation or application

e) Security

- status of central panel
- status of each addressable security sensor or relay
- alarm conditions relative to specific sequence of operation or application

f) Vertical Transport

- status of all elevator control panels
- status of all elevator pit sump pumps
- sump moisture detector
- alarm conditions relative to specific sequence of operation or application

g) Medical Gases

- central oxygen manifold cylinder bank in use status (primary/reserve)

- central oxygen pressure
- central oxygen general unit alarm to annunciate any alarm monitored by local equipment panel
- central nitrous oxide manifold cylinder bank in use status (primary/reserve)
- e. central nitrous oxide pressure
- central nitrous oxide general alarm to annunciate any alarm monitored by local equipment panel
- for each medical gas zone panel;
  - oxygen pressure
  - nitrous oxide pressure
  - medical air pressure
  - medical vacuum pressure
  - dental air pressure
  - general zone alarm to annunciate any alarm monitored by local equipment
  - general unit alarm to annunciate any alarm monitored by local equipment
- status of medical air compressor
- status of medical vacuum pump
- dental vacuum pump suction pressure

h) Laboratory Flow Hoods

- fan status
- fan start/stop
- air flow switch
- air volume control based on sash opening height

i) General Exhaust Fans

- fan status
- fan start/stop
- air flow

j) Boiler Plant Equipment (boiler typically controlled by boiler manufacturer provided packaged control system - BAS monitors only)

- boiler status
- boiler start/stop
- boiler general alarm
- supply header pressure or temperature
- supply header set point
- return header pressure or temperature

- flowmeters for steam
- glycol make-up pump status
- hydronic circulating pump
    - status
    - start-stop
    - pump failure alarm
    - lead/lag control
- alarm conditions relative to specific sequence of operation or application
- stack temperature
- fuel consumption

k) Chilled Water Pump

- pump status
- pump start/stop
- flow rate

l) Domestic Water Hot Water Generators

- circulating pumps
- temperatures
- flow rates

m) Water Softener

- status
- alarm conditions relative to specific sequence of operation or application

n) Incinerator

- burner status
- secondary combustion chamber temperature
- alarm conditions relative to specific sequence of operation or application

o) Chillers (controlled by manufacturer's self contained, packaged control system, interlock unit control panels with BAS. Allow override of unit controls by BAS)

- chiller status
- chiller start/stop
- lead/lag chiller selection
- chilled water return temperature - each circuit
- chilled water supply temperature - each circuit

- master chilled water supply setpoint
- general unit alarm to annunciate any alarm monitored by local unit controls
- chilled water flow rate through chiller
- vaporator refrigerant pressure and temperature
- condenser refrigerant pressure and liquid temperature
- compressor refrigerant discharge temperature
- compressor refrigerant suction temperature
- pressure at chilled water inlet and outlet
- pressure of condenser water at inlet and outlet
- alarm conditions relative to specific sequence of operation or application
- condenser water flow rate

p) Dietary Walk-in Freezers

- compressor status
- freezer space temperature

q) Blood Banks

- blood bank temperature

r) Fuel Supply Systems

- storage tank fluid level
- leak detectors
- transfer pump status
- general leak detection alarm panel

s) Essential Electrical Systems

- generator status
- generator oil pressure
- generator cooling fluid temperature
- transfer switch status
- voltage for each phase
- amperage for each phase
- total run-time
- general alarm from unit's control panel
- frequency
- total load (KW, KVA) at system bus

t) Electrical Service Metering

- shall comply with 42 U.S.C. § 8253(e), Metering of Energy Use

- provide housing for utility meter of energy use (KW, KVA, Power Factor, and THD)
- all New Constructions and Major Renovations, install advance meters on the feeder line entering the healthcare facility or staff quarters
- if the budget permits, sub-meter for high-energy end uses (e.g., high intensity loads, Chillers, AHU, etc.)
- install a separate advance meter for renewable energy sources
- incorporate the advance meter into the facility Data Management System (DMS)
- the DMS shall be able to automate the capture of real time information and perform data analysis functions per specifications

u) Natural or Liquefied Gas

- provide energy usage

v) Nurse Call System

- power status
- trouble alarm

w) Lighting

- general and/or specific areas

x) Specific Relative Pressure/Temperature Alarms

- operating rooms
- nursery
- ICU
- computer room
- isolation rooms
- laboratory

End of Chapter 21.5 Electrical Guidelines

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Appendix A – Standby System Risk Calculation (SSRC) Form

Facility: ____________________ Location: ____________________

Evaluator: ____________________ Date: ____________________

A. Type Occupancy

Type:	1	2	3	4	5	6	7	
Index Score:	10	8	8	5	4	2	1	________

B. Utility Variance History

Variance:	>10%	6%-9%	0%-5%	
Index Score:	10	6	0	________

C. Persons Resident (Overnight)

Number:	≥ 16	10-15	1-9	
Index Score:	10	7	5	________

D. Full Time On-Site Maintenance Staff (trained to maintain/operate generator)

Yes/No:	Yes	No	
Index Score:	5	0	________

E. Utility Feeder Type

Feeder Type:	Single Radial	Dual	Grid	
Index Score:	10	5	1	________

F. Designated by Emergency Management Plan for Continuous Service (NFPA 99 Ch. 12)

Yes/No:	Yes	No	
Index Score:	10	0	________

SUBTOTAL (A to F): ________

G. Utility Power Outage History Index 15 Minute Outages Per Year (record of last 3 years from local utility co.)

Outages:	0-1	2-3	4-6	6-12	≥13	
Index Score:	5	4	3	2	1	________

Calculate SSRC Value

Total A to F		G		SSRC Value
	÷		=	

YES: ________ Standby System Generator Supported .... (SSRC Value greater than 8)
YES: ________ Portable Standby System Generator Connections Only .... (SSRC Value = 5, 6, 7, 8)
NO: ________ Standby System Generator Is Not Justified .... (SSRC Value less than 5)

Appendix A – Standby System Risk Calculation (SSRC) Form Definitions

A. Type Occupancy

1. Hospital 10
2. Ambulatory Health Care Center.. 8
3. Large Health Center greater than 920 GSM 8
4. Alcohol/Substance Abuse Program Facility (ASAP) 5
5. Health Clinic or Station 920 GSM or less 4
6. Staff Residential Building 2
7. Support or Other Facility.. 1

B. Utility Variance History

Greater than 10% voltage variation.. 10
Between 6% and 9% voltage variation 6
0-5% voltage variation 0

C. Persons Resident (Overnight)

16 or greater 10
10 to 15 7
1 to 9 5

D. Full Time On-Site Maintenance Staff (Trained to maintain/operate generator)

Yes 5
No 0

E. Utility Feeder Type

Single Radial Line Feed.. 10
Dual Line Feed.. 5
Grid Line Feed 1

F. Designated by Emergency Management Plan for Continuous Service (NFPA 99 Ch.12)

Yes 10
No 0

G. Utility Power Outage History Index 15 Minute Outages Per Year (Record of last 3 years from local utility co.)

0 to 1 5
2 to 3 4
4 to 5 3
6 to 12 2
13 or Greater.. 1