

Healthcare Facilities Management

Module 3: Operations & Maintenance

Student Workbook



Lesson 12 ~ O & M 4



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4

BIM

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Computer Aided Design (CAD)

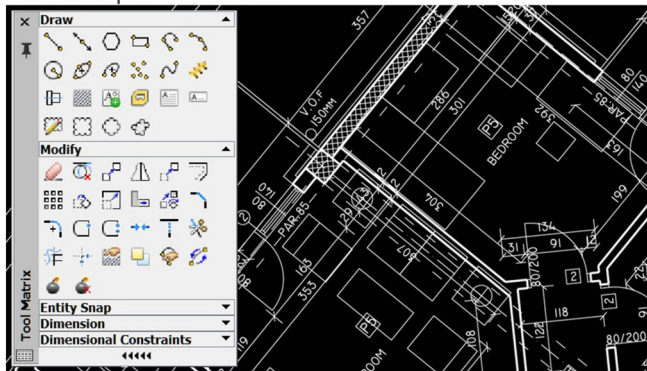
Computer-aided design (CAD) is the use of computer systems to aid in the creation, modification, analysis, or optimization of a design.

- Increase the productivity of the designer
- Improve the quality of design
- Improve communications through documentation
- Create a database for manufacturing

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Computer Aided Design (CAD)

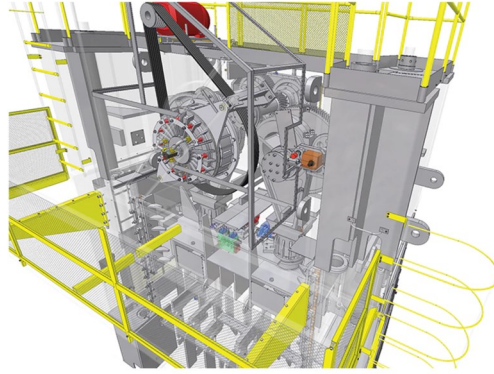
2D Example ~ CorelCAD



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Computer Aided Design (CAD)

3D Example ~ Autodesk



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Computer Aided Design (CAD)

3D Example ~ CorelCAD



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Computer Aided Design (CAD) vs. (BIM) Building Information Modeling

CAD

- "the use of computer technology for design and design documentation. CAD software replaces manual drafting with an automated process."

Autodesk

BIM

- "Building Information Modeling (BIM) is a digital representation of physical and functional characteristics of a facility. A BIM is a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle; defined as existing from earliest conception to demolition."

U.S. National BIM Standard Project Committee

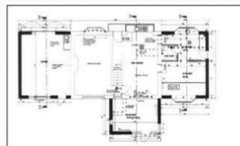
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Computer Aided Design (CAD) vs. (BIM) Building Information Modeling

CAD versus BIM

Computer Aided Design

- Primarily 2D
- Dumb graphics
- Lines, arcs, circles
- AutoCAD



Building Information Modeling

- 2D 3D 4D 5D 6D & beyond
- Intelligent objects
- Walls, windows, floors, roofs
- Revit



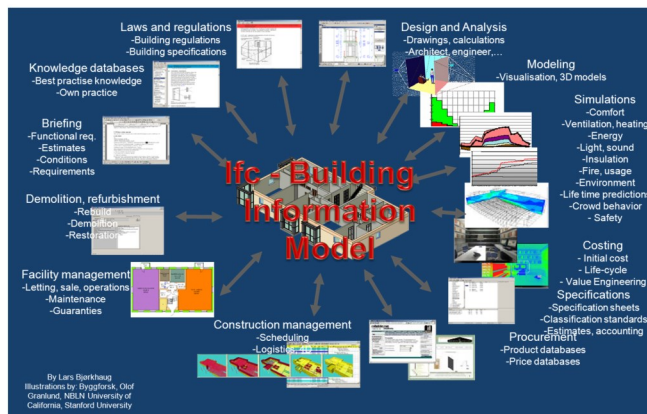
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Building Information Modeling (BIM)

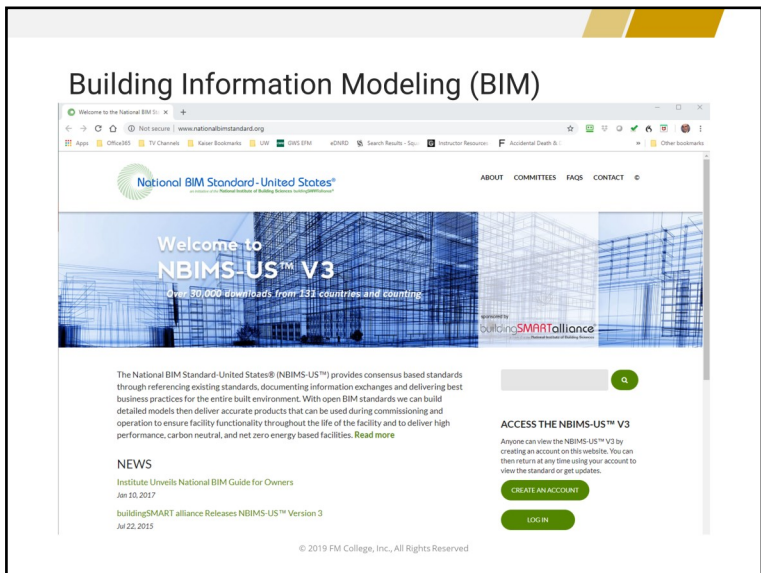
- What is BIM?
 - Building Information Modelling (BIM) is the process of creating information models containing both graphical and non-graphical information in a Common Data Environment (CDE) (a shared repository for digital project information).
- 3D (The shared information model)
 - 3D BIM is perhaps the BIM we are most familiar with - the process of creating graphical and non-graphical information and sharing this information in a Common Data Environment (CDE).
- 4D (Construction sequencing)
 - 4D BIM adds an extra dimension of information to a project information model in the form of scheduling data.
- 5D (Cost)
 - The benefits of a costing approach linked to a model include the ability to easily see costs in 3D form, get notifications when changes are made, and the automatic counting of components/systems attached to a project.
- 6D BIM (Project lifecycle information)
 - Sometimes referred to as integrated BIM or iBIM, 6D BIM involves the inclusion of information to support facilities management and operation to drive better business outcomes.

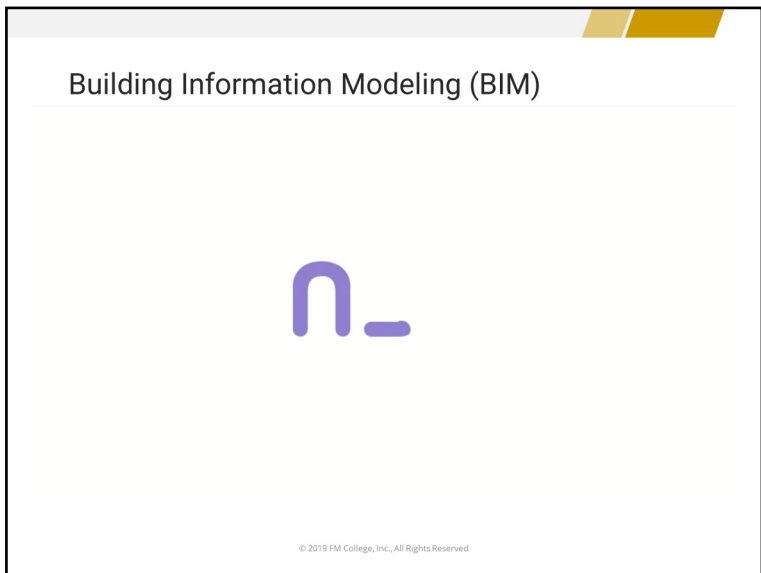
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Building Information Modeling (BIM)



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GIS

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Geographical Interface Systems (GIS)

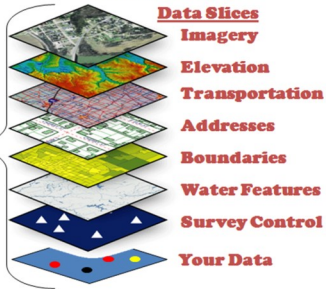
What is GIS?

The Real World



➤ Identify Problems
➤ Monitor change
➤ Perform forecasting
➤ Set priorities
➤ Understand trends
➤ Manage & respond to events

GIS World Model



Data Slices
Imagery
Elevation
Transportation
Addresses
Boundaries
Water Features
Survey Control
Your Data

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Geographical Interface Systems (GIS)

Maps

- Maps are the geographic container for the data layers and analytics you want to work with.
- GIS integrates many different kinds of data layers using spatial location.

Analysis

- Spatial analysis lets you evaluate suitability and capability, estimate and predict, interpret and understand

Apps

- Apps provide focused user experiences for getting work done and bringing GIS to life for everyone.

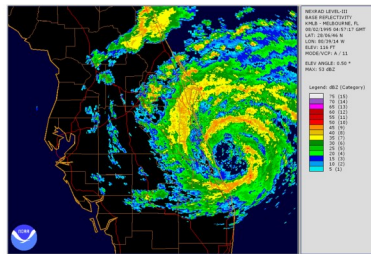


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Geographical Interface Systems (GIS)

FM Uses:

- Real estate portfolio management
- Asset management
- Sustainable facility operations
- Increasing organizational productivity
- Emergency preparedness and business continuity



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Geographical Interface Systems (GIS)



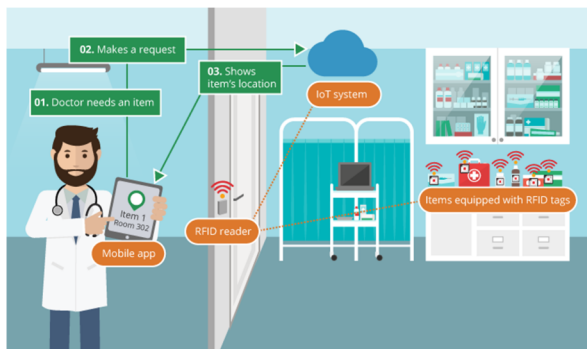
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RFID

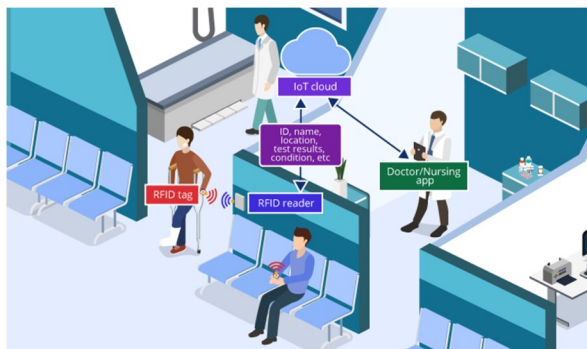
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RFI – Equipment Tracking example



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RFI – Patient Tracking example



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RFID ~ Main Features

- Able to Read and Write data without direct contact
- By "combining an item with its information", a highly pliable and reliable system configuration becomes possible
- With the adoption of space transmission technology and protocols, highly reliable communication is made possible
- Reading and writing is possible without line of sight, u
- Can simultaneously access information of multiple RF tags sing electric and electromagnetic wave transmission



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MBCx

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Monitoring Based Cx: MBCx

Commissioning for Performance

- MBCx - process that ensures that new and existing buildings achieve optimum performance
- MBCx utilizes
 - Energy metering info from electrical, gas and thermal meters
 - Energy targets from energy models
 - Trend-logs from building control systems
 - Equipment Sequences of Operation (SOO)
- MBCx provides
 - Rigorous assessment of building performance
 - Identification of performance discrepancies
 - Adjustments to building use and control sequences for ensuring optimum performance

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Monitoring Based Cx: User Interface

Example

The screenshot shows the 'Diagnostics' module interface. It includes a search criteria section, a table of 132 data records, and a 'Tasks' column. A red circle highlights a 'Tasks' entry with a 'Call' icon, and a text box points to it with the text 'Don't show me 100 Problems, Prioritize what is most worthy of my time and attention'.

Building	Equipment	Subtask	Start Date	Notes Summary	Tasks	Call	E	C	M
Building 2	BP02_APR03 (Air Handler)	AHU Calls	7/14/2016	Leading heating valve. Return air higher than setpoint. Supply temp increase.	3	144			
Denns Headquarters	AP03_3 (Air Handler)	AHU Calls	7/14/2016	Simultaneous heating and cooling. Leading cooling valve.	3	114			
Building 1	BP01_APR02 (Air Handler)	AHU Fan	7/14/2016	Fan on while unoccupied. Return air flow lower than typical. Monitor for control.	0	93			
Building 4	BP04_APR03 (Air Handler)	AHU Calls	7/14/2016	Simultaneous heating and cooling.	0	117			
Building 2	BP02_APR03 (Air Handler)	AHU Economizer	7/14/2016	Excess mechanical cooling. OA Damper should be max. Flow imbalance.	0	131			
Building 3	BP03_APR03 (Air Handler)	AHU Calls	7/14/2016	Simultaneous heating and cooling.	0	114			
Denns Headquarters	AP03_1 (Air Handler)	AHU Economizer	7/14/2016	Heating air economizer should be off. OA Damper should be on.	0	110			

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Monitoring Based Cx: Opportunities

<p>Air Distribution</p> <ul style="list-style-type: none"> AHUs Coils Economizers Heat Recovery 	<p>Zones</p> <ul style="list-style-type: none"> VAVs FCUs DX Units 	<p>Cooling</p> <ul style="list-style-type: none"> Central Plant Chillers Cooling Towers Air Cooled Condensers 	<p>Fault Detection and Diagnostics</p> <p>1) Faults – and their cost</p> <ul style="list-style-type: none"> • Simultaneous heating & cooling • Stuck dampers • Leaking valves • Sensor malfunctions • Manual overrides • Short cycling • System Fouling
<p>Heating</p> <ul style="list-style-type: none"> Central Heating Plant Hot Water Loop Boilers 	<p>Plant</p> <ul style="list-style-type: none"> Secondary Loops Pumps Heat Exchangers Storage Tanks 	<p>Utility Meters</p> <ul style="list-style-type: none"> Electric Gas Steam Water 	<p>2) Sequence Improvements – and value</p> <ul style="list-style-type: none"> • Economizing control opportunities • Equipment staging opportunities • Improving temperature and pressure reset strategies • Implementing scheduling

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Monitoring Based Cx: Key Components

- Building DDC System
- Building Energy Model(s)
- Energy End-use Sub-metering
- Metering System Calibration Tools
- Data Acquisition System and Remote Database
- Energy Management Analytics
- Maintenance Analytics
- Occupant Comfort Analytics

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Monitoring Based Cx: Case Study

PROGRAM AT A GLANCE
Location: [Redacted]

Facility
[Redacted]

RESULTS
Over \$1,400,000
[Redacted]

Fortune 500 Pharmaceutical Manufacturer Implements Portfolio-wide FDD

Challenge:
[Redacted]

Organizational Benefits:
[Redacted]

9,900
Equipment Assets

15,000,000
Square Feet Analyzed

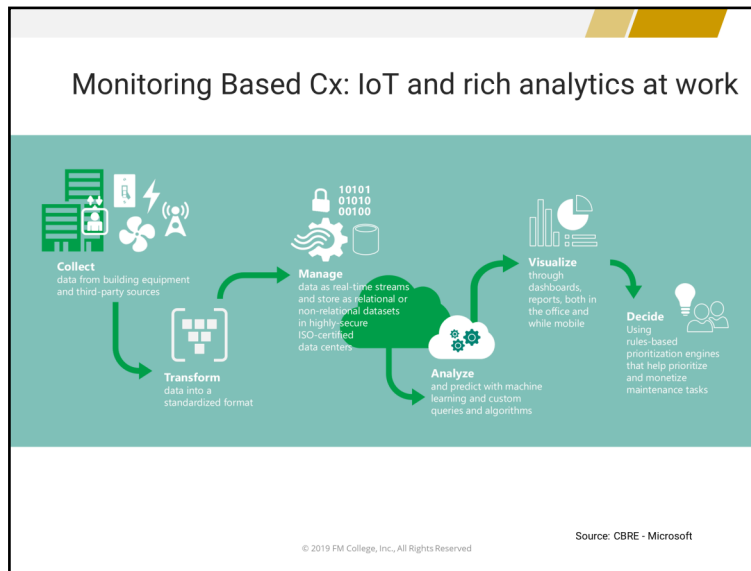
74
Mile Drives

8,100,000
Dollars Saved

Adobe Acrobat Document

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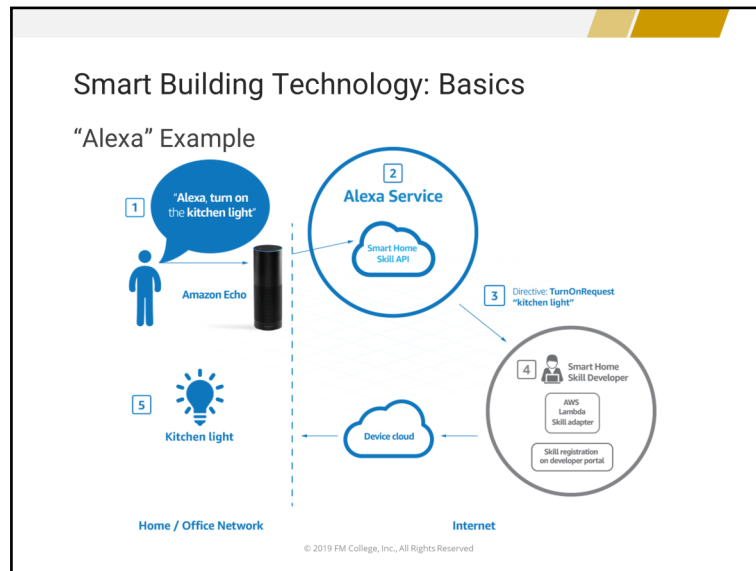
Monitoring Based Cx: IoT and rich analytics at work



8

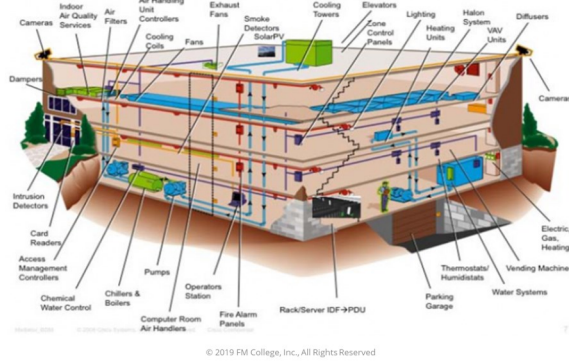
Smart Buildings and IoT

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Smart Building Technology: Integrate

Today's building systems and components must communicate



Smart Building Technology: Innovate

The Internet of Things in Smart Commercial Buildings 2018 - v3.0



Smart Building Technology: Future

IoT Smart Building Trends

- Predictive maintenance
- Air Quality Measurement
- IoT supported Complex Applications
- Measurement and Verification using IoT
- Real-time Data Accessibility
- IoT in Green building movement
- IoT and prefabricated building components

- IoT in efficient construction management
- IoT for Energy Efficiency
- IoT for Better Asset Optimization



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MODULE 04-G UTILITIES

Utility Management Program, Shutdowns, Outages

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1

Program Description

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Utility System: Definition

Building systems that provide support to the environment of care, including:

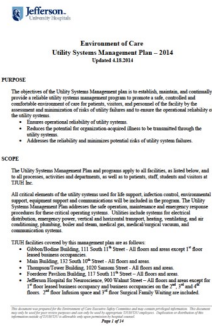
- Electrical distribution and emergency power
- Vertical and horizontal transport
- Heating, ventilating, and air conditioning (HVAC)
- Plumbing
- Boiler, and steam
- Refrigeration
- Piped gases;
- Vacuum systems
- Fire alarm and suppression systems
- Communication systems, including data exchange systems.

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Manage the Utility Management Program

Program description

- Purpose
- Scope
- Objectives
- Authority
- Risk Assessment
- Performance Elements
- Orientation and Education
- Program Effectiveness
- Performance Monitoring
- Annual Evaluation



Sample (from web)

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Manage the Utility Management Program

- Indoor Air Quality (IAQ) for High Risk Areas
- Maps and Distribution of Utility Systems Layout and Controls
- Incident Reporting and Investigation
- Orientation and Education Program
- Performance Monitoring and Improvement
- Emergency Procedures
- Annual Evaluation

<https://www.uky.edu/ppdmc/policies/category-04/40-utility-systems-management-plan>



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Coordinate utility shutdowns for construction/renovation projects

Also for:

- Maintenance, repair & testing
- Utility shutdowns
- Power outage
- Restarting
- Communications (IT, Surgery, etc.)

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Coordinate communications and resets after a momentary utility power outage



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Manage Fuel Oil Storage Systems

Manage primary and backup fuel storage systems (e.g., oil, propane).

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Investigate equipment or utility failures

Root cause analysis
Steps to prevent recurrence
Documentation

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2

Planned Maintenance

Assure that code-required maintenance is completed and documented (e.g., utilities, fire systems, medical equipment, etc.).

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E/Gen Sample PM Plan

Emergency Power SS Sample PM Plan							
System or Component	Procedure			Frequency			
	X – Completed / OK			W – Weekly	S – Semiannually		
	R – Requires Repair / Replacement • Qty as Required			M – Monthly	A – Annually		
	Visual	Verified	Replace	Q – Quarterly	** Freq	Hours as Required	
1. Fuel							
(a) Main supply tank level	250gal	X					W M
(b) Day tank level	X	X					W M
(c) Day tank float switch	X				X		W Q
(d) Supply or transfer pump operation	X	X			X		W Q
(e) Solenoid valve operation	X				X		W Q
(f) Strainer, filter, debris leg, or combination	X	X		X			Q Q
(g) Water in system	X	X		X			W Q
(h) Flexible hose and connectors	X	X			X		W M
(i) Tank vents and overflow piping unobstructed	X	X			X		A A
(j) Piping	X	X			X		A A
(k) Gasoline in main tank (if used)	N/A	Diesel					A A
2. Lubrication System							
(a) Oil level	X	X					W M
(b) Oil change		50gal	R				A A
(c) Oil filter(s)		2	R				A A
(d) Lube oil heater	120deg	X					W M
(e) Crankcase breather	X	2	R				Q S
3. Cooling System							
(a) Level	X						W M
(b) Antifreeze protection level		X			X		S A
(c) Antifreeze	37gal	X	R				A A
(d) Adequate cooling water to heat exchanger	X						W M
(e) Flood heat exchanger	X			X			A A

2019 - NFPA 110

8.1.1 – The routine maintenance and operational testing program shall be based on all of the following.

- Manufacturers Recommendations
- Instruction Manuals
- Minimum Requirements of this chapter
- The Authority having Jurisdiction

NFPA 110 includes Inspection, Maintenance, and Testing Requirements for your Complete Emergency Power Supply System (EPSS).

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3

Testing/Inspection

Assure that code-required testing is completed and documented (e.g., monthly generator test, fire protections system test).

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Facility Permits, Licenses & Certificates

Ensure that healthcare facility permits, licenses, and certificates are maintained, recorded, and current (e.g., boilers, elevator, heliport).

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Staff Permits, Licenses & Certificates

Ensure that all healthcare facility staff licenses and certificates are maintained, recorded, and current (e.g., boiler operator, electrical, refrigeration).

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2

Electrical Systems

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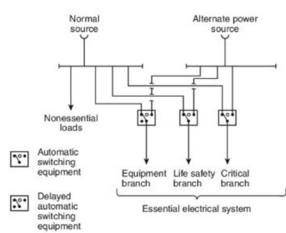
Electrical Systems

Healthcare Specific Requirements:

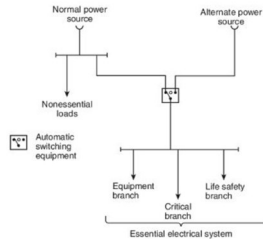
- ✓ Essential power systems (3 branches)
- ✓ Nurse call systems
- ✓ Communication systems (paging, telephone, radio, etc.)
- ✓ Security systems
- ✓ Fire alarm systems
- ✓ Infant abduction systems
- ✓ Wireless communications and telemetry

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517.29 – 31 Essential Electrical Systems for Hospitals and Other Health Care Facilities



Informational Note Figure 517.31(a) Hospital — Minimum Requirement (greater than 150 kVA) for Transfer Switch Arrangement.



Informational Note Figure 517.31(b) Hospital — Minimum Requirement (150 kVA or less) for Transfer Switch Arrangement.

NFPA 70, 2017

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Essential Electrical Systems

" ... Shall be comprised of two separate systems capable of supplying a limited amount of lighting and power service, which is considered essential for life safety and effective hospital operation during the time the normal electrical service is interrupted for any reason. These two systems shall be the Emergency System and the Equipment System."

NFPA 99, Chapter 3

Requirements:

- Life safety and critical branch are kept entirely separate of all other equipment and systems
- Outlets identified

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Emergency / Essential Electrical System

3.3.45* Essential Electrical System. A system comprised of alternate sources of power and all connected distribution systems and ancillary equipment, designed to ensure continuity of electrical power to designated areas and functions of a health care facility during disruption of normal power sources, and also to minimize disruption within the internal wiring system. (ELS)

3.3.87 Life Safety Branch. A system of feeders and branch circuits supplying power for lighting, receptacles, and equipment essential for life safety that is automatically connected to alternate power sources by one or more transfer switches during interruption of the normal power source. (ELS)

NFPA 101
NFPA 72
←

3.3.27 Critical Branch. A system of feeders and branch circuits supplying power for task illumination, fixed equipment, select receptacles, and select power circuits serving areas and functions related to patient care that are automatically connected to alternate power sources by one or more transfer switches during interruption of the normal power source. (ELS)

Life Critical
Systems
←

NFPA 99, Chapter 3, 2015

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Equipment Branch

3.3.43 Equipment Branch. A system of feeders and branch circuits arranged for delayed, automatic, or manual connection to the alternate power source and that serves primarily 3-phase power equipment. (ELS)



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THANK YOU

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