



Power Availability in Hospitals

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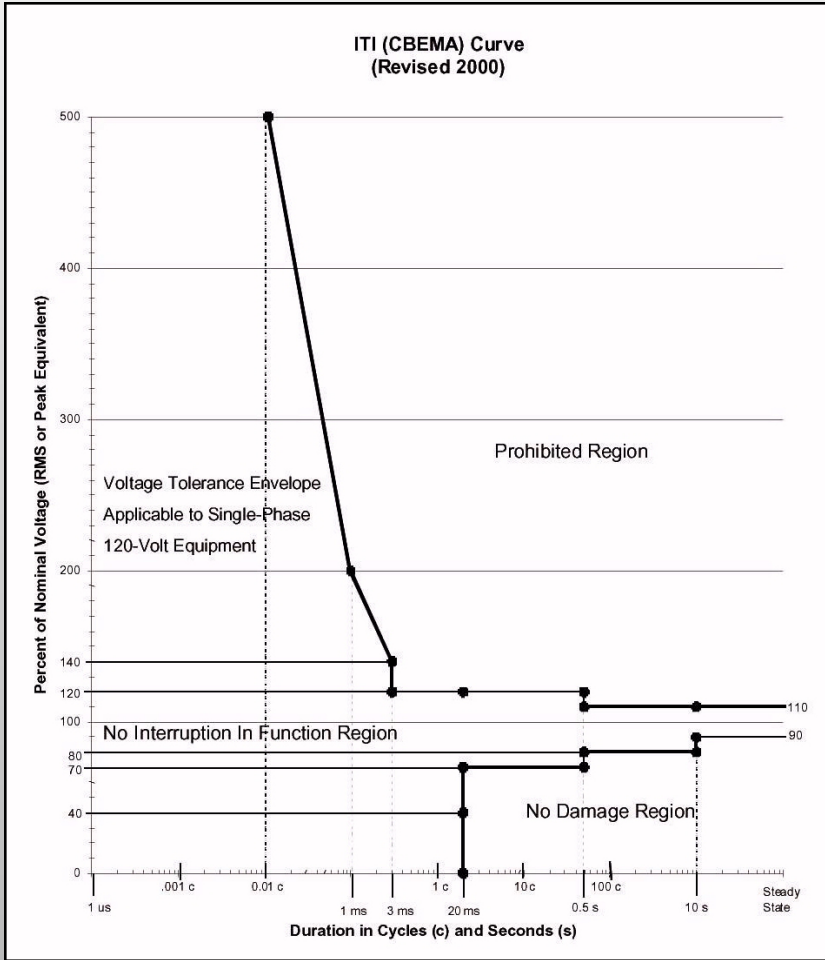




Topics that will be discussed:

- **Does this talk belong at 7x24?**
- **Are hospitals as concerned about power availability as our data center clients?**
- **Consequences of power failures**
- **What the Codes and Standards do well**
- **What the Codes and Standard don't do well**
- **Recommendations for improved power availability**

CBEMA (ITI) Curve



Horror Stories

- **"Black Thursday" in a hospital in Oregon**
- **Hurricane Allison and Texas Medical Center**
- **Providence - Rhode Island Hospital**
- **Valley General - Black Wednesday**
- **2003 Power Blackout in Northeast**



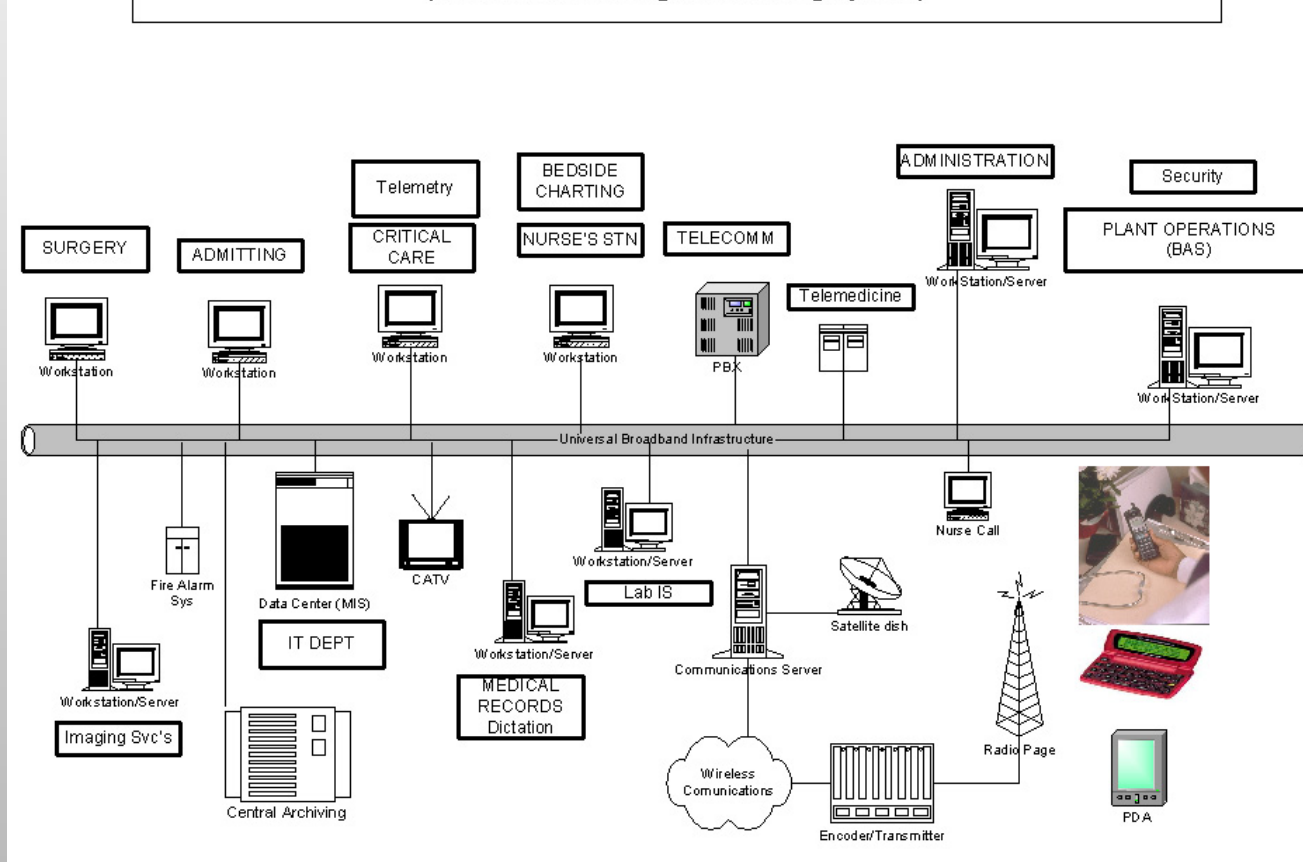
**Should the health care industry
participate in 7x24?**

Is the health care industry concerned?

- **Writers of hospital codes have been concerned about systems reliability issues for years**
- **"We don't want to put all of our eggs in one basket." – head electrician and lab manager at a hospital in Oregon.**
- **Data centers in hospitals**
- **Technology Convergence – Cause for further concern**

Technology Convergence

Designing Infrastructure to Support the Future
(Structured and Integrated Cabling System)



Vulnerable Areas of Hospitals

- **Operating Rooms**
- **Intensive Care Units (ICU) and Critical Care Units (CCU)**
- **Neonatal Intensive Care Units (NICU)**

Codes and Standards

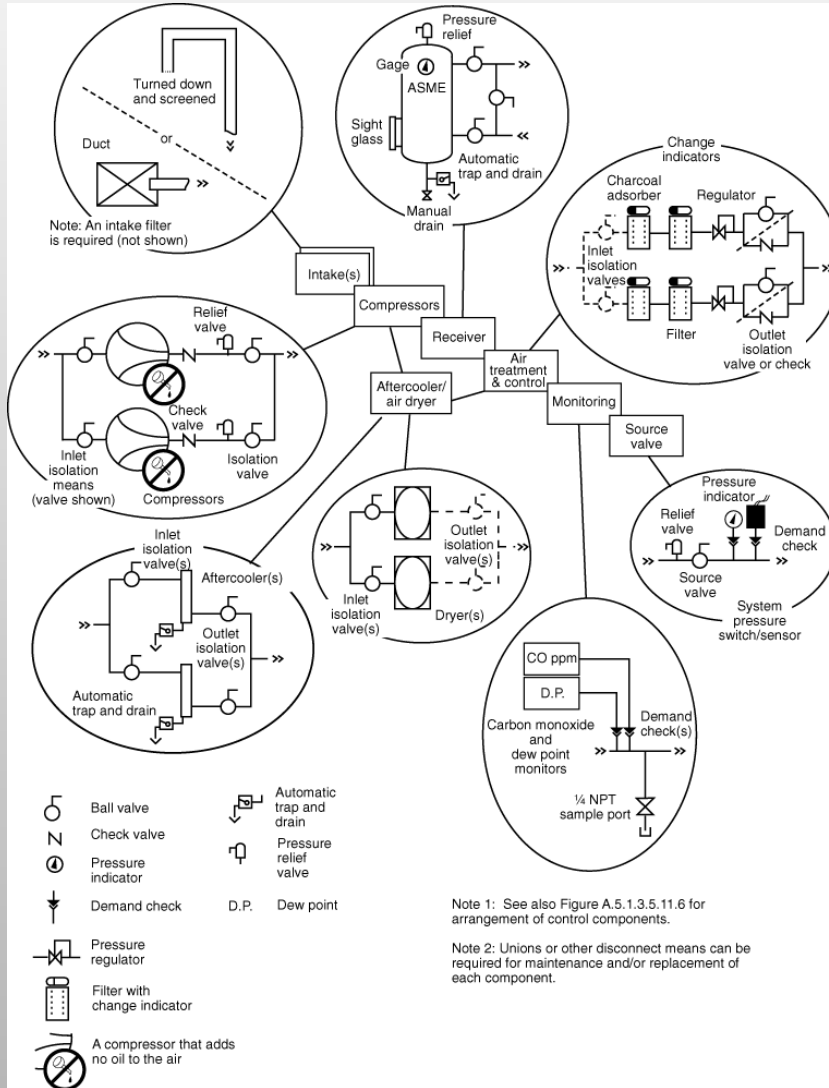
- **National Electrical Code - Article 517**
- **NFPA 99 - Health Care Facilities**
- **JCAHO - Hospital Oversight Organization**
- **WAC 246-320**
- **AIA Guidelines**
- **NFPA 110 - Emergency Generators**

What the Codes Do Well

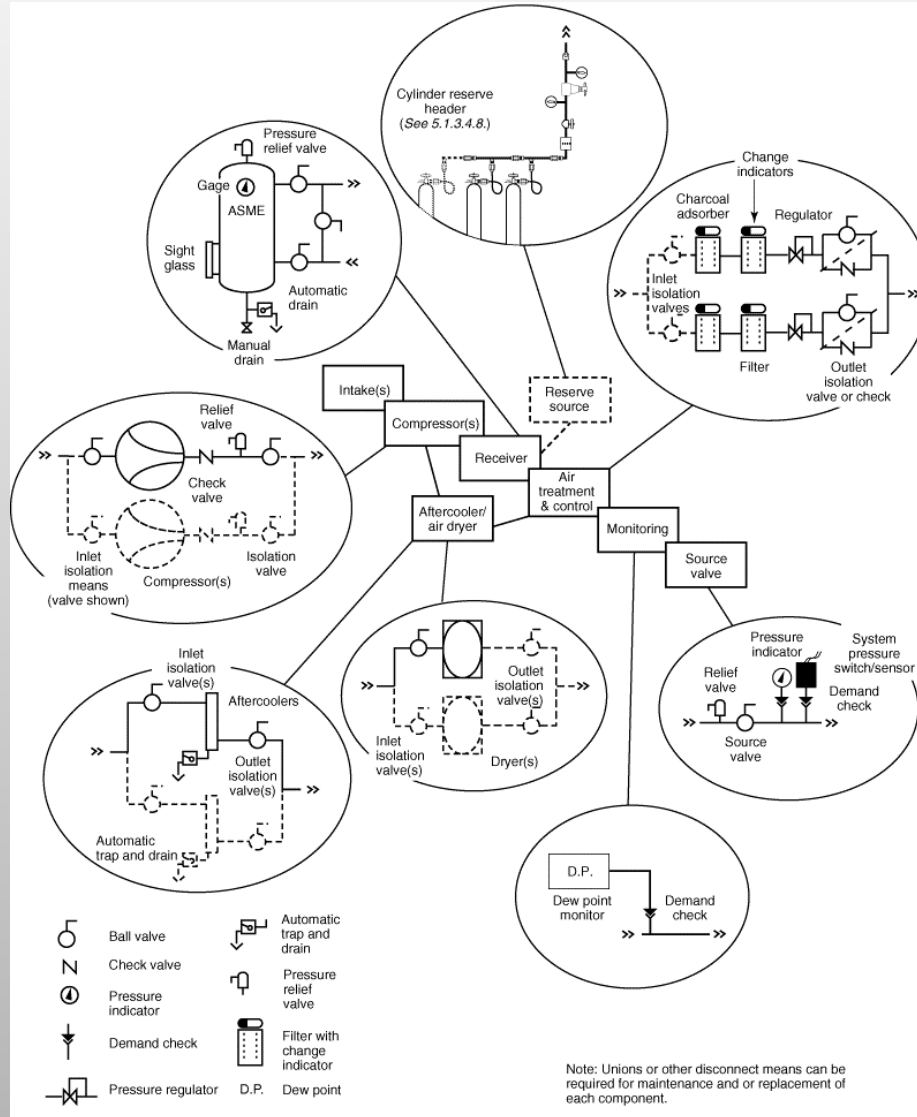
Mechanical

- **Medical Air**
- **Instrument Air**
- **Vacuum Systems**
- **Monitoring and Alarm Systems**

Medical Air



Instrument Air

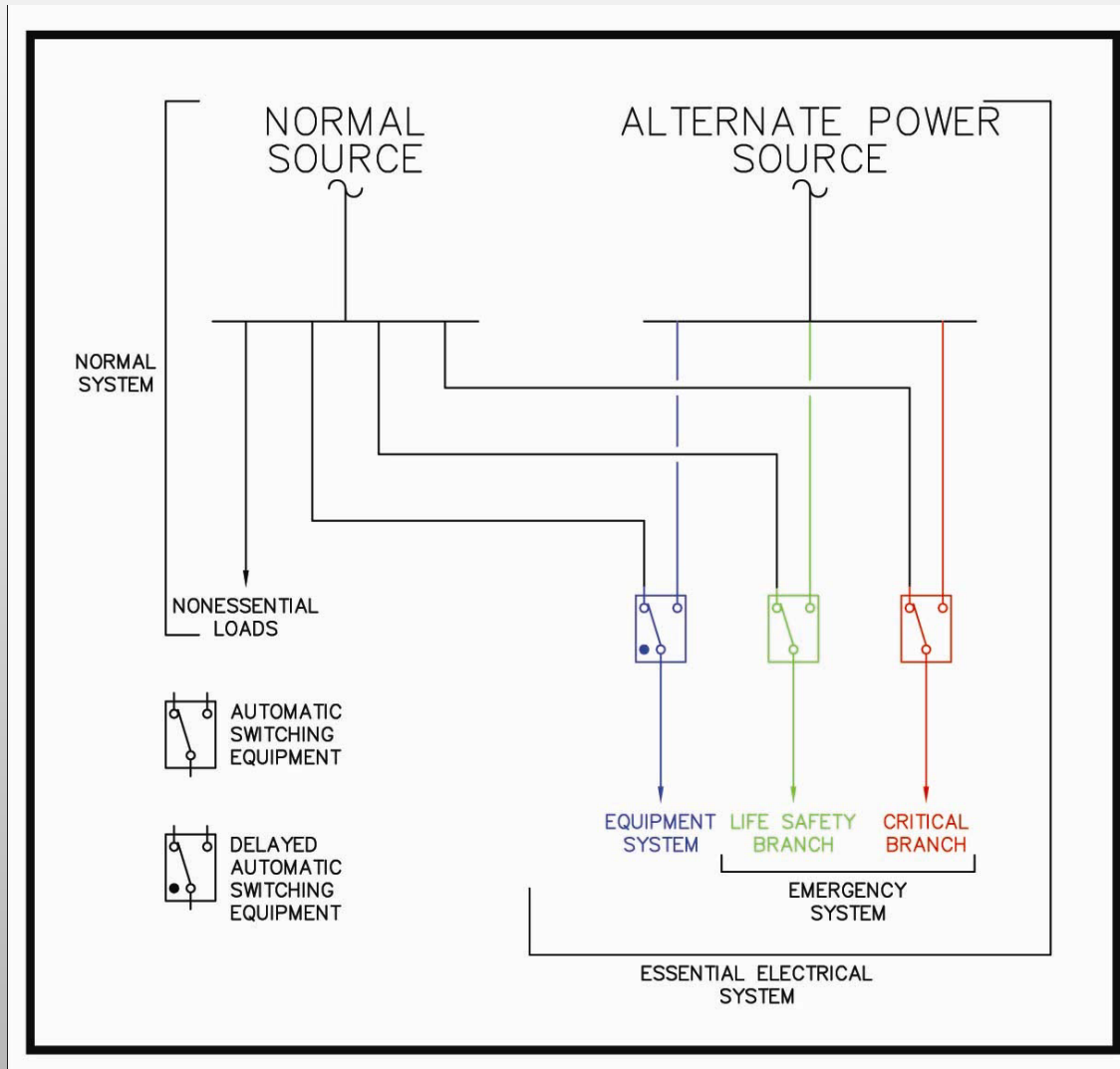


What the Codes Do Well

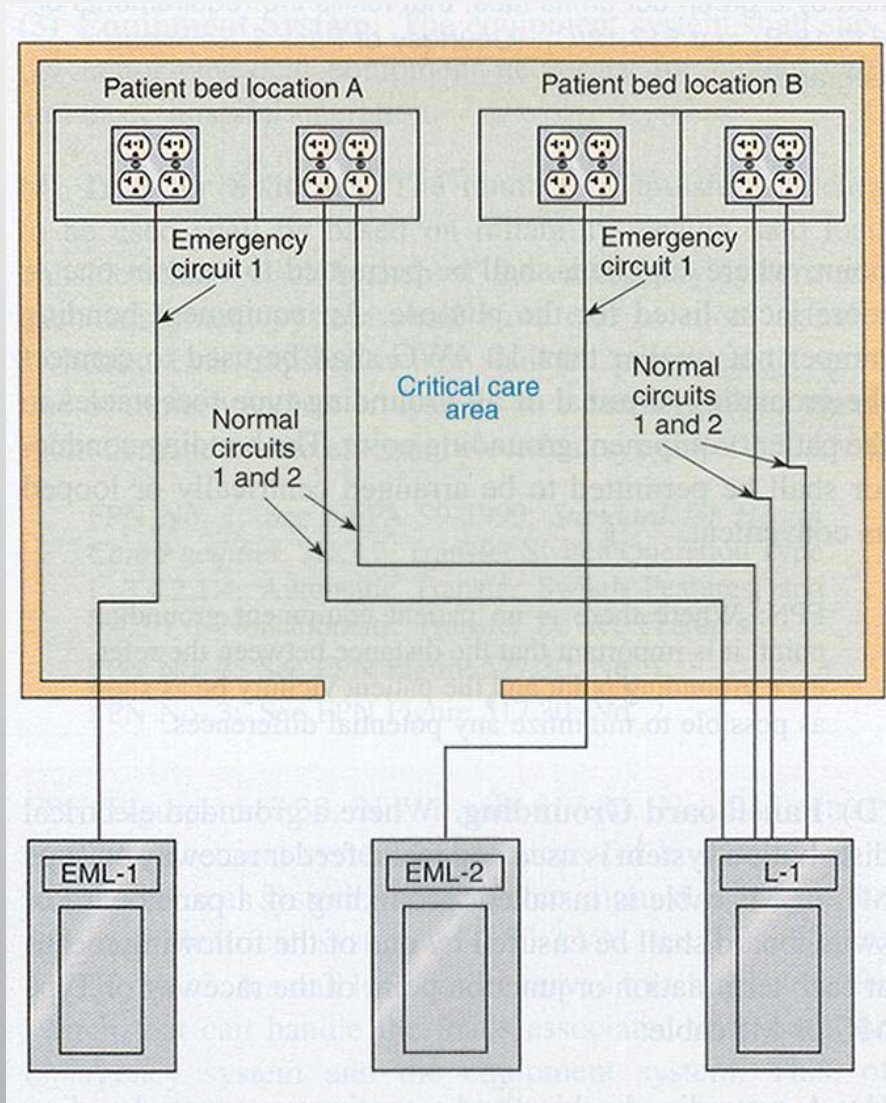
Electrical

- Segregation of power branches
- Load shedding
- Circuit breaker coordination is required.
- More than one power branch in critical care areas

Typical Hospital Power System



Patient Care Area Circuiting



What the Codes Do Well

Electrical Testing

- **Generators – Various monthly, quarterly, semi-annual, annual, and every 3-year tests and inspections**
- **Generator Batteries – Monthly visual inspections and quarterly electrolyte checks**
- **Transfer Switches – Monthly**
- **Circuit Breakers – Annually**
- **Receptacles – 4oz tension**

What the Codes Do Well

Medical Equipment

- **New programmable patient care equipment is required to be quickly resettable after a power interruption.**
- **No loss or change of program during a power outage.**
- **If loss or reset occurs, equipment must alarm.**
- **Equipment has battery back-up (theoretically).**
- **What about older equipment????**

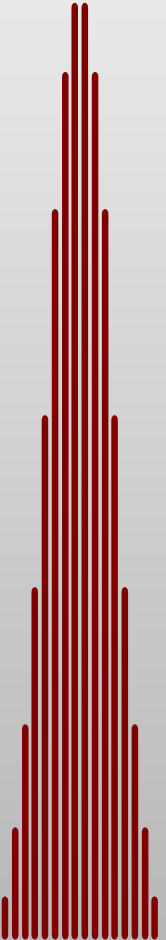
What the Codes Do Well

Medical Equipment Testing

- **Medical Equipment (General Care Areas) -
At least every 12 months**
- **Medical Equipment (Critical Care Areas) -
At least every 6 months**
- **Wet Locations - At least every six month**
- **The reality**

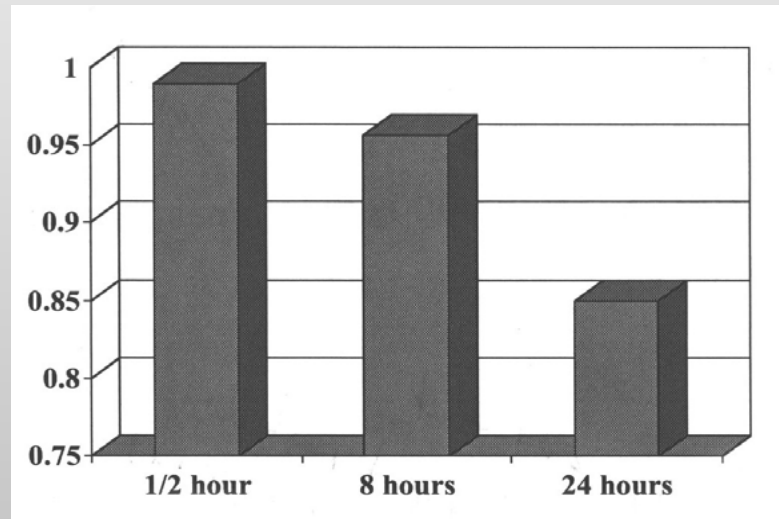
What the Codes Do Not Do Well

- Emergency generator plant is sized for load, not redundancy



Generator Reliability

- Reliability (Start, Load and Run) of Emergency Diesel Generators

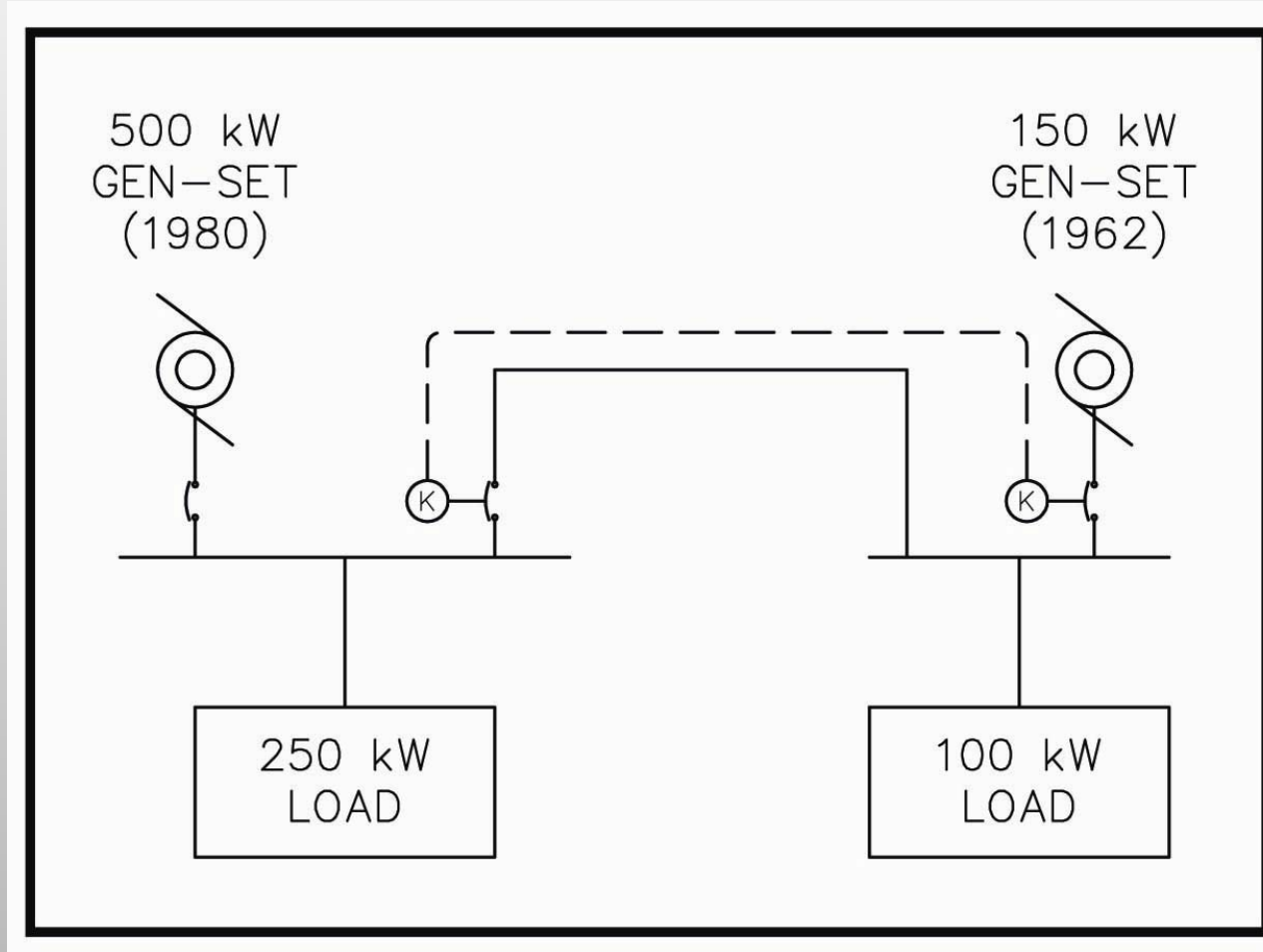


Emergency Diesel Engine Generator Power Systems Reliability
1987-1993 Grant, G.M., et al., Idaho National Engineering
Laboratory, INEL-95/0035, February 1996

What the Codes Do Not Do Well

- Lack of full commissioning
- "JCAHO certified" does not necessarily mean the hospital systems are adequate.

JCAHO Certified Hospital



What the Codes Do Not Do Well

- Common cause failure modes
 - Generators in main electrical rooms in existing hospitals
 - Electrical rooms in basements
 - Multiple generators in the same room (???)

Why don't hospitals do more?

- Don't hospitals know that this is about life and death?
- Most hospitals aren't profitable and Code writers know it.
- Hospital administrations often allocate money for cosmetic upgrades rather than infrastructure.
- Insurance industry doesn't seem to care.
- Doctors take for granted that generators will start.

Recommendations

- Suggest at least two generators (N+1 would be best).
- UPS for critical care areas.
- Closed transition bypass/isolation transfer switches or no-break bypass transfer switches. (verify with AHJ)
- Manual Transfer Switches for all critical mechanical equipment between normal and emergency branches (verify with AHJ).

Recommendations

- **Tie breakers with attention to ground fault scenarios or manual transfer switches**
- **Thorough commissioning**
- **Power monitoring systems**
- **Cogeneration Plant (?)**
- **Fuel Cells**

Hospitals and 7x24 Exchange

- Data center design should inform healthcare design.
- Health care design should inform data center design.

Questions/Comments?

