Taking Care of Business – How Hospital Electrical Shutdowns Can Facilitate Emergency Management

This paper was originally presented at ASHE's 45th Annual Conference, July 2008.

SUMMARY

This paper examines a comprehensive approach to managing hospital electrical power shutdowns in light of the increasing complexity of hospital infrastructures and operational constraints. All hospitals need to turn off their electrical power systems for modification and maintenance. This comprehensive and proactive utility management program approach uses lessons learned from the shutdowns to improve the hospital's facilities, power system reliability and training.

David L. Stymiest, PE, CHFM, FASHE, CEM, GBE
Senior Consultant – Compliance and Facility Management
Smith Seckman Reid, Inc., Nashville, TN
DStymiest@ssr-inc.com

CONTENTS

Abstract 3
Introduction 3
Shutdown Risk Assessments 5
Need for Electrical System Shutdowns 7
  Construction / Renovation Project Shutdowns 7
  Emergency power testing is not enough 8
  When should you plan for a shutdown? 8
Planning and Conducting the Shutdown 9
  Shutdown activities and tools 9
  Working with others – communication is key 9
  Basic Shutdown Management 10
  Walkthroughs – a critical activity 11
  Shutdown Scope of Work 12
  Clinical Unit and Support Service Training 12
  Short NP Planned Outages 12
  Shutdown Contingency Planning 13
  The Effect of Electrical System Design on Shutdown Costs and Durations 13
  Reporting to Other Groups 13
  Shutdown Task Force 13
  Working Groups 14
  Command Station 14
  Communicating Shutdown Information and the Shutdown Logo 14
  Generator Loading - Planned Shutdowns vs. Unanticipated Utility Outages 14
  Requests for Emergency Power Connections 15
  Elevators - A Special Concern 15
  Shutdown Planning Schedule 16
  Hold Point List 16
  The White Paper 16
After the Shutdown 17
  Lessons Learned, Emergency Management, and Sentinel Event Alert 37 17
Other Issues 19
  The Costs of Building-Wide Electrical Shutdowns 19
  Designs for Temporary Connections of Rented Generators 19
Appendix 1 - Sample Walkthrough Confirmation Memo 20
Appendix 2 – Sample Shutdown Task Force Schedule For First Shutdown 21
Appendix 3 – Sample Hold Point List: 3 Parts in 9 Pages 22
Appendix 4 – Sample Shutdown White Paper (5 Pages) 31
Appendix 5 – Sample Shutdown Feedback Form 36
Appendix 6 – Sample Lessons Learned from a Normal Power Shutdown 37
Appendix 7 – Sample 16 Hour / 2 Building Shutdown Labor 38
Endnotes and References 39

ABSTRACT

Managing hospital electrical shutdowns is more important than ever in light of increasing concern about the impact electrical power outages can have on hospital operations. Electrical distribution equipment requires regular repair or maintenance, yet often this critical work is deferred because it is too difficult for the hospital facility director to get clinical permission to turn off the power. If equipment is not regularly shut down for maintenance, unexpected failures will be more probable, and then it is too late to train the clinicians in this aspect of the Environment of Care. This management monograph demonstrates the credible need, plans, communicates, trains clinicians, and provides guidance for conducting safe, effective building-wide or multiple building electrical shutdowns, based on specific case studies and lessons learned at other hospitals. It also discusses the interrelationships between proactive shutdown management and emergency management concepts.

INTRODUCTION

Emergency Management is not just a paper exercise. New regulations require an all-hazards approach, including preparing for power outages. Many hospitals still do not maintain their electrical power systems because they will not turn them off. Why the dichotomy? Why does our unwillingness to deal with this necessity put our patients at increased risk while we plan for a result we are unwittingly helping to bring about?

An electrical "shutdown" as described here is a pre-planned and scheduled partial or full electrical distribution system outage necessary to satisfy the needs for electrical equipment modification, replacement, upgrade, maintenance, and/or repairs; support staff training and clinical unit training. Shutdowns can meet needs in all of these areas that may not be met any other way.

The purpose of this monograph is to discuss a Utility Systems Management Program approach that recognizes the imperative for planned electrical shutdowns in hospitals and builds upon their need to improve the hospital's infrastructure facilities and training, both for support services and for clinical caregivers. It also updates this monograph's predecessor [1] to reflect current issues and concepts, along with the lessons learned from Y2K preparations and several recent large electrical utility blackouts. Blackouts can be the result of localized storms, such as lightning storms, tornados, straight line windstorms, ice storms and blizzards; large weather patterns such as hurricanes; earthquakes; wildfires; electrical power grid unreliability such as the Northeast/Midwest blackout that occurred in August 2003; or any number of other emergencies, including terrorism. The shutdown processes and recommendations discussed in this monograph will prepare the hospital staff to cope with these blackouts more effectively.

Lessons learned from the large utility blackouts include the fact that sometimes equipment that was supposed to be connected to emergency power was in fact connected to normal power. These unfortunate circumstances were despite as-built documentation to the contrary and despite the understanding of maintenance and engineering personnel who were surprised when some systems went down during an extended utility blackout. Several hospitals discovered after the blackouts commenced that their emergency generators failed because the fuel oil transfer pumps or remote radiator fans were connected to normal power. Several hospitals discovered that radiology equipment connected to emergency power operated only for a short while because support equipment or ventilation and cooling equipment was connected to normal power. Only a true normal power shutdown shows the reality of what is and is not connected to emergency power.

Hospitals train their personnel to respond to internal and external disasters, including disasters affecting the utility systems. Shutdowns allow hospitals to assess the operating capabilities of the clinical and support services during utility power outages. Electrical distribution equipment can require modification, replacement, upgrade, maintenance, and/or repairs, necessitating that it be turned off. Meeting these needs requires partial, building-wide or even multi-building normal power (NP) shutdowns, depending upon the electrical system configuration.

Studies have shown that people work best in emergencies doing what they normally do. A power outage is not a normal circumstance, so how can emergency managers take advantage of this dictum as it applies to the all-hazards issue of power outages? It follows that those who have performed their jobs effectively during a planned power outage (shutdown) are more likely to cope with an unplanned power outage more effectively as well.

Depending on the needs of the facility, the shutdown planning process can involve detailed planning at several levels, comprehensive multi-level communication, brief scheduled power outages for assessment purposes, focused assessment of the shutdown impact on each space and activity, action plans for each service, shutdown contingency plans, a hold point list permitting clinical control of the process, feedback forms, an overall shutdown white paper, timely lessons learned critiques and test reports.

SHUTDOWN RISK ASSESSMENTS

The facilities that do not presently conduct electrical shutdowns for maintenance often do not because the shutdowns are perceived to be a patient safety risk. In most cases they have probably not conducted a comprehensive shutdown risk assessment (SRA) that fairly considers the impact of not conducting the shutdown. The SRA is recommended, and examples of some issues to consider follow.

The Joint Commission's risk assessment process includes the following seven steps, along with the author's commentary as to how they might be applied to the issue of conducting planned shutdowns for electrical equipment maintenance.

1. Identify the issue
    a. The issue being considered is whether to undertake a new program of carefully managed electrical shutdowns for normal power system maintenance.

2. Develop arguments for that issue. Examples of arguments that support this issue are:
    a. The electrical equipment has been operating 24/7/365 since it was installed and has never been maintained. Some of this equipment is now more than 15 or 20 years old.
    b. Some circuit breakers have already failed and will not operate when required to clear, or stop, a short circuit, but we do not know which circuit breakers these are.
    c. The hospital's facility management professionals believe that it is just a matter of time before something important fails and places the hospital in an emergency situation.
    d. The hospital is concerned about planning for power outages.
    e. Recent thermographic (infrared) scanning results have shown an increasing incidence of hot spots requiring rework.
    f. The power system vulnerability analysis has highlighted the lack of maintenance as a point of increasing system vulnerability.

3. Develop arguments against that issue. Arguments that do not support this issue are:
    a. The normal power system serving the area has an excellent operational history.
    b. We have never had a shutdown before and we have not had an internal electrical outage yet. Why disturb something that has worked so far? If it does not appear to be broken, why do we have to fix it?
    c. The hospital, or a portion of its power system, is new and can go for several more years until maintenance becomes necessary on that equipment.
    d. Hospital administration is concerned about something going wrong during the shutdown – say a generator failure – that could place patients at risk.

4. Objectively evaluate both sets of arguments. Look for empirical evidence to support each argument.
    a. Operational documentation
    b. Utility failure incident reports
    c. Maintenance documentation
    d. Thermographic inspection findings
    e. Construction / renovation (C/R) project shutdown findings and lessons learned
    f. Industry recommendations
    g. Codes and standards
    h. Internal equipment failure backup policies, plans and procedures
    i. Clinical and support service action plans that can be used during power outages
    j. Power system vulnerability analyses
    k. Emergency power gap analyses
    l. Other facilities' shutdown findings and lessons learned

5. Reach a conclusion. Examples of conclusions that might have been reached by this risk assessment are:

a. Schedule small-scale localized shutdowns at first in areas served by the oldest continuously-operating electrical equipment. This approach will allow the hospital leadership to become familiar with the shutdown management process and comfortable with its comprehensiveness.
b. Establish a utility management policy that all future C/R electrical shutdowns (which must occur because C/R projects will be completed) will allow time for maintenance of the equipment that is turned off. Schedule shutdowns with sufficient advance notice that the maintenance can be fully planned and scheduled as well. Obtain agreement from hospital leadership that C/R project management personnel will impose this policy on the hospital's contractors.
c. Require that design engineers involved in future construction / renovation work demonstrate that their designs are easily maintained and shutdown-friendly.

6. Document the [risk assessment] process.
    a. Include in the hospital's Utility Management Plan.
    b. Report to the EOC Committee.
    c. Report to the Safety Committee.

7. Monitor and reassess the conclusion to ensure it is the best decision.
    a. Include a specific date to reassess the risk assessment's conclusion.
    b. Make sure that the actions taken did indeed have the positive results anticipated.

NEED FOR ELECTRICAL SYSTEM SHUTDOWNS

What happens when electrical equipment is not maintained? Eventually it will fail. Sometimes that failure will be violent and accompanied by heat and fire. A circuit breaker is a rarity in the world of hospital infrastructure – it fails ON and you never know that it failed until it is called upon to operate and then does not do the job it was designed and installed to do.[2]

Circuit breakers that have not been maintained can fail to operate.[3] Several studies have found that circuit breakers that have not been maintained according to the manufacturers' instructions for a period of five consecutive years experience a 40% to 50% failure rate.[4, 5] Some might ask what the problem is if a circuit breaker will not open, since we want the power to stay "on" in our hospitals. Since we know that power system failures (short circuits, or faults) will occur, the well designed and well maintained power system will limit (or mitigate) the impact of the short circuit by opening, or tripping, the circuit breaker or fuse electrically closest to the short circuit on the side of the power source.

Circuit breakers that do not trip when they should will increase the impact of power system failures. If one considers an unanticipated internal power failure to be an "emergency" then maintaining circuit breakers to ensure that they trip when necessary is one of the four required elements of emergency management – mitigation. Think what the absence of this required element of emergency management means to the hospitals that have never maintained their electrical distribution systems.

The next edition of NFPA 70E is likely to require proper maintenance of this equipment in accordance with NFPA 70B requirements and manufacturers' recommendations.[6] This is because improper or inadequate maintenance of overcurrent protective devices such as circuit breakers can result in increased incident (arc fault) energy. Since OSHA electrical safety regulations are based upon compliance with NFPA 70E, and since OSHA may update its requirements to the new standard, it is wise for hospitals that have not been performing regular maintenance to start the risk assessment and planning processes now.[7]

Do you maintain both your normal and emergency power systems? Or does your hospital "plan" to have electrical shutdowns for maintenance year after year but never get around to them because it is just too hard or too costly to turn the power off just for maintenance? Your hospital's power system is only as good as its weakest link. Therefore the shutdown is likely to occur anyway, although it might be of the unplanned variety.

Many hospitals' existing electrical power maintenance program appears to be one of "reactive maintenance" or "breakdown maintenance," that is, fix it after it fails. Why is it so difficult to get approval for a power system shutdown? Bear in mind that any electrical power system is more likely to fail if you do not turn it off for maintenance. What will the reaction be when this power system fails unexpectedly and the result is worse than it might have been because of the lack of maintenance?

Hospital administration and clinical leadership need to recognize that unexpected and unscheduled electrical system outages pose a much greater risk to patient care than well managed shutdowns pose.

Electrical maintenance should never be done with the equipment hot. This is dangerous and can cause an unexpected power outage of that equipment, thereby adversely affecting both patient safety and maintainer safety.

Construction / Renovation Project Shutdowns

Hospital construction/renovation (C/R) projects often include carefully-planned electrical shutdowns. The C/R project shutdowns are often difficult to accomplish, but they do occur because they must occur for the C/R project

to move forward. While that portion of the power system is off anyway, why not also do the recommended power system maintenance? The low additional cost and high operational benefits indicate that this approach should be made into a Utility Systems Management Plan policy. This approach will allow the affected equipment to be kept in a state of higher reliability and will also reduce the overall maintenance shutdown scope and duration.

Emergency power testing is not enough

Monthly emergency power tests demonstrate the capabilities of the emergency power system (EP system) to perform its automatic functions and to serve its load.[8] However, these tests do not demonstrate the capabilities of the clinical and other supporting services' personnel to perform their functions during a full or partial utility blackout, and they do not demonstrate the shortcomings of existing EP system coverage. They simply test the existing system.

Without normal power (NP) shutdowns, clinical and support personnel will have unrealistic expectations because they do not experience true NP outages until the unexpected blackout occurs. A controlled outage of normal electrical power can train medical, laboratory and support personnel in what to expect if the power goes out, and how to respond to that scenario. In fact a well-planned NP shutdown can go a long way in preparing the hospital's personnel in this element of all-hazards preparation. The heightened and focused attention given during the shutdown planning period allows the facilities maintenance staff to conduct localized NP outages, both as training and as field-verification tests for the EP coverage. It is not unusual for the facility staff that is planning a normal power shutdown to discover shortcomings in EP coverage that they correct before the shutdown. Needless to say, this also benefits the hospital greatly when the next unexpected blackout occurs.

When should you plan for a shutdown?

Hospitals need to plan electrical shutdowns whenever modification, replacement, upgrade, maintenance, and/or repairs must be made to the equipment. Industry experts will tell you that working "hot" is never a good idea if there is any other way. There is always another way – a well-planned shutdown. Proactive facilities will also use the shutdowns for training, emergency management exercises, and continuing verification of previously-developed action plans for power failures.

You have a brand new building – it does not need a shutdown anytime soon – right? Wrong. Shutdowns should be planned shortly after completion of new construction or renovations in the vicinity of the electrical equipment, even if the electrical system itself is new. This surprising situation occurs because concrete dust can get inside the electrical equipment after it is energized for startup and testing of other systems, and this conductive concrete dust can cause the electrical equipment to fail unexpectedly, particularly if the air in the room ever becomes humid. If you had to clean the construction dust off the floor and the other visible horizontal surfaces, you will likely have to clean it off the electrical components. Knowledgeable owners require a planned shutdown to clean the new electrical equipment thoroughly right before the new building's Date of Substantial Completion.

Shutdowns should be planned when predictive maintenance (PdM) techniques such as thermographic (infrared) scanning indicate hot spots in the equipment that need rework. Excessive heat often indicates impending failure.

Finally, shutdowns should be planned on a preventive maintenance (PM) schedule similar to that recommended by equipment manufacturers, the latest issue of National Fire Protection Association (NFPA) Standard 70B, or the InterNational Electrical Testing Association (NETA) Maintenance Testing Specifications.[9] [10]

PLANNING AND CONDUCTING THE SHUTDOWN

Hospitals that have not been conducting regular electrical shutdowns are likely to find that the first such shutdown in each building requires a large amount of planning time.

Shutdown activities and tools

Depending on the needs of the facility, the shutdown planning process can involve one or two individuals canvassing all of the affected areas and services, or can involve official task forces and meetings. Both approaches can be effective and can result in safe shutdowns. The hospital could decide the approach to use based upon the preferences or strengths of the individuals involved and the hospital's culture. Examples of effective shutdown activities include:

- Detailed planning at several levels
- Personalized walk-through of each affected area
- Comprehensive multi-media communications
- Focused assessment of the shutdown impact on each space and activity
- Brief scheduled localized power outages for assessment purposes
- Action plans for each unit or department
- Shutdown contingency plans
- Pre-shutdown work plans or checklists
- Hold point list that permits clinical control of the process
- Checklists of shutdown work scope
- Checklists of specific temporary grounds and temporary backup feeders to be removed
- Overall shutdown plan for the hospital community, also called the Shutdown White Paper
- Group paging with e-mail responses for very effective rapid communication between the shutdown command center and the clinical units. Using pre-written e-mail messages with just the subject line (such as "Green 3 Dialysis all clear to proceed") allows rapid assessment of hospital status during pre-planned hold points.
- Feedback forms that formalize the continuous improvement process
- Timely "lessons learned" critiques
- Official shutdown reports for the Utility Systems Management Plan record

Working with others – communication is key

When a shutdown is being planned, facilities management becomes the focal point for information and action. As much as any other activity in the hospital, the safe shutdown is about two-way communication. But facilities management cannot do the shutdown alone. A Shutdown Task Force will report to the Safety Committee, clinical groups, and department heads. Reports during the shutdown planning process, and again after the shutdown, can be made at Safety Committee meetings, in order for the Safety Committee to provide oversight, as well as for inclusion in the official hospital record.

Communication of a shutdown is critical. People need to know that the shutdown is about to happen, what its impact on their activities will be, and what they should be doing to prepare for it. Among the available communication vehicles are the personal walk-through, E-mail, posters, group paging, individual letters, official memoranda, network computer sign-on screens, the white paper, and voice mail systems.

Basic Shutdown Management

A focused building systems working group will do the early shutdown planning and establish the beginning scope of work. The group's work begins before the rest of the Shutdown Task Force starts meeting, and should continue throughout the planning period. This group will review the impact of the building systems themselves on others, and will assess the best way to respond to requests for backup power to make the shutdown as tolerable as possible for the hospital. Among the group's activities are:

1. *Identify and evaluate the scope, schedule, time durations, cost, action assignments, and overall impact of the required maintenance* to be performed before, during, and after the shutdown.
2. *Identify and evaluate the need, scope, schedule, time durations, cost, action assignments, and track progress of all infrastructure upgrades* necessary before, during, and after the shutdown.
3. *Review lessons already learned from previous outages* and determine how those lessons impact shutdown planning in today's hospital because changes occur constantly.
4. *Review the Utility Systems Management Plan (USMP) for the loss of electrical power* and update the plan as necessary to factor in new information brought to light during the shutdown planning process.
5. *Review the Emergency Operations Plan* to determine how it will affect the shutdown. Also take the lessons learned from the shutdown back to those responsible for updating the Emergency Operations Plan.
6. *Review the old Y2K contingency plans for long term power* outages to determine what extra equipment may have to be temporarily wired to the emergency power system for the shutdown. When they were preparing for Y2K, many hospitals learned for the first time that code requirements alone usually did not provide for effective hospital operation.
7. *Obtain updated floor plans and telephone lists* for the areas to be affected. These floor plans and phone lists will assist the working group in verifying that all affected services, units, and departments participate in the shutdown planning process.
8. *Review cost reduction and value engineering decisions that were made during the construction or renovation of the spaces affected by the shutdown* since these decisions will often point directly to problem areas requiring special attention during the shutdown.
9. *Review what the power shutdown will do to other utilities* such as HVAC, domestic water, cell phones, other communication and data systems, vertical transportation, pneumatic tube system, nurse call system, patient care information systems, security access control systems, etc.
10. *Review and determine responses to requests* for additional emergency lighting and power that come from the departments and areas affected by the shutdown.
11. *Identify normal powered equipment and lighting to be shifted* to one of the EP system branches, or to receive a temporary backup normal power (NP) source from somewhere else during the shutdown. Examples of such equipment or areas include some cooling capacity, steam condensate return pumps, hot water circulating pumps, radiology procedure rooms, patient bathroom lighting, etc. Identify the need for new NP or EP backup feeders; track progress of new feeders.
12. *Establish specific schedule for periodic EP system load monitoring* as new loads are added to the EP system.
13. *Keep a strong handle on the growth of the EP system load* due to all of the above. The last thing the hospital needs is an overloaded generator, transfer switch, emergency feeder, or circuit breaker during the shutdown.
14. *Brainstorm about what can go wrong during the shutdown* and ensure that there are contingency plans to cover every possibility. Reinforce staff training for these events. Examples include hidden swing bus or maintenance bus designs, backfeeds, secondary spot networks, neutral currents circulating through transfer switches into NP switchgear, generator failures, transfer switch failures, and circuit breaker failures.
15. *Understand that equipment may fail its testing during the shutdown* and plan for sufficient replacement components, spare parts, after-hours access to electrical supply houses, etc.
16. *Create detailed procedures* – lists of things to remember, things to do, work quality checks, technical tasks, administrative tasks, worker safety issues, unusual situations. List all tools used and make sure

they are all accounted for after the work. Make sure nothing is forgotten inside of the equipment where it can create a disaster later.

17. *Plan for sufficient emergency lighting in the switchboard and electrical rooms* during the shutdown. Work inside switchboards is very difficult under normal lighting conditions and even more difficult when the normal lighting is turned off. The cleaning and maintenance could require more lighting than even the normal lighting provides.
18. *Arrange for special training for personnel that will be doing non-typical support tasks* such as cleaning inside electrical equipment. An experienced factory-trained field service person can educate hospital maintenance personnel on minimum acceptable cleanliness standards and cleaning procedures that should be used during the shutdown to avoid delaying the return to normal power.
19. *Identify and evaluate areas requiring more information* from the Shutdown Task Force, the Medical Advisory Committee, or others in the hospital community.
20. *Review the results of periodic EP system testing, NP system planned outages, and other events* that have an affect on shutdown planning or operations. Use the results of each week's testing and planned outages to plan testing requirements for following weeks, as well as equipment, system, and/or setpoint modifications required because of the lessons learned each week.
21. *Identify procedures to limit operational errors* such as operating the wrong switch or circuit breaker at the wrong time. This sort of operator's error also occurs during shutdowns just as it occurs during emergency situations, due sometimes to operator stress, sometimes to the "heat of the moment," sometimes to labeling that perhaps could be more foolproof, and sometimes to other reasons. A buddy system or color-coded sticker system for special circuit breaker opening times may help prevent future mistakes like this.
22. *Obtain and review manual operating instructions for switchboards and switchgear* that are normally automatically operated, such as double-ended unit substations with tie breakers. Electricians who do not usually manually operate this type of equipment could often use a refresher when preparing detailed switching procedures for the shutdown.
23. *Identify whether Interim Life Safety Measures (ILSM) are required* due to the work of the shutdown. Electrical equipment rooms are often too small to do all of the required maintenance during a full-scale shutdown, and that work often spills over into nearby corridors.
24. *Identify whether confined-space work permits are required* and if so how that work will be accomplished safely during the shutdown conditions.
25. *Carefully consider the normal personnel needs during the shutdown.* If a hospital assigns all on-duty maintenance personnel to the shutdown, then an unrelated unexpected event, such as a water leak (which can happen any time) can be handled without adversely affecting the shutdown's progress and delaying the return to normal power.
26. *Identify the individual(s) who will have the "fresh eyes" at the end of the shutdown.* Experience has shown that the individuals who were on duty during a long shutdown may be drowsy and not fully capable of the detailed interior inspections that are necessary before electrical equipment is closed up after maintenance, repairs, and modifications. These individuals need to have go / no go authority at the end of the work and need to review all interior work before covers are closed and side panels are re-installed.

Walkthroughs – a critical activity

Walk through all areas that will be affected by the shutdown. Get an official contact person to represent that floor or service. During your walkthrough, differentiate between "must have" requests and "would like to have" requests. Both types of requests have value, but limited resources (dollars, time) may make it impossible to respond to all such requests.

After the walkthrough, summarize your understandings and send that person written documentation such as a form memo. Make the response an automatic positive, as shown in Appendix 1. Note that this memo could be a form

generated directly from a database or spreadsheet, with the list automatically generated from the database or spreadsheet.

If everything appeared to be adequate, say so in your confirming memo. Make sure to remind the contact person of that unit's responsibilities. For example, even office or clinic areas that may be closed during the shutdown and do not need any emergency power are likely to have refrigerators (should be emptied) and computer workstations (should be unplugged).

Shutdown Scope of Work

There are many complementary tasks that can be addressed simultaneously during shutdowns, even during shutdowns that are driven by construction/renovation projects. These include responding to predictive maintenance (PdM) findings, electrical equipment maintenance, testing and infrastructure upgrades. The upgrade scope of work may include new circuit breakers or just overcurrent trip unit upgrades, switchboard upgrades and transformer replacements.

A shutdown's scope might be partial, with work that is deferred due to timeline limitations, this deferral could be highlighted for management's purposes by exception reporting. That is, "during the shutdown we will maintain all normal power switchboard and distribution panel breakers EXCEPT the following: …." Without clarifications of this type, many people have an expectation that ALL such issues will be covered during a shutdown.

Although unrelated to the basic shutdown scope of work, it is useful to have experienced clinicians and the hospital's design engineers tour all affected areas during the shutdown to assess such issues as emergency lighting coverage, clinical unit and support service operations. There is no substitute for experiencing the real thing.

Clinical Unit and Support Service Training

This training can be achieved through the meetings, written communications, and personal contacts used throughout the shutdown planning process. The facility may have all affected areas and services prepare written Action Plans that then enable them to manage the Environment of Care more proactively in the event of an unexpected complete or partial utility NP outage. Also refer to the "Lessons Learned" section later in this document for a discussion of the additional benefits of shutdown preparation in clinical units and support services.

Short NP Planned Outages

The facility can use planned outages of the NP system to assess the adequacy of the existing emergency power coverage. This approach can be useful before the first major shutdown in each building or area, and is highly recommended after any space renovations. There are several reasons for this, including confusion about EP outlets, change in use of space, change in personnel or task despite the space usage itself not changing, mistakes in emergency circuit installation or marking. Sometimes past planning for emergency power coverage is not completely effective, and sometimes there are mistakes during installation. A planned outage will often highlight these deficiencies before they adversely affect patient care during an unplanned outage. The short local outages can also be used effectively to limit the duration of the shutdown itself if selected maintenance is conducted in the local electric closets while the field assessment is occurring. Tightening and cleaning local NP panelboards during the local outages means that this work does not have to occur during the shutdown itself.

Pre-shutdown verification must include assessment of what outlets small uninterruptible power supplies (UPS's) are plugged into. During one hospital building shutdown, a clinical floor's data system UPS in a data closet was mistakenly left plugged into a normal power receptacle when the shutdown commenced. The UPS battery held

until it was fully discharged, and then the data system for that floor went down during the shutdown. Needless to say, this UPS should have been plugged into emergency power before the shutdown commenced.

Shutdown Contingency Planning

Once the upgrade or maintenance function of a shutdown has started, it can become difficult to return to NP instantly in the event of an electrical malfunction. This occurs because shutdowns often involve circuit breakers being withdrawn from their normal locations for primary injection testing, some cabling perhaps being withdrawn from its normal terminations for modification, and personnel actual being inside larger switchgear for better access to clean and tighten components.

If a generator failure occurs during a shutdown, it is critical for patient care and life safety that power be restored to those branches of the EP system immediately. This contingency planning is a necessary part of the pre-shutdown planning. One approach could be bringing in one or more backup lines with easy means of connections. The use of "quick connects" along with clear instructions for isolating the back-fed equipment by opening switches or circuit breakers can permit the hospital electricians to restore power to life safety and critical branches very quickly. "Contingency" walkthroughs with the electricians are important to review the procedures to be followed if a failure occurs. Appropriate lock-out/tag-out procedures need to be in place to ensure that workers are not placed in harm's way.

The Effect of Electrical System Design on Shutdown Costs and Durations

The main electrical switchgear in a building provides power to all spaces in the building. The spaces often involve separate uses with different needs. Sectionalizing switchgear and switchboards with separate main breakers and tie breakers can facilitate maintenance by allowing partial shutdowns to occur in place of complete normal power outages. If distinct uses are powered by separate switchboard sections, it may be possible to limit the scope of an individual shutdown to less than the entire building. This approach can reduce shutdown cost and disruption, but may not provide adequate training for unit clinical and support services.

Reporting to Other Groups

The Shutdown Task Force may report to different groups, including the Environment of Care Committee, Safety Committee, Safety Department, clinical groups, and department heads. Reports during the shutdown planning process, and again after the shutdown, can be made at Safety Committee meetings, in order for the Safety Committee to provide oversight, as well as for inclusion in the official hospital record. Reports made at Department Head meetings can cover those Department Heads and Chiefs of Service who are not personally involved in the shutdown planning process.

Shutdown Task Force

The initial Shutdown Task Force membership should include those departments or services located in the affected Building(s), along with departments having hospital-wide responsibilities that would be affected by shutdowns in any building. As planning progresses, the initial representatives can identify others that could either (1) be affected by the shutdown and should be part of its planning, or (2) could help them or others cope with the challenges presented by the shutdown. The Shutdown Task Force makes many important decisions in a collaborative manner. Among these decisions are the dates and times for local planned outages, the recommendation for the shutdown day and times, and the level of communications. The Shutdown Task Force is also the mechanism for communicating information about special electrical system testing or modifications that may be required. It is important that all

affected groups and services be represented in this process. It is useful for different services to have the opportunity to hear other services' issues. This stimulates a broader consideration of the impact of an unexpected power outage as well as of the shutdown itself.

The hardest part of the shutdown in some buildings will be coming to consensus about the day of week and times for the shutdown. This process requires that all parties collaborate as a team to determine the date and time that will have the least overall impact on the institution's patients, visitors, other customers, and staff. Gaining consensus of services with competing needs could require that backup feeders be installed to permit some services to have more flexibility in scheduling the shutdown.

Working Groups

It may be necessary to establish working task forces to coordinate the multiple inputs to the shutdown. These working groups will perform much of the background work necessary to a successful shutdown. The following subcommittees or working groups may be necessary: Building Systems, Patient Care, Vertical Transportation, Communicating Shutdown Information, Laboratories, Physician and Tenant Offices, Code Call Team, Radiology, Surgery, Emergency Department, and Information Resources / Network Services. Other departments, such as Communications, Dietary Services, Research Affairs, Cardiac Services, etc., also form their own specific interest areas to deal with the shutdown's impact on their mission. The chairs of each group, along with representatives from each individual department not otherwise covered by other working groups, could contribute to a White Paper subcommittee.

Command Station

The shutdown command station should be the location typically used for internal disaster control unless that location is part of the building being shut down. The reason for this choice of location is that people perform best in emergencies when they are doing what they do every day. The Shutdown Task Force or Safety Committee may elect to use the commencement of the shutdown as a Disaster Exercise, although this approach is not a necessary part of a shutdown.

Communicating Shutdown Information and the Shutdown Logo

Communication of a shutdown is critical. People need to know that the shutdown is about to happen, what its impact on their activities will be, and what they should be doing to prepare for it. The purpose of the logo is to build a consistent thread and raise staff awareness of all electrical system management activities. Over time, this approach helps occupants to understand what will be required of them. All correspondence (such as agendas, meeting notes, and other communications) should carry the same logo. It is important to reach the hospital community through as many media as possible, since any one individual may selectively ignore certain types of media. Among the communication vehicles available to the Shutdown Task Force are electronic mail (E-mail), text messages, pagers, posters, individual letters, official memoranda, network computer sign-on screens, the white paper, and voice mail systems.

Generator Loading - Planned Shutdowns vs. Unanticipated Utility Outages

There are several types of load that are powered by hospital generators. This discussion will focus on the electrical or usage characteristics of these loads rather than the branch classification. Among these types are the base load that rarely changes even for a shutdown, occupancy related load that has a predictable profile during a typical weekday or weekend day, task related loads that will also be severely reduced during a shutdown, and extra or optional loads that may be connected to the EP system specifically for the shutdown. It is important for plant

engineers to verify that there is no possibility of overloading the generators with temporary loads before, during or after the shutdown.

A facility's engineers should identify available EP system capacity for new loads before convening the Shutdown Task Force in order to limit unrealistic expectations. However, when shutdown planning commences, several classes of loads may not have EP power sources. Although this situation is an existing condition, and therefore may be "grandfathered" by code changes not being retroactive, it may not an acceptable situation during a shutdown. This issue is more problematic with older buildings where consistent design philosophy was not applied with building electrical system evolution over time.

As an example, code requirements do not normally dictate supplying EP to laboratory freezers or incubators. However, long shutdowns of power to incubators in tissue culture rooms can cause the loss of valuable cultures, perhaps representing many years of work and could adversely affect the advancement of medicine. Backup feeders may be necessary in this event, even if there is inadequate generator capacity to provide EP.

Requests for Emergency Power Connections

Many emergency power systems were designed for code requirements in effect at the time of design along with predicted additional operational needs. The dependence on electrical power often increases over time. Since planning for a NP shutdown often identifies operational needs that exceed previous code requirements or existing emergency power system capacities, the challenge is to respond to the new needs within existing constraints.

Examples can include cafeterias, patient floor nourishment stations, more than the code-required single elevator for increased vertical transportation capacity, more than the code-required lighting in patient care areas, pneumatic tube system, patient television system, environmental rooms, freezers, incubators, ice machines, and selected radiology procedure rooms that do not have emergency power.

Existing loading of the presently-installed emergency generators may preclude adding some of the requested loads, despite their newly-determined importance. In this event, the hospital may find it necessary to triage the total emergency power system while funding is obtained and emergency power upgrades are designed, licensed and installed.

It is generally not a good idea to provide extra (spare) EP receptacles in new areas unless the loads in the areas are considered in generator loading analyses. The occupants of each area can decide to plug in their important equipment or processes during a power outage, even if those items are not normally connected to the EP system.

Sometimes certain equipment (mechanical, radiology, etc.) will be temporarily connected to the EP system at the beginning of the shutdown and then reconnected back to normal power at the end of the shutdown since conducting an extra outage of that equipment or service a couple of days or week before the shutdown is problematic. In these cases, very detailed procedures are recommended, along with close attention to the timelines and allowances for delays. If this reconnection is a hold point, unexpected delays can result in the entire affected shutdown area being without power for longer than anticipated. This approach also must be communicated clearly to the clinical and support personnel and technicians on duty at the beginning and end of the shutdown since they may not have been involved in the planning and may not be allowing for the outage in their own work planning.

All such requests should be included in the hospital’s Emergency Power Gap Analysis. Refer to the ASHE Management Monograph on Managing Hospital Emergency Power Systems for more information.[11]

Elevators - A Special Concern

Elevators should have battery-backed lighting in the cars. Depending upon the hospital's preference and procedures, the shutdown might start with a complete normal and EP outage while the generators start. Because of the possibility of patient or public anxiety from a complete blackout in the elevator cars, it is important to determine carefully exactly how the elevator cars will be controlled during the shutdown switching operations themselves.

Shutdown Planning Schedule

However critical the electrical shutdown is to the reliability of the electrical distribution system, it is nevertheless an intrusion into the normal work environment of the hospital's clinical, research and support staff. Critical shutdown targets should be communicated clearly to all parties. Critical shutdown targets include both periodic and special EP tests required for system verification, scheduled NP outages for training and verification purposes, scheduled normal or EP outages for system upgrades in anticipation of the shutdown, target dates to submit action plans (department-specific shutdown management plans), and target dates to prepare the White Paper.

As hospital shutdowns occur more regularly, it is important to attempt to reduce the planning duration. Departments may tend to delay their initial planning work because they expect to catch up as the planning effort continues. This causes a ripple effect that will increase the cost from having to repeat work already done.

Hold Point List

A predetermined written hold point list can indicate every affected patient care unit, with the name of the clinical contact and shutdown personnel radio contact. The clinical contact (usually a nurse manager) could be responsible for verifying and relaying on the responsible physician's concurrence that the shutdown may proceed.

There are actually three separate recommended hold point lists. Examples of each are shown in Appendix 3. These hold point lists formalize clinical and administrative control of the process on the day of the shutdown for each major element that changes the operating condition of the hospital:

- Before normal power is turned off
- After normal power is turned off but before work (maintenance or modification) commences inside the electrical equipment that will delay re-energizing normal power. This work includes removal of circuit breakers or other elements from their housings.
- After the maintenance or modification work is completed and before normal power is re-energized.

The White Paper

While the Action Plans provide training for the individual Units and Services, the White Paper is the means for the hospital to train as an entity. The White Paper also is the vehicle for communicating to others who were not part of the detailed planning process. Because the White Paper summarizes important information common to many groups, it becomes a convenient reference for disaster management as well. A sample White Paper for a shutdown in two buildings, one patient care and one combined office and laboratory, is illustrated in the appendix.

AFTER THE SHUTDOWN

Finally, planned shutdowns also include what emergency management policies call “recovery” – getting back to normal. This can be a burdensome process if a lot of temporary wiring or back-feeds were used to get through the shutdown. It may be necessary to have detailed procedures for switching back to the normal operation in order to minimize the potential for accidents. Equipment that had remained de-energized during the outage should also be shut off before recovery begins to minimize the possibility of damage to sensitive electronics from power surges (voltage fluctuations) during the initial power-up.

After you have successfully completed the shutdown, there is still work to be done – analyzing, reporting, and future planning. An important component of this process is to improve the conduct of future shutdowns.

Finalizing the process should occur quite soon after the shutdown. The main reason is that people will forget the issues due to the press of other business. This finalization includes the following:

- Feedback from all affected services, whether with Feedback Forms as previously used or some other mechanism.
- Final Lessons Learned meeting with Shutdown Task Force.
- Official Shutdown Report for Utility Systems Management documentation and presentation to the hospital’s EOC Committee and Safety Committee.

Lessons Learned, Emergency Management, and Sentinel Event Alert 37

The final Shutdown Task Force meeting, a week after the shutdown, is billed as a "Lessons Learned" meeting. This is an opportunity for people to report their perceptions and their recommendations for improving future shutdowns. It is important for many reasons - mission, programming future infrastructure and space upgrades, credibility, and the improvement of future shutdowns, that lessons learned in each shutdown be used effectively. The results of this meeting should be entered into a cumulative database for future reference.

Lessons learned are an invaluable aid to improving the Environment of Care. Hospitals should critique the entire process and plan to adjust any procedures as appropriate. Shutdown lessons learned can often help the hospital to improve its Emergency Operations Plan (EOP). The level of detailed planning that is necessary for a safe power shutdown lends itself to the level of specificity that can work well in most EOP’s.

Ongoing maintenance requirements also require regular shutdowns, perhaps on a rotating three year schedule. The requirement for updating the Shutdown White Paper and resulting Action Plans will result in continuously updated input to the EOP as well. This results in an improved emergency management program.

The power failure contingency plans *[What do we do if the generator fails during the shutdown?]* lead directly to the power failure planning concepts envisioned in The Joint Commission’s Sentinel Event Alert Issue 37. [12] The department and service Action Plans discussed in this monograph also incorporate the level of interdepartmental analysis and clinical/administration cooperation discussed in Sentinel Event Alert 37. The contingency plans and Action Plans and are very workable because they are written for a real planned event. The shutdown also requires these plans to be scrutinized and proven before they are used in emergency management exercises or in real disaster situations.

Many shutdown preparation activities relate directly to the issues raised by Sentinel Event Alert 37. These activities include conducting risk assessments, identifying power system vulnerabilities, considering the impact of multiple power system failures on hospital activities, and the detailed activities such as:

- Consideration of a generator connection box to allow rapid response to a generator failure coinciding with utility power failure

- Using disaster scenario planning to identify critical systems that could potentially be lost during extended [normal] power outages
- Matching the critical equipment and systems needed in an extended emergency against the equipment and systems actually connected (in whole) to emergency power
- Providing ongoing competency training and testing of operators and maintainers

The Shutdown Task Force and its working groups have already determined the equipment that is fed by normal power and needs to be either on emergency power before the shutdown or powered by a backup power source from some other source. This effort is the hospital's Emergency Power Gap Analysis for those areas, services and systems, also as discussed in Sentinel Event Alert 37.

OTHER ISSUES

The Costs of Building-Wide Electrical Shutdowns

The costs of shutdowns can vary widely, depending upon, in descending order of importance; (1) the scope of corrective work that must be accomplished before the shutdown; (2) how long it has been since the last shutdown (with training as well as infrastructure field verification) was conducted; (3) the scope of system modifications that are programmed to be accomplished during the shutdown; (4) the scope of electrical equipment maintenance that must be accomplished during the shutdown; and (5) the amount of time required to plan the shutdown.

Designs for Temporary Connections of Rented Generators

Whenever new generators are installed in hospitals, a spare backup feeder (cable and conduit system) should be installed from the generator location out to a convenient location at the street. If the cable and conduit are rated for full generator output, a generator failure can then be accommodated by bringing in a rental generator and connecting it to the outside end of the backup feeder. In addition, generator load bank tests can also be accommodated by the backup feeder if necessary to meet regulatory requirements or to help in troubleshooting emergency generator malfunctions. The backup feeder eliminates the need for the heavy load bank to be rigged through the hospital for the troubleshooting.

NFPA Disclaimer: *Although the author is Chairman of the NFPA Technical Committee on Emergency Power Supplies, which is responsible for NFPA 110 and 111, the views and opinions expressed in this monograph are purely those of the author and shall not be considered the official position of NFPA or any of its Technical Committees and shall not be considered to be, nor be relied upon as, a Formal Interpretation. Readers are encouraged to refer to the entire texts of all referenced documents. NFPA members can obtain staff interpretations at www.nfpa.org.*

David Stymiest is a Certified Healthcare Facility Manager, an ASHE Fellow and a Senior Consultant at Smith Seckman Reid, Inc., specializing in Facilities Management and Regulatory Compliance Consulting for hospital clients. Before joining SSR in 2000, he was Senior Electrical Engineer for more than 10 years for Massachusetts General Hospital and the other hospitals of the Boston-based Partners HealthCare System, Inc. He has over 35 years of experience in all facets of facilities electrical engineering. He lectures extensively, has written many ASHE papers and Health Facilities Management articles on hospital electrical system management and engineering, and he co-edited the 1200-page McGraw-Hill Facilities Management and Management Handbook for Commercial, Industrial, and Institutional Buildings. He is Chairman of the NFPA Technical Committee on Emergency Power Supplies, which has responsibility for NFPA 110 and NFPA 111. He has a Bachelor's degree and a Master of Engineering degree in Electric Power Engineering, a Certificate of Special Studies in Administration and Management, and is a Registered Professional Engineer in four states. Mr. Stymiest can be reached at DStymiest@ssr-inc.com.

APPENDIX 1 - SAMPLE WALKTHROUGH CONFIRMATION MEMO

Date: Date of walkthrough
Floor and Room(s): Specific areas discussed
Area: Name of unit or service
Contact: Contact's name, phone number and title

The following list from our mm/dd/yyyy walkthrough expresses our understanding of your department's emergency or backup power requirements pertaining to the upcoming normal power shutdown. Please note that this list only details equipment requiring emergency power that, based on our walkthrough observations, was fed from a normal power source or from a source that could not be verified.

It is important that you review this list and give us your comments within one week. If we do not hear from you, we will assume that the information below is complete and accurate. Please contact us at 555-5555 if you have any questions.

Floor 7 – *name of service*

1. Emergency Lighting
    a. MUST HAVE:
        i. No requirements
    b. WOULD LIKE:
        i. Supply closet 701A
2. Emergency Power
    a. MUST HAVE:
        i. Corridor 700C1, Room 727B alcove – two defibrillators
    b. WOULD LIKE:
        i. Lounge 701A – coffee maker

APPENDIX 2 – SAMPLE SHUTDOWN TASK FORCE SCHEDULE FOR FIRST SHUTDOWN

Weeks to Shutdown	General Topics Covered or Introduced
-27	(Medical Advisory Committee): Selection of building, background and need for shutdown, required scope & duration, describe scope of power outage, distribute previous Shutdown Report, only when OR's are down.
-13	Background, needs and required duration for shutdown, previous Shutdown White Paper and lessons learned, initial subcommittee structure, review EP testing & 2 hour NP planned outages.
-12	Discuss utility blackouts, schedule preferences, scope of shutdown, schedule for special EP testing & planned outages, Medical Advisory Committee, subcommittee reports, NP vs EP coverage, backup power needs.
-11	Establish shutdown date & time, review Action Plans, review network & communications issues, report on special tests, discuss obvious infrastructure upgrades, determine prelim. ED, lobby, marquee, security issues.
-10	Report on special EP testing, respiratory care action plan, lessons learned in earlier shutdowns with ultrasounds on patients when respirators are on generators, need to review UPS for tele/data systems.
-9	Specific area field verification results, other areas becoming concerned about shutdown now.
-8	Review typical action plans, determine special operational needs during shutdown, identify field investigations needed, discuss UPS'es & identify areas with low power disruption tolerances, monitoring of emergency system loading, communication to 3rd shift & weekend personnel (previous lesson learned).
-7	Review results of special EP testing, need for more emergency outlets & emergency lighting, identify impact of shutting down other areas, elevatoring issues, limitations on new emergency power connections.
-6	Review results more 2 hour NP outages for field verifications, identify concerns and needs to be resolved. Review backup feeder needs for important equipment on NP.
-5	Need for testing critical systems, detailed radiology and cardiology cutover plans, more backup power needs during shutdown, OR guidelines, review results of planned outages & required upgrades before shutdown.
-4	Review results of more NP 2 hour planned outages, some corridors need more & some need less emergency lighting, installing backup NP feeders to double galleys, special outages scheduled for cutovers, reviewed sample public information notices, PC workstation UPS info distributed.
-3.5	Discuss presentation to chief residents, dietary backup power plans, system shutdowns for upgrades, dry ice notice, Review Action Plans: Emergency Dept., Laboratories, Information Resources, Police & Security, Radiology, Patient Care Units, Respiratory Care, Vertical Transportation, others.
-3	Review input from Medical Advisory Committee, planned use of daily "countdown" EMail messages, Inter-service review of Action Plans, review public notices, patient letter, elevator schedules, final White Paper draft..
-2	Final review of results and lessons learned from all planned outages, reviewed overall list of improvements made, review Hold Point List, Feedback Forms. Distribute White Paper, etc. Collect final Action Plans.
-1	Approve final patient TV letter, adequacy of ongoing communications, approve wording of daily EMail messages.
-0.2	Distribute Hold Point Action Plan for Shutdown, reminder about ID badge requirements, final questions.
+1	"Lessons learned" technical critique with all departments.

APPENDIX 3 – SAMPLE HOLD POINT LIST: 3 PARTS IN 9 PAGES

PATIENT CARE BUILDING POWER SHUTDOWN

ACTION PLAN -- SAMPLE HOLD POINT LIST

REQUIRED HOLD POINTS PRIOR TO SHUTDOWN:

LOCATION	Floor	ASSIGNED PERSONNEL	RADIO UNIT	PHONE	HOLD POINT	CHECKED	
						TIME	BY
Generator # 1 & 2 Room					All Systems Operable/Standby, Backups Energized		
Operations			Operations		No Utility Line outage		
Fuel Oil Pump Room					Fuel Oil System Operational / Ready		
Emergency Dept CT Scanner			Emerg Dept		No procedures to be started		
Radiology			Radiology		No procedure to be started in Angiography room		
Emergency Services		Admin. Charge Nurse	Emerg Dept		No Major External Disaster		
Operations		B&G	Operations		Generator run notifications made		
Bldg B ATS/ Switchboard Room					Ready to Proceed - all systems operable		
Bldg A low Switchboard Room					Ready to proceed, test pwr on		
Bldg A high Switchboard Room					Ready to report ATS status after 10s outage.		
X-Ray Switchboard Room			Radiology		Ready to report ATS status after 10s outage.		
Bldg A main Switchboard Room			21		Ready to proceed, test pwr on		
Bldg C Swbd Room	Bldg C 1		Bldg C Swbd Rm		Ready to monitor ATS & Backup Feeder Bkr		
All Gen & ATS Rooms	All		Engineering		Ready to Proceed (Gen/ATS loading)		
Bldg A Patient Floors	Bldg A 6-15				Ready to monitor patient floor LS,CB,EB loading		
Pharmacy	Bldg B-Bsmt				Nothing tubed to Bldg A after 11:30 PM		
Pharmacy	Bldg B-Bsmt				Ready to proceed		
Router Room	Bldg A Bsmt				Router Room ready to proceed		
Bldg B Elevator Lobby	Bldg B 1		Security		Security personnel present		

Bldg A Elevator Lobby	Bldg A 1		Security		Security personnel present		
Bldg A Elevator Lobby	Bldg A 1		Operations		All passenger elevators secured		
Bldg A Elevator Lobby	Bldg A 1		Operations		Service elevator secured		
Bldg B Elevator Lobby	Bldg B 1		Operations		All passenger elevators secured		
Bldg A Elevator Machine Rm	Bldg A 16		Elevator Repair		Bldg B elevs. 2-3 & Bldg A elevs. 2-5 MGs off		
Lab - Phlebotomy	Bldg B-4				Lab ready to proceed		
Operating Rooms	Bldg A 3		OR's		Bldg A OR's down, OK to proceed		
Post Anesthesia Care Unit	Bldg A 3		OR's		PACU ready to proceed		
Central Sterile Reprocessing	Bldg A 4				Folding Room ready to proceed.		
Lab - GYN, Andrology	Bldg B 1				Lab ready to proceed		
Lab - IVF	Bldg B 2				Lab ready to proceed		
3rd Floor Offices	Bldg B 3				Offices closed		
4th Floor Offices	Bldg B 4				Offices closed		
Lab - Cardiac Ultrasound	Bldg B 5				Lab closed		
Lab - QA	Bldg B 6				Lab ready to proceed		
Lab - Cardiology	Bldg B 7				Lab closed		
Lab - Histology	Bldg B 8				Lab closed		
Lab - Neurology, Mech Room	Bldg B 9,10				Lab closed		
Medical Records	Bldg F Bsmt				Medical Records closed		
Orthopaedics	Bldg A 6	Charge Nurse/			Nurse Mgr/Phys OK to proceed		
Surgery	Bldg A 7	Charge Nurse/			Nurse Mgr/Phys OK to proceed		
Surgery	Bldg A 8	Charge Nurse/			Nurse Mgr/Phys OK to proceed		
Medicine	Bldg A 9	Charge Nurse/			Biomedical Tech stationed		
Medicine	Bldg A 9	Charge Nurse/			Nurse Mgr/Phys OK to proceed		
Ortho-Neuro	Bldg A 10	Charge Nurse/			Nurse Mgr/Phys OK to proceed		
Surgery	Bldg A 11	Charge Nurse/			Nurse Mgr/Phys OK to proceed		
Neuro	Bldg A 12	Charge Nurse/			Nurse Mgr/Phys OK to proceed		

GCRC	Bldg A 13	Charge Nurse/			Nurse Mgr/Phys OK to proceed		
Operator Services	Bldg A 14	Operator/			Communications ready to proceed		
Mechanical Room	Bldg A 15				Ready to observe & report		
All Patient Floors	all		All		Check Med Gas Alarms/ATC Compressor		
Operations			Operations		No fire alarm in process		
Emergency Services	Bldg A 1				No External Disaster, ED Radio Transferred		
Emergency Services	Last:3	Admin Charge Nurse			All emerg. procedures ready to proceed		
Radiology	Last:2		Radiology		No emerg. procedures in process in VBldg A		
Communications, White 14	Bldg A 14	Operator			No code call in process, ready for 10 sec		
Medical Advisory Committee	Bldg A 1	Physician Representative	Engineering		All clinical issues ready to proceed		
Administration	Bldg A 1		Engineering		Final permission to proceed		
Administration	Bldg A 1		Engineering		Info. to Dept Heads		

REQUIRED HOLD POINTS PRIOR TO COMMENCING MAINTENANCE:

LOCATION	Floor	ASSIGNED PERSONNEL	RADIO UNIT	PHONE	HOLD POINT	CHECKED TIME / BY
Generator # 1 & 2 Room	Bldg A SB				All systems functioning well	
Operations			Operations		No Utility Line outage	
Fuel Oil Pump Room					Fuel Oil System transfer system working okay	
CT Scanner	Bldg A 1		Emerg Dept		Required systems operable	
Radiology	Bldg A 2		Radiology		Required systems operable	
Emergency Services	Bldg A 1		Emerg Dept		No Major External Disaster	
Operations	Gr SB		Operations		No major CAS/BAS alarms, fire alarms on	
Bldg B ATS/Switchboard Room	Bldg B SB				Ready to proceed, bkrs tagged, ATS okay	
Bldg A low Switchboard Room	Bldg A SB				Ready to proceed, bkrs tagged	
Bldg A high Switchboard Room	Bldg A 6				Ready to proceed - all ATS okay	
XRay Switchboard Room	Bldg A 2		Radiology		Ready to proceed - all ATS okay	
Bldg A main Switchboard Room	Bldg A Bsmt				3 network protectors tagged by all workers	
Bldg C Switchboard Room	Bldg C Bsmt				Ready to monitor backup feeder to Bldg A	
All Gen & ATS Rooms	All		Engineering		Ready to Proceed (Gen/ATS loading)	

All Elec Closets	All				Ready to Proceed (Gen/ATS loading acceptable)	
Pharmacy	Bldg B-Bsmt				Ready to proceed	
Router Room	Bldg A Bsmt				Router Room ready to proceed	
Bldg B Elevator Lobby	Bldg B 1	Security	Security		No security problems	
Bldg A Elevator Lobby	Bldg A 1	Security	Security		No security problems	
Bldg A Elevator Lobby	Bldg A 1	Operations	Operations		Elevator #1 working on emergency	
Bldg A Elevator Lobby	Bldg A 1	Operations	Operations		Service elevator secured	
Bldg B Elevator Lobby	Bldg B 1	Operations	Operations		Elevator #1 working on emergency	
Bldg A Elevator Machine Rm	Bldg A 16	Elevator Repair	Elevator Repair		Standing by in machine room, #2-4 & Bldg B off	
Pharmacy	Bldg B Bsmt				Pharmacy ready to proceed	
Lab - Phlebotomy	Bldg B-4				Lab ready to proceed	
Operating Rooms	Bldg A 3		OR's		Bldg A OR's down, OK to proceed	
Post Anesthesia Care Unit	Bldg A 3		OR's		PACU ready to proceed	
Central Sterile Reprocessing	Bldg A 4	Supervisor/			Backup feeder power from Bldg D OK	
Lab - GYN, Andrology	Bldg B 1				Lab ready to proceed	
Lab - IVF	Bldg B 2				Lab ready to proceed	
Lab - QA	Bldg B 6				Lab ready to proceed	
Lab - Histology	Bldg B 8				Lab ready to proceed	
Mechanical Room	Bldg B 9				Mechanical equipment ready to proceed	
Labs - Neuro, Transplant	Bldg A 5				Lab ready to proceed	
Orthopaedics	Bldg A 6	Charge Nurse			Nurse Mgr/Phys OK to proceed	
Surgery	Bldg A 7	Charge Nurse			Nurse Mgr/Phys OK to proceed	
Surgery	Bldg A 8	Charge Nurse			Nurse Mgr/Phys OK to proceed	
Medicine	Bldg A 9	Charge Nurse			Biomedical Tech stationed	
Medicine	Bldg A 9	Charge Nurse			Nurse Mgr/Phys OK to proceed	
Ortho-Neuro	Bldg A 10	Charge Nurse			Nurse Mgr/Phys OK to proceed	

Surgery	Bldg A 11	Charge Nurse			Nurse Mgr/Phys OK to proceed	
Neuro	Bldg A 12	Charge Nurse			Nurse Mgr/Phys OK to proceed	
GCRC	Bldg A 13	Charge Nurse			Nurse Mgr/Phys OK to proceed	
Operator Services	Bldg A 14	Operator/			Communications ready to proceed	
Mechanical Room	Bldg A 15				EMCC and MCC backup power working okay	
All Gen & ATS Rooms	Bldg A SB	Engineering			ATS status verified, ready to monitor breakers	
All Patient Floors	all		All		Med Gas Alarms/ATC Compr working okay	

Operations			Operations		No drill in process	
Emergency Services	Bldg A 1		Emerg Dept		No External Disaster, ED Radio Transferred	
Emergency Services	Last:3	Admin Charge Nurse	Emerg Dept		All systems operating okay	
Radiology	Last:2		Radiology		All required systems operating okay	
Communications	Bldg A 14		N/A		All required systems operating okay	
Medical Advisory Committee	Bldg A 1	Physician Representative	Engineering		All clinical issues ready to proceed	
Administration	Bldg A 1		Engineering		Final permission to proceed	
Administration	Bldg A 1		Engineering		Info. to Dept Heads	

REQUIRED HOLD POINTS PRIOR TO RETURN TO NORMAL POWER:						
LOCATION	**Floor**	**ASSIGNED PERSONNEL**	**RADIO UNIT**	**PHONE**	**HOLD POINT**	**CHECKED BY / TIME**
Generator # 1 & 2 Room	Bldg A SB		23		All transfer switches in automatic	
Biomed Techs / Resp Care	Bldg A 5-14	Resp Care Charge Ther.	Page ####		Notify 60 minutes before return to normal power	
Info Resources Help Desk	Bldg D		N/A		Notify 60 minutes before return to normal power	
Communications/ Oper Svces	Bldg A 14	Operator/			Notify 60 minutes before return to normal power	
Radiology Page	Bldg A 2		Radiology		Notify 60 minutes before return to normal power	
Dietetics Data Center	Bldg A Bsmt				Notify 60 minutes before return to normal power	
Operations			Operations		No CAS or BAS alarm issues	
CT Scanner	Bldg A 1		Emerg Dept		No procedures to be started	
Emergency Services	Bldg A 1	Admin Charge Nurse	Emerg Dept		Ready to proceed	
Bldg B ATS/Switchboard Room	Bldg B SB	PM Contractor 1/			All tags removed, all ATS in automatic	
Bldg A low Switchboard Room	Bldg A SB	PM Contractor 2/			All tags removed	
Bldg A high Switchboard Room	Bldg A 6				All tags removed, all ATS in automatic	
X-Ray Switchboard Room	Bldg A 2		Radiology		All tags removed, all ATS in automatic	
Bldg A main Switchboard Room	Bldg A Bsmt	PM Contractor 1/			All tags removed, medium voltage system ready	
Bldg C Switchboard Room	All	Engineering	Engineering			

Pharmacy	Bldg B-Bsmt				Ready to proceed	
Router Room	Bldg A Bsmt				Router Room ready for blip	
Bldg B Elevator Lobby	Bldg B 1	Security	Security		Security personnel present	
Bldg A Elevator Lobby	Bldg A 1	Security	Security		Security personnel present	
Bldg A Elevator Lobby	Bldg A 1	Operations	Operations		Elevator #1 secured	
Bldg A Elevator Lobby	Bldg A 1	Operations	Operations		Service elevator secured	
Bldg B Elevator Lobby	Bldg B 1	Operations	Operations		Elevator #1 secured	
Bldg A Elevator Machine Rm	Bldg A 16	Elevator Machine Room	Elevator Repair		Standing by in elev mach room	
Lab - Phlebotomy	Bldg B-4		Bldg B 4 Labs		PC's off for blips, lab ready to proceed	
Operating Rooms	Bldg A 3		OR's		PC's off for blips, ready to proceed	
Post Anesthesia Care Unit	Bldg A 3		OR's		PC's off for blips, ready to proceed	
Lab - GYN, Andrology	Bldg B 1		Bldg B 1		PC's off for blips, lab ready to proceed	
Lab - IVF	Bldg B 2		Bldg B 2		PC's off for blips, lab ready to proceed	
Lab - QA	Bldg B 6		Bldg B 6		PC's off for blips, lab ready to proceed	
Lab - Histology	Bldg B 8		Bldg B 8		PC's off for blips, lab ready to proceed	
Mechanical Room	Bldg B 9		Bldg B 9		Mechanical equipment ready to proceed	
Medical Records	Bldg B Bsmt		Bldg B Bsmt		PC's off for blips, ready to proceed	
Labs - Neuro, Transplant	Bldg A 5		Bldg A 5		PC's off for blips, lab ready to proceed	
Orthopaedics	Bldg A 6	Charge Nurse	Bldg A 6		Nurse Mgr/Phys OK to proceed, PC's off	
Surgery	Bldg A 7	Charge Nurse	Bldg A 7		Nurse Mgr/Phys OK to proceed, PC's off	
Surgery	Bldg A 8	Charge Nurse	Bldg A 8		Nurse Mgr/Phys OK to proceed, PC's off	

Medicine	Bldg A 9	Charge Nurse	Bldg A 9		Biomedical Tech stationed	
Patient Care Units	Bldg A.9	Charge Nurse	Bldg A.9		Resp care techs stationed at all vents	
Medicine	Bldg A 9	Charge Nurse	Bldg A 9		Nurse Mgr/Phys OK to proceed, PC's off	
Ortho-Neuro	Bldg A 10	Charge Nurse	Bldg A 10		Nurse Mgr/Phys OK to proceed, PC's off	
Surgery	Bldg A 11	Charge Nurse	Bldg A 11		Nurse Mgr/Phys OK to proceed, PC's off	
Neuro	Bldg A 12	Charge Nurse	Bldg A 12		Nurse Mgr/Phys OK to proceed, PC's off	
GCRC	Bldg A 13	Charge Nurse	Bldg A 13		Nurse Mgr/Phys OK to proceed, PC's off	
Operator Services	Bldg A 14	Operator	Bldg A 14		Communications ready to proceed	
Mechanical Room	Bldg A 15		Bldg A 15		Ready to observe & report	
All Gen & ATS Rooms	Bldg A SB	Engineering	Engineering		Ready to monitor normal power breakers	
All Patient Floors	All		All		Chk Med Gas Alarms/ATC Compr	
Operations			Operations		No drill in process	
Emergency Services	Bldg A 1		Bldg A 1		Ready to proceed	
Emergency Services	Last:3	Admin Charge Nurse	Emerg DEpt		All emerg. procedures ready to proceed	
Radiology	Last:2		Radiology		No emerg. procedures in process	
Communications	Bldg A 14		N/A, use phone		No code call, ready for blip in 2-5 mins	
Medical Advisory Committee	Bldg A 1	Physician Representative	Engineering		All clinical issues ready to proceed	
Administration	Bldg A 1		Engineering		Final permission to proceed	

APPENDIX 4 – SAMPLE SHUTDOWN WHITE PAPER (5 PAGES)

THE _____ BUILDINGS A & B POWER SHUTDOWN

REASON FOR THE POWER SHUTDOWN and DESCRIPTION OF EXPECTED EVENTS:

This shutdown is necessary as a training exercise to review the operating performance of the clinical units as well as all support services in the event of a complete utility power blackout. Necessary critical upgrades and maintenance will also be performed inside the Buildings A & B electrical switchboards and other equipment.

The Buildings A&B normal and emergency electrical power systems will be tested on June 24, 1995 from approximately 11:00 PM until approximately 3:00 PM. (Approximately 2300 - 1500 Hours). This test simulates a complete utility power blackout. The power will be out for 16 hours.

All Areas Should Have an Adequate Supply of Flashlights and Batteries on Hand Before Saturday Night.

SCHEDULE:	EVENT:
11:00pm (2300 Hours) Saturday Night	The Buildings A&B normal power systems will be turned off. The shutdown will be experienced throughout the Buildings A&B as a 6 to 10 second loss of all AC power while the buildings' two emergency generators start up. All electrically-powered equipment in the building will turn off except for battery-backed equipment. After the 6-10 second period, emergency equipment (on red outlets) will receive power from the generators. Some equipment may have to manually restarted. Areas without emergency power will be without power for 16 hours.
11:30 pm (2330 Hours)	After an approximate 30 minute stabilization period, during which all areas will be checked to ensure that emergency power and equipment plugged into red outlets are functioning normally, the maintenance work will commence.
Before Normal Power Returns	Computer users should start logging off to the PCIS login screen. Turn off all nonessential PC's in anticipation of the switch back to normal power.
3:00 pm (1500 Hours) Sunday Afternoon	Non-emergency equipment (after being off for 16 hours) will receive power again and may automatically turn on. A short time (approx. 5 minutes) later, all emergency equipment (which operated during the shutdown) will experience a short "blip" [the system voltage will drop to 0 volts for 1/2 up to 3 seconds] as emergency transfer switches go back from the generators to the utility power. During this transfer operation, microprocessor and computer driven systems on red outlets will experience unpredictable results. This last "blip" will signify the end of the test.

THIS TRANSFER _____ BACK TO NORMAL UTILITY POWER MAY HAPPEN EARLIER, WITH 60 MINUTES PRIOR NOTICE, IF THE MAINTENANCE REQUIRES LESS TIME THAN PROJECTED.

Terminating the Test: If a major equipment malfunction occurs at any time prior to or during the test, the test will be terminated immediately and the building will be returned to normal utility power. If a major external disaster occurs during the shutdown, the shutdown will be terminated immediately and the building will be returned to normal power. Once the maintenance has begun, this return to normal power will take approximately 1 hour. Electricians will be stationed on each Bldg. A&B floor from just before each switching operation until approximately 30 minutes after the switching is finished.

IMPACTS OF THIS SHUTDOWN ON HOSPITAL OPERATIONS:

SYSTEMS:

Communications: Personnel with radios will be stationed in each unit for the switching operations (at all 8 patient unit nursing stations, Operator Services, PACU, Radiology, Emergency Services, Pharmacy, and each laboratory floor).

Elevator Emergency Alarms: will work after the 6-10 second generator startup time

Paging (Overhead): will work wherever there is existing coverage.

Panic Buttons will operate. Extra security personnel will be patrolling all floors, or call ____.

Telephones (patient, house phones, pay phones and other single line telephones: will work.

Telephones, multiline (typically found at nursing stations): will work after emergency power comes back on. There will be a dial tone during the actual 6-10 second switching operation, but the ringers and lights will not work until emergency power comes on.

Code Call: Refer to the CODE CALL SYSTEM ACTION PLAN. The code call team will have access to one Bldg. A elevator and one Bldg. B elevator after the switching operations. Beepers will be paged at specified intervals to remind the code call team of the elevator limitations.

Electrical Power, Normal (gray, white, ivory, brown and orange outlets): will be off for 16 hours.
Electrical Power, Emergency (red outlets): will be off for 6-10 seconds at 11:00, and will experience a one-half second outage at approximately 3:00 pm the following afternoon.

Elevators: At 10:45 PM, all Bldg. A&B elevator cars will be brought to the first floor lobbies and secured. All personnel in Bldgs. A&B should use stairwells whenever possible during the test. Only one car in each building (Bldg A #1 & Bldg B #1) will operate until the shutdown is terminated. Medical emergency keys will work. The Bldg A #1 car will be manned (phone ____) after 6:00 AM Sunday. These cars may only be used for patient transport or other emergencies related to patients. Security personnel will be stationed in the Bldg A 1 and Bldg B 1 lobbies to direct others to the Bldgs C and D elevators. When the test is completed, both cars will be brought to the first floor lobby and taken out of service temporarily until normal power is restored.

Isolation Room Ventilation Systems: All supply and exhaust fans will stop at 12:01 AM for a period of 6-10 seconds and then restart. During this time frame, the isolation rooms will be in neither a positive nor negative pressure mode. All personnel should refrain from opening isolation room doors during this period if possible. After the 6-10 second, critical exhaust fans will restart to keep isolation rooms under a negative pressure. Supply fans will restart to provide adequate fresh air changes during the 16 hour test period.

Lighting: Over-bed and bathroom lighting in patient rooms will be re-powered after 10 seconds. Lighting in public restrooms, lounges, and locker rooms will not work. Signs will direct visitors to restrooms in Bldgs C&D.

Linen Service: to the Bldg A Building will be between 6:00 AM and 7:00 AM.

Medical Compressed Air and Vacuum Pressures may dip slightly at the beginning of the test during the 6-10 second generator start time.

Medical Gas Systems: O_2 and N_2O supply pressure will remain normal.

Nurse Call Systems: Battery-backed systems should operate normally throughout the test. Systems which are not battery-backed will be reset by electricians after the switching operations.

Pneumatic Tube System: Refer to the LABORATORY ACTION PLAN and the PHARMACY ACTION PLAN for Bldg A. The PTS will not work in Bldg A for 16 hours. All use in Bldg A should cease at 10:30 PM Saturday night. The PTS will work throughout the shutdown to all other buildings including Bldg B and the Pharmacy.

Television System, Bldg A; will be off for 16 hours - patients will be advised when they order TV.

EQUIPMENT:

Cold Rooms and Walk-In Boxes: do not have emergency power. These will need dry ice, which is available at the loading dock. Refer to Safety Office notice "HAZARDS OF HANDLING DRY ICE" for safety precautions. Contact Research Affairs or Clinical Lab Administration before 6/10/95 for more information.

Computers (Offices, Lab, Clinical Areas): will lose RAM memory at 11:00 PM (2300 hours) and at 3:00 PM (1500 hours). They should be shut off or information should be saved frequently to avoid loss of important data. They will not function unless they are plugged into red outlets.

Computers & Terminals, Patient Data Network: Users should try to log off to the normal "login screen" by 10:50 pm on 6/24/95. All requests for printed output should be stopped at this time. Terminal servers in the Bldg A & Bldg B communications closets will require 3 to 5 minutes to reload. Only network terminals and printers on red outlets at the nursing stations will be functional. These devices should be available approximately 5 minutes after emergency power comes on. If printed materials have not been delivered in a normal time frame, perform a manual lookup after the switching operation. Call the Help Desk at ____ if terminals do not respond by 11:15 PM. This same procedure will also be followed just before the Sunday afternoon return to normal power. Users should log off 5 minutes before the switching operation, and the system should be reloaded approximately 10 minutes after the normal power returns.

Radiology Terminal Servers: will be turned off at 10:50 pm and will remain out of service until 10 minutes after the test concludes. Refer to the Radiology Action Plan for alternative procedures.

Doors (Patient Rooms & Fire Doors with Magnetic Hold-open Devices): WILL ALL CLOSE during the switching operations. Please remind your patients so they will not be frightened. They may be opened after emergency power returns.

Doors, Electric: may require manual reset buttons to be pushed after each of the switching operations.

Fax Machines: will not work unless they are plugged into red outlets.

Ice Machines: generally will not work. Ice must be hand-carried from Bldgs. C or D.

Patient Care Equipment: (Should be plugged into red outlets).

Beds, Patient: will work after the initial startup

Bedpan Washers: will not work. Request additional bedpans as needed.

Heaters, Peridialysis : do not have battery backup -- plug into red outlets, short power interruption should not be a problem

Heating and Warming Equipment: generally, no reset is required

Hemodialysis Units, Bedside: do not have battery backup -- will power up in the same configuration, technician will be on hand

Power Strips: will be available for special or emergency needs by calling Operations at ____.

Printers, STAT: must be plugged into red outlets.

Pumps (Infusion): have battery backup and will work.

Ventilators: will audibly alarm during power loss. When electrical power is restored, a 7 second internal system check is done and then normal ventilation is resumed.

Monitors: Biomedical Engineering personnel will be located on Bldg A 9 at the time of the Shutdown and will be available for problems by paging beeper ____.

Flexible Monitoring Systems: (Bldg A 9 & 11). Monitors: battery backed, no expected effect. Servers: UPS powered, no expected effect. Alarm/Message Annunciators: will reset, may need to be reconfigured by Biomed. Eng.

Stand Alone Monitors: Rovers will lose alarm limits and require reconfiguration. Monitors are battery backed, no expected effect. Pulse Oximeters are battery backed, alarm limits may need to be manually reset. Miscellaneous alarm limits may need to be manually reset.

OTHER ACTIVITIES:

EEG: Emergency portable EEGs only; the EEG Tech will use a red plug at the patient's bedside.

EMG: No tests are scheduled on the weekend.

Emergency Department: Refer to the EMERGENCY DEPARTMENT ACTION PLAN. Two CT Scanners (Bldg A 1 and Bldg E 2) will be available during the shutdown. Additional transport staff will be on duty to hand-deliver specimens to the labs and provide ancillary support to the clinicians.

Food Service Activities: Refer to the DEPARTMENT OF DIETETICS ACTION PLAN. Contact ____ for special assistance.

Employee/Staff/Visitor Feeding: The cafeterias in the Bldg A Building will be closed Sunday during the shutdown. The full services of the Bldg. E Cafeteria will be in operation from 7:00 AM to 2:00 PM (0700 - 1400 hours), the regular service hours.

Nourishment Stations: The nursing nourishment stations will not have power. Nursing Assistants should remove all food and clean the refrigerator. Food supplied by Dietetics (juices) can be placed in the galley refrigerators for patient needs. All patient personal items and staff food cannot be placed in galleys (Public Health Regulation.)

Patient Feeding: All Bldg A Building galleys (6-14) will function normally with temporary power from Bldg. C. All normal meal service will be as usual.

Tube Feedings will be delivered on ice if necessary. A second pump will be delivered on Saturday. All pumps will be fully charged and run on batteries. To assure no problems, pumps in use on Saturday will run on batteries from 11:00 PM (2300 hours) until 7:00 AM (0700 hours). Then, the second pump should be started at 7:00 AM.

Information Desk, Bldg A Lobby: Emergency power and lighting are available. Activities will be as normal.

Laboratory Activities: Refer to the LABORATORY ACTION PLAN. Phlebotomists will make their normal Sunday rounds and specimens will be transported to the laboratories according to normal Sunday procedures. For transport of STAT specimens in the affected areas, refer to PTS Guidelines, pages 11&12. Reports will be available at the normal Sunday times. A dedicated messenger (Beeper #____) will be stationed in the Bldg A OR/PACU area. Labs that do not have emergency power to incubators, refrigerators and freezers can store their critical products in O_2 and CO_2 incubators, refrigerators, -20 freezers and -80 freezers in laboratories on Bldg. C 2 and Bldg. D 5.

Medical Records: Dictation equipment will be operational, however, only STAT Transcription will be performed on Sunday. All other services will operate as usual.
Operating Rooms: Refer to the OPERATING ROOM GUIDELINES. There will be no cases scheduled in the Bldg A Building. The Bldg. D and F O.R.'s will be used for all surgery during this time period. The Bldg A control desk administrative functions will relocate to the Bldg. C control desk by 10:00 PM. The control desk functions will be returned to the Bldg A Building after the Charge Nurse and Anesthesia Administrator have been notified that normal power has been restored.

Pharmacy: All fax machines should be plugged into red outlets. Where fax machines are operating, Refer to "PHARMACY PLAN A." In the event that fax machines do not function, refer to "PHARMACY PLAN B." Nothing will be tubed to the Bldg A Building after 10:30 PM Saturday, 6/24/95 to avoid losing any carriers in the system during the shutdown. Technicians will continue to make Q 2 hour runs to all inpatient care units according to the current schedule. All meds normally tubed (new IV orders and first time doses) will be placed on Q 2 hour pharmacy delivery runs. Stat meds will be delivered by pharmacy personnel as needed and as determined by Regional and Triage Pharmacist.

Radiology Activities: Refer to the RADIOLOGY ACTION PLAN. The following areas in the Bldg A Building will have services available: GI (PR__), Ultrasound (PR___) and Nuclear Medicine (PR__). Bldg A 1 emergency radiology will be fully operational. CT will be available on Bldg. C 2 and Bldg A 1 radiology.

Respiratory Care: will be coordinating maintenance of mechanical ventilation.

Feedback to improve future shutdowns: Return filled-in FEEDBACK FORMS to Facilities Management at ___.

APPENDIX 5 – SAMPLE SHUTDOWN FEEDBACK FORM

FEEDBACK FORM:
IMPORTANT OR
UNUSUAL
OBSERVATIONS
DURING SWITCHING
OPERATIONS

Please record your observations during the 11:00 PM and 3:00 PM (2300 and 1500 hours) switching operations on this form. Use the reverse side for observations during the actual 16 HOUR SHUTDOWN itself.

LOCATION	IMPORTANT OR UNUSUAL OBSERVATION	WAS THIS EXPECTED?	TIME	NOTED BY

COMMENTS: How should we improve future shutdowns?

_____
_____
_____
_____
_____

Signed _____, Department _____, Phone _____

APPENDIX 6 – SAMPLE LESSONS LEARNED FROM A NORMAL POWER SHUTDOWN

Increasing reliance on tele/data systems requires that more attention be given to visibility of LCD displays under emergency lighting, inter-building data ties, better coordination between nursing and network services in determining emergency power needs for PC components (CPUs, CRTs and printers,) network terminals and printers, and their relationship to emergency outlet locations. Some PCs and terminal servers did not re-boot easily. Instructions for dealing with this possibility should be included in future white papers. Some personnel shut off only the CRTs (instead of both the CRTs and the CPUs) before the first switching, and some forgot to shut off their PCs at the end.

Battery-backed and UPS-powered equipment worked fine during the switching and shutdown. As much patient care equipment as possible should be purchased with battery backups in the future. Eventually, this approach will minimize the disruption and cost impact of continuing shutdowns and tests on normal hospital Maintenance.

Some mechanical equipment that was off included the xxx lab air conditioning equipment and the heating control circuit for the xxx Dept. During the xxx 2 hour NP outage, instrument control air had tripped, which would also have caused the steam control valves to go fully open. This masked our understanding of the real reason behind the xxx Dept getting too hot during the earlier planned outage. Field-verify control power sources in the future.

The Area zzz temp. wiring was delayed by the lab xxx overheating issue. This was actually in accordance with the Hold Point List. The temp. wiring was originally intended to be installed during the week prior to the shutdown, but agreements were reached at the last minute to use the first hour of the shutdown instead. This will not be repeated.

The Dept xxx personnel did not log off their computer properly before the return to normal power. Since it was not fully off, the Dept xxx computer lost RAM. More training is required for those present during switching operations.

Rooms xxx did not have lights fed by the Bldgs A/D backup feeder, although this was expected. Although this caused no problems during the shutdown, the incorrect information was a source of concern. Investigation revealed that the Bldg A lower floor 2 hour NP planned outage did not indicate the incorrect wiring situation because some vertical risers had been left powered during the outage at the request of Dept yyy. Future planned outages must be complete to avoid future situations of this nature, even if it means that they must be during 3rd shift or weekends.

The hot water system did not operate on floors xxx, because the hot water recirculation pumps were on normal power. Medical air dryers were fed by normal power and did not function until temp-wired. The assumption was that because the medical air system itself was confirmed on equipment branch, all system components were also on EB. The dryers were not. Future planning will address all components that make up required mechanical systems.

Area xxx lighting was off because it was fed by the corridor lighting circuits, although the area's local panels were tied to a backup feeder for the shutdown. When areas need backup power, we will also focus on their lighting.

The mechanical floor alarm system was in the "no response" mode, although it did have power. This did not allow Maintenance to be aware of equipment failures in the area. Future shutdowns will also include such response modes.

Some Dept xxx systems did not function despite having EP because required ancillary devices didn't have EP also. System engineers must review all portions of a system to assure it will function during outages.
Some mechanical control system failures were attributable to unexpected memory losses or software lapses during the switching (instrument air compressor PC; HVxx, EFyy & EFzz failure to restart). Battery or UPS backup for small PC or microprocessor units, or software modifications, should be installed to resolve these problems.

APPENDIX 7 – SAMPLE 16 HOUR / 2 BUILDING SHUTDOWN LABOR

Task Description	Qty. of Tasks	Hours / Task
18 Building System Planning Meetings	18	1.5
Shutdown Management for 19 Weeks	19	4
Additional Effort During Last 4 Weeks	4	8
Task Force Participation by Facilities Management for 13 Weeks, 4 Representatives	13	6
Prepare White Paper	1	40
Prepare Contingency Plans	5	8
Revise Switchboard Coordination Studies and Update Generator Loading Documentation	2	40
Conduct Four 2-Hour Outages, 12 Electricians	4	24
Conduct special EP Testing, 6 Electricians	3	6
Monitor ATS Loads	10	2
Install Backup Feeders Between Buildings	2	Contracted
Furnish & Install Temporary Wiring	4	12
Miscellaneous Local Upgrades for Shutdown	10	16
Monitor Generators during shutdown	2	18
Facilities Management Labor during Shutdown, 26 people	26	18
Switchboards, Breakers, Transformers PM & Testing	8	18
Dry Ice for Shutdown	1	1
Participation in 13 Task Force Meetings	13	15
Action Plan Preparation & Unit Training	15	8
Additional Labor During 16 Hr. Shutdown	18	20
Feedback and Wrap-Up	15	2

ENDNOTES AND REFERENCES

[1] Stymiest, David L. ASHE Technical Document, Managing Hospital Electrical System Shutdowns, *Healthcare Facilities Management Series* (No. 055126). Chicago: ASHE, April 1996.
[2] Weigel, Joseph. Maintenance concerns should be a call to action for electrical inspectors, *May-June 2008 IAEI news, pp.94-97*, www.iaei.org, International Association of Electrical Inspectors, Richardson, TX: 2008.
[3] O'Reilly, Daniel P., Power System Outage Causes Chaos in Critical Care, originally posted November 2001 by Motor & Generator Institute, www.healthcareengineering.net/webmodules/newsmanager/ShowNews.aspx?NewsID=265, Winter Park, FL: Healthcare Engineering Network, Inc., 2004.
[4] Callanan, Michael, Neitzel, Dennis, and Neeser, Dan, Preventative Maintenance and Reliability of Low Voltage Overcurrent Protective Devices.
[5] Smith, Jack, Out With the Old - Planning helps manage electrical system upgrade, Plant Engineering, www.plantengineering.com/article/CA6271634.html, October 1, 2005.
[6] Reference: NFPA 70E-2008 ROP "Preprint" copy as published on www.nfpa.org.
[7] 29 CFR Part 1910 Electrical Standard Final Rule. Reference Federal Register / Vol. 72, No. 30 / Wednesday, February 14, 2007 / Rules and Regulations.
[8] Within the context of this monograph, the generic term emergency power system (EP system) is used all inclusively. That is, it refers to the Emergency Power Supply System (EPSS) as defined in NFPA 110 plus the Essential System branch subsystems defined in NFPA 70 and NFPA 99 – the life safety branch and critical branch of the "Emergency System" plus the equipment system. Thus the term "EP system" in this monograph incorporates the generator(s) through and including elements such as the red outlets and emergency lights. Refer to Table 1 in the ASHE management Monograph "Managing Hospital Emergency Power Systems."
[9] NFPA 70B-2006 Edition or later, Recommended Practice for Electrical Equipment Maintenance, Quincy, MA: NFPA, 2006.
[10] NETA Standard for Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems, 2007 Edition, Morrison CO: NETA – InterNational Electrical Testing Association, www.netaworld.org, 2007.
[11] Stymiest, David L. ASHE Management Monograph, Managing Hospital Emergency Power Systems – Testing, Operation, Maintenance and Power Failure Planning, Chicago: ASHE, 2008.
[12] Sentinel Event Alert Issue 37: "Preventing adverse events caused by emergency electrical power system failures." September 6, 2006, The Joint Commission. Also refer to the SEA-37 discussion in the September 2007 issue of Environment of Care News, The Joint Commission.