preventive maintenance, corrective maintenance, and the other types of maintenance used or required.

The results of assessing the risks of failures of the utility systems are used to identify those systems and areas for which emergency action plans for high risks are needed to assure ongoing safety to patients, staff and visitors.

C. *Maintenance Strategies*

The RUHS Medical Center has developed appropriate strategies for all utility systems equipment in the inventory for ensuring effective, safe, and reliable operation. These strategies include:

- Preventive and predictive maintenance – for equipment that will benefit by regular replacement of parts, greasing, or other physical activity; or by regular testing or inspection of the equipment. This testing may be done by staff, certified outside contractors, original equipment manufacturer's agents, or other competent persons.

- Corrective Maintenance – for equipment deemed to have no maintainable parts, or whose failure will not cause serious risk of harm to patients, staff, or visitors.

- Timed Maintenance- maintenance based on an hour meter, or other time measurement, based on the manufacturer's recommendations.

- Maintenance prior to use – maintenance based on irregular use and maintenance prior to use.

- Other strategies - based on the needs of the equipment and organization history with that equipment.

D. *Maintenance Intervals*

The equipment and the maintenance activity are based upon manufacturers' recommendations, evaluated risk levels, and prior experience. Most intervals are annual, semi-annual and/or quarterly, with few monthly and weekly maintenance activities. The preventive maintenance activity is automatically scheduled by a maintenance management system that generates work orders on a periodic basis. The work orders are distributed to the appropriate staff, and when complete, the data is entered into the maintenance management system.

The results, including past due work orders, compliance rates, timeliness rates, and outliers (corrective maintenance needed after preventive maintenance) are evaluated to determine the effectiveness of the system, the need to replace components, and opportunities to improve by changing intervals and activities. The results of the analysis are reported to the Environment of Care Committee, and used internally for program improvements.

E. Emergency Procedures

RUHS Medical Center has identified and implemented emergency procedures for responding to utility system disruptions or failures that address the following:

- What to do if utility systems malfunction (on a departmental and/or organization wide basis)
- Identification of an alternative source of organization-defined essential utilities (where alternate sources are appropriate)
- Shutting off the malfunctioning systems and notifying staff in affected areas
- How and when to perform emergency clinical interventions when utility systems fail (This is focused on clinical staff and support staff)
- Obtaining repair services (This includes both internal and external resources)

The plans for these emergency responses have been integrated into the Emergency Operations Manual.

These plans are developed to include the criteria and indications for implementing a utility response plan; the staff responsible for making the decisions; activities and resources used to mitigate the emergency (such as an emergency power system to mitigate external power failure); and preparation for the failure (e. g., flashlights, staff training about how to respond to a power failure). The recovery plans focus on return to normal conditions, and the resetting and recovery of emergency equipment and supplies.

F. System Layout and Controls

The Chief of Plant Operations is responsible for managing the process for documenting the layout of utility systems and the locations of critical or emergency controls for a partial or complete shut-down of the system.

New utility systems and major updates to existing utility systems are required to be developed by the architect or engineer and provided to RUHS MEDICAL CENTER as computerized drawings.

Day-to-day use of historical documents and computerized drawings includes additions, deletions, and other changes to the layout of utility systems to be documented in a timely manner. This ongoing process of making changes allows the overall accuracy of the utility system layout to be maintained at a very high level at all times.

Critical or emergency operating components of utility systems are identified on historical documents or computerized drawings. A variety of techniques such as legends, symbols, labels, numbers, and color-coding are used to identify the location and type of critical or emergency controls. Shut-off valves above drop ceilings are identified by colored dots to identify the location of the valve. This process is designed to provide technicians with accurate information about the location and function of a control before it is activated for scheduled maintenance or during an emergency.

G. *Management of Waterborne Pathogenic Agents*

The organization has identified and implemented processes to minimize pathogenic biological agents in cooling towers closed loop water systems and other aerosolizing water systems.

The Medical Center has implemented a maintenance program to manage pathogenic biological agents in water systems; the Infection Control Practitioner and the Chief of Plant Operations collaborate to identify a treatment program to prevent biological growth.

Ornamental water will be avoided in patient care areas. Ornamental water in non-patient care areas will be periodically treated and the potential aerosol will be controlled by ventilation or other methods acceptable to the Infection Control Practitioner.

H. Maintenance of Air Pressurization, Filtration, and Filter Efficiency

RUHS Medical Center designs, installs, and maintains ventilation equipment to provide appropriate pressure relationships, air-exchange rates, and filtration efficiencies for ventilation systems serving areas specially designed to control airborne contaminants (such as biological agents, gases, fumes, and dust).

The air handling and filtration equipment designed to control airborne contaminants including vapors, biological agents, dust, and fumes is monitored and maintained by the Plant Operations Department. The schedule of regular inspection of filter performance monitoring equipment, air pressure sensing equipment, and airflow rate sensors is managed by the Chief of Plant Operations.

A qualified service provider is engaged to verify volume flow rates (air exchange rates, and positive or negative pressure rates) and pressure relationships as part of the commissioning of all new building projects and major space renovations. In addition, the air volume flow rates and pressure relationships are tested periodically throughout the Hospital including investigation of complaints related to indoor air quality. The results of testing are used to adjust the performance of air handling systems by changing control software parameters and mechanical or electrical controls.

If system performance cannot be adjusted to meet code requirements or occupant needs, the Chief of Plant Operation works with the Infection Control Practitioner to develop temporary management practices. In addition, a recommendation for upgrading or replacing the equipment involved is prepared and submitted to Hospital Administration as appropriate.

I. Emergency Electrical Power Systems

Riverside University Health System provides reliable emergency power systems, as required by the Life Safety Code requirements for both exit illumination and task area lighting. Emergency power is supplied to the following areas when normal electricity is interrupted:

- Fire Protection System
- Emergency egress illumination
- Emergency communication systems
- RUHS-MC exit signs are nuclear/Tritium. Blood, bone, and tissue storage units
- Patient care areas

- Elevators (at least one for non-ambulatory patients in each bank)
- Medical air compressors
- Medical and surgical vacuum systems

J. *Maintenance, Testing, and Inspection of Utility Systems*

Riverside University Health System maintains a current documented inventory of all of the utility components identified by the criteria in the utility management plan. This inventory includes all equipment maintained by Plant Operations staff, by manufacturers' representatives, and by contractors. The inventory is the basis of the maintenance management system, as well as other maintenance activity.

The inventory is maintained by addition of new equipment and, as appropriate, replacement components; and removal of equipment no longer in use. The inventory is maintained on the maintenance management system and brought together periodically to allow analysis and evaluation.

Each critical component identified in the plan is subject to performance and safety testing before initial use as part of the acceptance process, and is included into the inventory. The maintenance management system then schedules and documents the maintenance of those critical components of life support utility systems/equipment consistent with maintenance strategies identified in the Utility Management Plan. Items that are selected for preventive and predictive maintenance are included in that program, and other items are maintained by corrective maintenance.

A criteria based assessment tool is used to evaluate utility systems and associated equipment. Documentation of utility systems maintenance is recorded in the Hospital Equipment Management System (HEMS). Reports regarding the results of maintenance are analyzed and reported to the Environment of Care Committee. Information about significant failures and equipment concerns are also highlighted on those reports.

K. *Emergency Power Systems*

The Chief of Plant Operations, Supervising Stationary Engineer, and the Building Maintenance Supervisor are responsible for managing a program of inspection, maintenance, and testing of the essential electrical system. Generators are tested under connected load conditions monthly.

Testing is conducted for at least 30 minutes under full-connected load. Testing time starts when the generator reaches defined operating conditions, generally full operating

temperature of either the exhaust system or coolant water. Appropriate testing parameters are recorded and evaluated by the Chief of Plant Operations or the Supervising Stationary Engineer. Any indication of performance below code requirements or expectations is immediately evaluated to determine the source of the problem and rectified.

If any diesel generator is not loaded to 30% or more of its nameplate capacity during connected load tests, temperature measurements are made to determine if the exhaust gas temperature reaches or exceeds the manufacturer's recommended temperature to prevent wet stacking. Any engine failing to meet the temperature recommendation will be exercised annually by

Connecting it to a dynamic load bank and performing the three step test process required by National Fire Protection Association (NFPA) 99 and NFPA 110.

All automatic transfer switches are tested as part of the regular generator load test. Their performance is verified during generator testing, as well as annual maintenance of each switch.

The maintenance program of regular inspection, maintenance, and testing includes starting batteries, fuel stored on site, and engine controls. Maintenance staff responsible for each component part of the essential electrical system observes or measures critical operating parameters in accordance with regulations, manufacturer recommendations, and good practice guidelines. All observations and measurements are recorded and reported to the Chief of Plant Operations, Supervising Stationary Engineer, Building Maintenance Supervisor, and the Environment of Care Committee. All repairs, calibration, and replacement needs are acted upon immediately to assure system reliability.

The Chief of Plant Operations, Supervising Stationary Engineer, and Building Maintenance Supervisor are responsible for identifying all battery-powered lights installed throughout the facilities to provide exit path illumination or for illumination of critical task areas. Each battery- powered emergency lighting device is tested for 30 seconds monthly and for 90 minutes annually. The 90-minute test meets the requirements of applicable codes and standards and manufacturer recommendations. An alternate for some systems in critical areas is a battery maintenance program, which assures the battery condition and includes annual replacement of batteries with tested and appropriate batteries.

The Chief of Plant Operations or designee is responsible for identifying all Stored Emergency Power Supply Systems supplying power for emergency exits, patient

ventilation, fire and life safety equipment, public safety and utility, communications, and processes that if disrupted would have serious life safety or health consequences.

In addition to the regularly scheduled inspection, testing, and maintenance activities, the Inspector of Record (IOR) is responsible for assuring evaluation of the impact of adding new loads to the system during construction or at the request of departments throughout the existing hospital. Any addition of a load that would result in an overloaded or poorly balanced system that could result in a safety shutdown will not be permitted until a suitable configuration can be designed or upgraded equipment is installed.

- The Inspector of Records (IOR) function is to make sure that all new construction is done per approved construction documents and California Building Codes.
  The Engineers when designing a new electrical project that will result in additional load to the current system will provide in their calculations and drawings the additional electrical gear/equipment that will help to maintain our infrastructure in compliance with codes and regulations.

L. *Medical Gas and Vacuum Systems*

Plant Operations maintains a preventive maintenance system on an annual basis to inspect, test, and maintain the critical components of the piped medical gas systems. Components that are maintained include the master signal panels (high and low pressure, transfer from normal to reserve indicators), area medical gas alarms, automatic pressure switches (high and low pressure), zone and main shutoff valves, flexible connectors (where installed), and medical gas outlets.

Plant Operations staff completes the preventive maintenance activity, with the assistance of Respiratory Therapy. Where appropriate, certified contractors are engaged to conduct the tests and inspections of elements that require special equipment and training. Documentation of the testing is maintained by Plant Operations and reported to the Environment of Care Committee.

Plant Operations uses a qualified contractor to test and certify piped medical gas and vacuum systems when the systems are initially installed, modified, or invasively repaired. Testing includes verification that there is no cross-connection of piping and outlets; testing the piping for content purity and particulates, and verification that the pipes maintain pressure. Testing is done to demonstrate the system meets NFPA 99 requirements.

The main supply valve and the area shutoff valves of each piped medical gas and vacuum system are labeled with the type of gases, and the areas the valve is to be accessible. Ongoing environmental rounds and observation are used to assure the valves are maintained clear of obstructions to facilitate prompt use in emergencies. In addition, staff is trained about the locations of the applicable medical gas zone valves that might be needed during emergencies and who is authorized to turn off medical gases.