
**Technical Advisor's
Findings and Recommendations**

**(OS1)[®] CLEANING PROCESS VS.
TRADITIONAL HOUSEKEEPING**

A Comparison Between the (OS1) Pilot Program in
Carroll Hall and Traditional Housekeeping in Dey Hall

University of North Carolina
Chapel Hill

Conducted April – July 2006

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Purpose of Report

The purpose of this report is to provide a technical evaluation of the zone housekeeping system currently used at the University of North Carolina at Chapel Hill and the ManageMen Operating System or (OS1) cleaning system instituted on a pilot basis in Carroll Hall, which is currently occupied by the School of Journalism at UNC.

A special committee was formed in April 2006 to evaluate zone cleaning and a proposed (OS1) cleaning system that was being piloted in Carroll Hall for a 90-day period. The evaluation is intended to determine which of the two systems is better for the UNC community. The committee was made up of representatives from across the campus including housekeeping, human resources, health and safety, student government, faculty council, and employee forum. The committee is independent of the administration and was tasked with providing a written report on the findings to the Director of Facilities Services.

Committee Members and Contact Information

Ron Howell, Chairman (Environmental and Health)
Elizabeth Crowley (Employee Forum)
Noreen Montgomery (Human Resources)
Bob McRae (Housekeeping)
Ellen Peirce (Faculty Council)
Timothy Stallman (Student Government)
Oscar Manuel (Housekeeping)
Mike Berry (Technical Advisor)

The assignment of the Technical Advisor to the committee was intended to assist the committee by providing technical expertise in comparing and evaluating (OS1) and Zone Cleaning in terms of cleaning and housekeeping effectiveness, training, equipment, ergonomics, quality control, work loading, indoor environmental quality and building health, worker safety, physical security, and environmental sustainability.



Technical Advisor's Recommendation

Based on the technical findings of this pilot study, the (OS1) system is recommended as a replacement to the current UNC zone system. From a technical point of view, the (OS1) housekeeping system is vastly superior to the zone cleaning system. The effectiveness of the (OS1) system resides in its comprehensive, scheduled, systematic cleaning coverage of the building; the use of cleaning equipment and technology tested and evaluated for effectiveness and safety; and most importantly the focused and specialized training provided to housekeepers. Professional training is at the heart of the (OS1) system. Therefore, it is crucial that the University establish and support a high visibility training program and position for the implementation and sustained operation of the (OS1) housekeeping system.

Quality Management System

(OS1) approaches cleaning in a systematic manner and incorporates, continuous improvement management processes. The (OS1) system cleans the entire environment in a comprehensive, effective, and consistent manner by using well-trained and equipped teams of housekeepers. UNC Zone housekeeping is not systematized. The zone system attempts to clean fragments of an environment, often cross contaminating, and failing to recognize environmental connectedness. Under the zone system, there is a high degree of cleaning variability, depending on the skill and motivation level of the individual housekeeper. Zone cleaning accepts inconsistency of cleaning effectiveness throughout multiple zones.

Communication and Housekeeper Recognition

The (OS1) system is designed to position housekeepers to be fully successful in a consistent fashion. The system evolves around a coordinated team in which each team member achieves a special cleaning objective. Housekeepers are involved in all aspects of cleaning operations. There is effective communication between team members, supervisors, and administrators. (OS1) assumes responsibility for cleaning knowledge and effectiveness at all levels - from management to supervisors to team members. The zone cleaning system at UNC tends to place the responsibility for performance primarily at the housekeeper level with limited informed guidance from supervisors or management. In zone cleaning housekeepers are generally left on their own, often not heard, and unsure of cleaning results or appreciation.

The UNC housekeeping program requires special attention to language barriers and translation, especially in regards to safety and housekeeper training. One particular translation need is found among the growing numbers of Burmese housekeepers. Translators are necessary but the (OS1) team structure provides an opportunity for more continuous translator-to-housekeeper contact than the current zone system where non-English speaking housekeepers are on their own for extended periods of time.



Training

(OS1) trains housekeepers and managers in a coordinated and comprehensive manner for the implementation of a specific and effective cleaning system. (OS1) training is far more professionally oriented, science based, and safety focused than the zone training currently conducted at UNC. (OS1) training begins with a clear explanation of what cleaning is, why cleanings is important, and the history and importance of the “professional” housekeeper. UNC Zone training generalizes housekeeping and safety information without regard to specific housekeeping responsibilities and performance expectations. In this study observations of zone training found several significant deficiencies in safety instruction. Respiratory protection was not in compliance with OSHA regulations; wrong protective gloves were provided (latex gloves should be used only for biological material); and essential MSDS information was missing from notebooks and safety manuals.

Safety & Health

Safety is an integral part of (OS1) training throughout all portions of the program. (OS1) training is superior to zone training in that it is not generalized and is focused on the housekeeping process. The (OS1) safety documentation is easy to read and understand, even by non-English speaking housekeepers. Safety information, equipment and supplies are color-coded for easy identification and access. (OS1) safety instruction—training films for example- addresses housekeeping. In zone training, safety instruction is too general and unspecific. For example, a safety film currently used in UNC zone training addresses safety in a manufacturing facility and does not in any part focus on or pertain to housekeeping operations in a university setting such as UNC.

Equipment and Storage

(OS1) cleaning technology have been tested, evaluated and employed for safety and cleaning effectiveness. The (OS1) prescribed vacuum cleaner reduces back strain and injuries, and has much lower particle emissions to the breathing zones of housekeepers than the typical upright machine used in zone cleaning. From an ergonomics standpoint the backpack vacuums provide overall reduced strain and better body position than standard upright vacuums being used under zone.

(OS1) mops are much easier to use and maintain than the mops used in the zone system. Along with their two-chamber mop bucket, the (OS1) flat mop reduces cross contamination by separating fresh water from rinse water and provides for significantly higher levels of sanitation. Zone housekeepers clean hard floors with a much heavier #12 Kentucky mop. The zone mop bucket is a single chamber plastic bucket. The single chamber bucket is not designed to reduce cross contamination through the separation of fresh water and rinse water. There is also a considerable weight reduction on the (OS1) mop/bucket system over the standard “Kentucky Mop”.

Observations were made of the cleaning equipment and chemicals used and stored in both the zone system and (OS1) system. In the zone system each housekeeper is assigned a closet in which to store equipment, chemicals, and supplies. There are on average, one housekeeper closet for every two floors throughout campus.



System simplicity is a main component of the (OS1) system. There is far more organization of cleaning equipment supplies in the (OS1) system than in the zone system, resulting in safer and more sanitary conditions. In the (OS1) system, multiple janitorial closets are replaced with a single, centrally located team check-in room that contains housekeeper lockers, and a regularly inventoried housekeeping supply cabinet. The entire (OS1) housekeeping team operates from this central location. A central “equipment room” provides storage for vacuums and heavy cleaning equipment. Paper supplies are restocked and stored in “pantries” located throughout the building for easy access.

Chemical (Safety/Efficacy)

The (OS1) system uses far less chemicals than the zone system with corresponding less risk of a significant chemical spill or accident. In the (OS1) system there are only two chemicals employed, a general-purpose disinfectant and a detergent. Under (OS1) the number of concentrated chemicals has been reduced from an average of 7 to 2 ensuring less unnecessary chemical exposure to housekeepers and building occupants.

Typically a UNC zone housekeeper has 5-8 different cleaning chemicals in an assigned closet. Most of these chemicals are in concentrated form, in half-gallon size containers. When the chemical is used, it is mixed by using a manufacturer supplied mixing machine. Many of cleaning chemicals used in zone cleaning are not necessary to effectively clean the zone area.

A number of zone housekeeping closets were observed in the course of this study. Unsafe and unhealthy conditions were observed in some closets to include dirty floors and surfaces, trash and extensive clutter, unlabeled or empty chemical containers, residue from cleaning chemicals, and drink bottles sitting beside cleaning chemicals.

Environmental

Clean is defined as an environmental condition free of unwanted matter - in the form of solids, liquids, gases, or living organisms - that has the potential to cause an adverse or undesirable effect. Cleaning, to include housekeeping, is the most basic form of indoor environmental management. It is the organized process of removing or repositioning unwanted matter so that human activities can take place in a built environment.

Cleaning/housekeeping is a systematic process of:

- 1) Knowing the environment, sub-compartment, or an object to be made free of unwanted matter,
- 2) identification of the unwanted matter,
- 3) separation of matter from the object/environment,
- 4) containment of the matter so it can be effectively moved,
- 5) transporting the unwanted substance to a suitable location and
- 6) properly/safely disposing or repositioning the matter.



The primary purpose of any cleaning and a housekeeping program in any institution such as UNC is to maintain and sustain a built environment which is healthy for occupants and which promotes, supports, and enhances the purpose of the building and the activities carried out in the building. (OS1) seeks and gives primary attention to the environmental health and well-being needs of the institution and building occupants.

Zone cleaning at UNC fails to recognize an environmental health objective. For example, the condition of many UNC zone housekeeping closets, in which large quantities of concentrated chemicals are stored in a generally haphazard fashion, is contrary to the value UNC places on a healthy environment. The (OS1) system with its emphasis on simplicity, limited chemicals, and cleaning effectiveness, reduce wastes and subsequent environmental degradation.

(OS1) chemicals are in pre-portioned plastic packaging and provided to specialists prior to each work shift according to their assignment and need. The PortionPac chemicals are specifically designed to reduce cleaning chemical injuries to housekeepers and minimize adverse environmental effects. The housekeeper carries the chemical packets and uses them only as required. The empty containers are returned to the check-in room at the end of each shift, accounted for and recycled.

The manufacturer of (OS1) cleaning chemicals, PortionPac, was recently recognized as a leader in environmental protection and sustainability. PortionPac products used in (OS1) are certified and labeled as green cleaning products by Green Seal. Green Seal is an independent non-profit organization dedicated to safeguarding the environment and transforming the marketplace by promoting the manufacture, purchase, and use of environmentally responsible products and services. Green Seal Certification ensures that a product meets rigorous, science-based environmental leadership standards. This gives manufacturers the assurance to back up their claims and purchasers confidence that certified products are better for human health and the environment. Government agencies increasingly recommend and require that only green certified products be purchased and used in facilities under their control.

Workloading

The (OS1) program begins with a detailed assessment and evaluation of the building's cleaning needs, known as Building Profiling. Cleaning tasks are divided into 'routine tasks' to be done daily; 'detail tasks' to be done within a specific building quadrant/area on a specific day of the work week; and 'project work' such as carpet extraction and flooring stripping that is scheduled on one day of the week. Specialist duties are tailored to fit the cleaning needs of a particular building. Team member tasks and scheduling are based on the building size, layout, and special needs. Based on the cleaning needs assessment, job cards are prepared for each team member to simplify the process and aid the housekeeper in effective cleaning.

(OS1) is designed to respond to variability of needs and conditions. The (OS1) system is flexible in that it provides for a normal level of absenteeism and allows for the addition of team members should the environment require additional cleaning. (OS1) is elastic enough to accommodate unique needs of individual



housekeepers should those needs arise. Additional team members are added to a building should that be necessary. There is also housekeeping depth within a (OS1) team. When one or more team members are absent, an “(OS1) Absence Staffing Plan” adjusts the team schedules and tasks to ensure critical housekeeping tasks are addressed without placing excessive demands on the team.

The (OS1) system is elastic enough to accommodate special needs—for example light work assignments for particular housekeepers who may have a physical ailment or temporary disability. In the zone process, there is no assurance that changing or unexpected conditions will permit consistent housekeeping services. For example, for unexpected absences, each supervisor must decide what cleaning tasks are to be changed and must inform each housekeeper in the zone of the changes. There is no consistency or reliability in this effort, as it relies on the differing judgment and experience of each supervisor. The zone process does not plan for the unexpected to the same extent as (OS1).

Quality Control

Housekeeping quality is provided by (OS1) in a number of ways beginning with compliance auditing and focused training. (OS1) uses benchmarking and compliance auditing to periodically verify the management process is on track and being properly followed and implemented. It is likely that a high level of environmental quality will be achieved and maintained if the (OS1) management process is followed as designed. Zone cleaning at UNC has no systematic evaluation or environmental quality measure program.

In the (OS1) system, through focused training and effective equipment, housekeepers are ensured of a high quality cleaning results.

The (OS1) system has quality control built into the team cleaning process that ensures a high level of cleaning effectiveness. For example as the vacuuming specialist follows the light duty specialist, the vacuum specialist checks that the wastebaskets are empty and have not been overlooked. The zone system has no equivalent provision for quality control.

Job cards serve as a checklist and allow clear understanding of the specific tasks to be accomplished, the approximate schedule, and the estimated time for each task or function. These cards also give supervisors, team leaders, and team members a general awareness of where to find team member at any point in the housekeeping process should there be an emergency. A standardized (OS1) Team Checklist helps supervisors in conducting quality control assessments of the building on a monthly basis.

Security

Security is built into the (OS1) system. The job cards indicate a location the housekeeper can be located during a housekeeping shift. Doors and entrances are marked with colored dots indicating their security level. The vacuum specialist turns out all lights and locks all doors after moving through an area.



Cleaning Effectiveness and Building Health

(OS1) recognizes more fully the purpose of cleaning. (OS1) recognizes the health protection value and importance of effective cleaning throughout the entire institution and expects a consistent high level of performance. *'Clean for Health First, Then Appearance'* is a central part of the (OS1) philosophy of cleaning. Zone cleaning at UNC claims no such philosophy. The current zone cleaning process tends to execute cleaning as a common, mundane task with limited health and sanitation value.

Effective housekeeping, such as that provided by (OS1) creates a healthy condition by reducing exposures and risks. It enables sanitation, breaks the transmission chain of infectious agents, and prevents illness. Housekeeping provides living and working space. It protects valuable materials and equipment, and maintains the value of property. Housekeeping encourages topophilia—attraction to or “love of place”. It accents aesthetics, promotes human dignity, sends caring messages, instills a sense of ownership. It projects a professional image and enhances human productivity. It is a form of insurance that prevents crisis and reduces the full range of costs related to property and real estate. Cleaning manages wastes and contributes to environmental protection and sustainability.

Environmental sampling of dusts, fungi, bacteria, and aerosol (PM10) was conducted for Carroll Hall prior to and during the (OS1) pilot study. To compare (OS1) to zone cleaning, samples were also taken in Dey Hall, a zone cleaned building adjacent to Carroll Hall.

Cleaning effectiveness is measured in terms of the quantity of unwanted matter removed. During the Carroll Hall pilot, (OS1) produced a measurable cleaning result that is (at least in this study) a factor of 2-5 times more effective in removing dust from the building envelope. The data suggest that the (OS1) system better manages fungal spores and reduces the risk of allergic reaction of occupants. The two highest fungal levels as indicated by TNTC (To Numerous To Count) plates were found in zone cleaned processes.

A measure of cleaning effectiveness and sanitation in restrooms is aerobic bacteria counts. The data suggests (OS1) cleaning system produces a sanitary condition consistently higher than zone cleaning. In two post-cleaning measurements of Dey Hall, it was observed that some restrooms were not cleaned at all. This is an artifact of inconsistent and fragmented zone cleaning. Another significant difference is that (OS1) produced a consistent sanitary condition using a single portioned disinfectant. No E-coli bacteria were found after restroom cleaning in both (OS1) and zone processes when the restroom was cleaned.

Throughout the pilot study, there was building construction adjacent to Carroll Hall. The construction activity added to housekeeping requirements and also affected indoor air quality. In the face of this extraordinary and less than desirable outside conditions, over the course of the pilot study, the (OS1) cleaning program reduced dust concentration in Carroll Hall by a factor of 2, (40-50%). The IAQ data are remarkably similar to the data collected in the Frank Porter Graham Child Development Center Study in 1990 that demonstrated that any systematic cleaning program has a positive influence on IAQ.



Summary of Findings

There is evident need and demand for improved housekeeping at UNC. Based on frequent observations over a four month study period and a comparative environmental assessment of a zone cleaned and (OS1) cleaned buildings along with a consideration of housekeeping satisfaction survey where 47% of respondents are dissatisfied with the university housekeeping program, there is a clear need to improve or change the current UNC housekeeping system.

In 2005 the Director of Facility Services at the University of North Carolina at Chapel Hill discovered a number of housekeeping issues at UNC. In June 2005, a customer satisfaction survey was conducted campus wide. A central finding of that survey was that 47 percent of respondents indicated they were dissatisfied with their current housekeeping service and the resulting environmental conditions. Other issues noted with UNC housekeeping were: outdated and physically demanding equipment that was harmful to housekeepers, less ergonomically appropriate cleaning practices, limited training program to include no training of supervisors, cleaning that did not reflect the standards expected of the housekeeping department, and an apparent management-employee relationship culture that was oppressive and adversarial.

(OS1) was selected for pilot testing at UNC because it addresses many of the problems identified in the UNC. (OS1) is an enhanced form of team cleaning that produces high performance cleaning results. (OS1), designed by ManageMen, Inc., is unique in that it is a comprehensive quality or high performance management system. Unlike most cleaning programs, (OS1) does not advocate or sell any equipment or chemicals that are manufactured by ManageMen itself. The only “product” that ManageMen sells is a housekeeping cleaning management system and a training program that implements the system.

(OS1) is recommended by other institutions and found to offer an excellent opportunity to improve cleaning effectiveness and provide a better work environment for the housekeepers. The system has been pilot tested, evaluated, and implemented by a number of universities, research, and industrial institutions throughout the country. Large universities currently using (OS1) include the University of Texas Austin, University of New Mexico, and University of Massachusetts Amherst. Yale University is currently evaluating the program. Research institutes, manufacturing and government facilities using (OS1) include Sandia National Laboratories; The Boeing Company; and Hill Air Force Base, Utah

Definition and Purpose of Cleaning

The evaluation of any cleaning program begins with an understanding of what constitutes effective cleaning/housekeeping and clear recognition of the purpose and value of the housekeeping activity. The purpose and value of cleaning and housekeeping must be recognized. (OS1) recognizes more fully the purpose of cleaning. (OS1) recognizes the health protection value and importance of effective cleaning throughout the entire institution and expects a consistent high level of performance. ‘Clean for Health Protection



First and Appearance Second' is a central part of the (OS1) philosophy of cleaning. Zone cleaning at UNC claims no such philosophy. The current zone cleaning process tends to execute cleaning as a common, mundane task with limited value.

Clean is an environmental condition free of unwanted matter in the form of solids, liquids, gases, or living organisms that have the potential to cause an adverse or undesirable effect. These unwanted, out of place substances, whether derived from humans or nature, are pollutants. They are commonly referred to with names such as waste, dirt, dust, trash, or germs.

There are many reasons and benefits for providing an effective housekeeping program. Housekeeping creates a healthy condition by reducing exposures and risks. It enables sanitation, breaks the transmission chain of infectious agents, and prevents illness. Housekeeping provides living and working space. It protects valuable materials and equipment, and maintains the value of property. Housekeeping encourages topophilia —attraction to or “love of place”. It accents aesthetics, promotes human dignity, sends caring messages, instills a sense of ownership. It projects a professional image and enhances human productivity. It is a form of insurance that prevents crisis and reduces the full range of costs related to property and real estate. Cleaning manages wastes and contributes to environmental protection and sustainability.

Cleaning, to include housekeeping, is the most basic form of indoor environmental management. It is the organized process of removing or repositioning unwanted matter so human activities can take place in a built environment. Cleaning is a systematic process of 1) knowing the environment, sub-compartment, or object to be made free of unwanted matter 2) identification of the unwanted matter 3) separation of matter from the object/environment, 4) containment of the matter so it can be effectively moved, 5) transporting the unwanted substance to a suitable location and 6) properly/safely disposing or repositioning the matter.

The primary purpose of a cleaning or housekeeping program in an institution such as UNC is to maintain and sustain a built environment/building, which is healthy and sanitary for occupants, and which promotes, supports, and enhances the purpose of the building and the activities carried out in the building. A useful UNC housekeeping program must primarily address the needs of building occupants and the value of cleaning. (OS1) seeks and gives primary attention to the health and well-being needs of the institution and building occupants. Zone cleaning at UNC acknowledges these needs but because of its management structure, the program is often distracted from its primary purpose and tends to focus mostly on the problems of housekeepers and supervisors and secondarily on the needs of occupants.

Effective cleaning and housekeeping is a systematic management process. (OS1) approaches cleaning as a systematic management process. The (OS1) system cleans the entire environment in a comprehensive and consistent manner. (OS1) cleaning seeks a consistent housekeeping result throughout the entire region of team responsibility.



The (OS1) system is designed to position housekeepers to be fully successful in a consistent manner. The system evolves around well-trained and equipped teams to achieve clearly defined cleaning objectives. In (OS1), housekeepers are involved in all aspects of cleaning operations and decisions.

“Zone Cleaning” is the traditional and primary method of housekeeping at UNC. Zone cleaning is a management system wherein one housekeeper is assigned a compartmentalized zone or section of a building to clean. A single housekeeper, working alone with only periodic direction and supervision of a zone manager, is held responsible for the special cleaning needs of the zone-environment. The zone cleaning management system is intended to give the housekeeper an optimum level of familiarity with the cleaning zone and a sense of “ownership” for the quality of the zone. In zone cleaning the housekeeper is a cleaning generalist and is responsible for all housekeeping services related to the zone. The zone housekeeper is responsible for trash collection, dusting, vacuuming, and restroom cleaning. (Standard tasks and frequencies for UNC Housekeeping are shown on the zone frequency table.)

Zone housekeeping is not systematized and does not have a clear, specific, environmental quality objective. The zone system cleans fragments of an environment, often cross contaminating, and failing to recognize environmental connectedness. Under the zone system there is a high degree of cleaning variability, depending on the skill and motivation level of the individual housekeeper. Zone cleaning accepts inconsistency of cleaning effectiveness throughout multiple zones

The (OS1) Cleaning System

(OS1) is an enhanced version of “team cleaning.” Team cleaning is a management process that employs housekeeping specialists in working together to clean a building or defined area. The (OS1) system includes many coordinated and integrated components that are not typically found in other cleaning programs.

The team of specialists goes through an area systematically. Each individual on the team performs specific tasks:

- Light duty specialist: Dusting, emptying trash, spot cleaning
- Vacuum specialist: Vacuum carpet and hard floors
- Restroom specialist: Clean, sanitize, and restock the rest room.
- Utility specialist: Clean lobby areas, spot clean glass, mopping and scrubbing hard floors, and hauling trash to the dumpster from central points.

Specialists’ duties are tailored to fit the cleaning needs of a particular building. Team member tasks and scheduling are based on the building size, layout, and special needs.

The (OS1) program begins with a detailed assessment and evaluation of the building’s cleaning needs. Cleaning tasks are divided into ‘routine tasks’ to be done everywhere daily; ‘detail tasks’ to be done in a



specific building quadrant/area on a specific day of the work week; and ‘project work’ such as carpet extraction and flooring stripping that is focused on one day of the week. Based on the cleaning needs assessment, job cards are prepared for each team member.

Job cards serve as a checklist and provide clear understanding of the specific tasks to be accomplished, as well as providing an approximate schedule for each task or function. These cards also give supervisors, team leaders, and team members a general idea of where to find a team member at any point in the housekeeping process.

The (OS1) system has quality control built into the process that ensures a high level of cleaning effectiveness. For example as the vacuuming specialist follows the light duty specialist, waste baskets are checked to verify they are empty and have not been overlooked. The system also includes a Team Checklist in which supervisors and housekeepers jointly verify that the proper equipment is available to the housekeeper and that the tasks are accomplished to standard.

Security is also built into the (OS1) system. The job cards indicate an approximate location where the specialist can be located during a housekeeping shift. Doorframes are marked with colored dots indicating their security level so as to assist the specialist in maintaining the appropriate door security. The vacuum specialist turns out all lights and locks all doors after moving through an area.

Variability and flexibility must be a part of any housekeeping program. (OS1) is designed to respond to variability of needs and conditions. The (OS1) system is flexible in that it adjusts the workload and schedule for a normal level of absenteeism. In cases of team member absences, an “(OS1) Absence Staffing Plan” adjusts schedules and tasks to ensure that critical housekeeping tasks are addressed.

Under (OS1), additional team members may be added to a building should that be necessary. There is housekeeping depth within a (OS1) team.

(OS1) is elastic enough to accommodate unique or special needs of individual housekeepers should those needs arise. For example, light work assignments can be assigned for particular housekeepers who may have temporary physical ailments or disabilities. In the zone process, there is no specific plan for changing or unexpected conditions that will assure consistent housekeeping services. For each absence or vacancy under zone cleaning, each supervisor independently identifies the tasks which should be accomplished or not accomplished, inform each housekeeper of that change, walk the housekeeper through the absent housekeepers area and then ensure the housekeeper has the equipment and knowledge to handle the additional workload. This allows for inconsistent levels of cleaning in the cases of absences. The zone process does not plan for the unexpected to the same extent as (OS1).



Leadership, Professionalism and Training

Effective housekeeping requires leadership and professionalism. (OS1) assumes responsibility for cleaning knowledge and effectiveness at all levels starting at the top. Zone cleaning at UNC tends to place the responsibility for performance primarily at housekeeper level with limited informed guidance from the top.

Training is an integral and crucial component of (OS1) system. The (OS1) training program involves training of both supervisors and housekeepers with specific focus on the (OS1) system and its cleaning objectives. Prior to (OS1) implementation, managers and supervisors attend a weeklong training session at ManageMen’s “Janitor University” in Salt Lake City where they learn the fundamentals of cleaning and the administrative, managerial and operational components of the (OS1) system.

Housekeeper training, for all four of the (OS1) specialties are provided at the implementing institution over a 2-day period. (OS1) training at UNC was observed during the nights of April 18th and 19th.

The training centers around a well structure and illustrated syllabus and emphasizes a philosophy of cleaning that includes:

- Treating cleaning workers as first class citizens
- Cleaning for health first then appearance
- Simplification and economy in the cleaning process
- The “clean syndrome”-a generalized description of the systematic cleaning process
- Beyond compliance policy for safety regulations
- Minimization of environmental impact
- High performance culture of exceeding all expectations.

The (OS1) system is designed to provide complete and consistent cleaning coverage to an indoor environment. All cleaning needs of the building are constantly accounted for. (OS1) Housekeepers rotate special duties on an agreed to schedule. Every housekeeper is trained in detail to perform all four of the specialist roles and duties.

Light Duty Specialist tasks include:

- Empty trash and reinstall liners
- Clean any pencil sharpeners, ask, chalk trays
- Dust all horizontal surfaces
- Pickup paper clips, paper, pencils
- Cleaning of switch plates
- Cleaning and disinfection of phones spot clean door glass.



The light duty specialist is trained and equipped with a well designed and organized set of cleaning tools. These tools and equipment are all the housekeeper requires to carry out duties. The (OS1) training is thorough in explaining the purpose and safe use of each item of equipment. They include a trash barrel on a dolly, an apron caddie, trash can liners, pre packaged and portioned detergent, a spray bottle for the detergent, a special cutting tool for the detergent package, putty knife, request forms and pencils, micro fiber dust cloths, wooly duster, job card, keys, protective gloves, and a field guide.

The Vacuum Specialist follows behind the Light Duty Specialist with the following tasks:

- Check the trash can in each office
- Vacuum all traffic areas
- Spot vacuum all other areas
- Vacuum visible matter on furniture
- Reposition furniture
- Turnout lights upon completion of a room
- Secure the area as required.

As with the zone training at UNC, housekeepers are taught how to properly wear, operate, and maintain the backpack vacuum. In actuality, the vacuum cleaner is supported on the housekeepers' hips and, if properly worn as designed, is intended to prevent strain on the back. In addition to proper fit, electrical safety is taught and emphasized.

The functions of the Rest Room Specialist include:

- Refilling toilet tissue and other dispensers
- Emptying rest room trash
- Cleaning and disinfecting all fixtures, mirrors and drinking fountains
- Spot cleaning and disinfecting partitions and doors
- Sweeping and mopping floors
- Turning out lights

Housekeepers are trained to execute a systematic flow of work in a safe, hygienic manner to include removing objects with the "Nifty Nabber", use of and application of disinfectant, the proper application of disinfecting spray, scrubbing of urinals and toilets, the disinfection of the floor. The restroom cleaning instruction emphasizes the proper mixing of and application of a single germicidal chemical.

The restroom cleaning tools and chemicals introduced in the program are specially designed for effective and safe cleaning. They include pre-portioned germicidal/disinfectant packs and dispenser bottles, flat



mop and two sided bucket to reduce cross contamination, a mechanical “nabber” to remove unsanitary materials, safety glasses and protective gloves, appropriated dusting supplies and safety signs.

The Utility Specialist is responsible for the following tasks:

- Police stairs and vacuum stair wells
- Clean glass
- Polish brass
- Pick up trash pre-positioned on specific floors
- Spot carpet Clean 1st impression areas
- Clean high visibility carpet
- Haul trash to dumpster

Zone training was observed on May 16th.

Prior to the mid 1990’s there was no formal housekeep training at UNC. Knowledge and housekeeper skill training was either introduced to the job through existing housekeeper experience or was acquired on the job over time. During the decade of the 1990’s, UNC established an entry level, 4-day, training program. Zone training at UNC begins with an introduction to how housekeeping is conducted at UNC, the zone system. The administrative portion of the training program is conducted in the first day. In the first session of training, housekeepers are processed and welcomed into the department, informed of the organizational and supervisory structure of the housekeeping department, informed of timekeeping and attendance standards, management of keys, and security devices such as radios. It was emphasized in the early portion of zone training that the purpose of housekeeping at UNC was for the “wellbeing of the students.”

The technical training begins on day 2 with an introduction to the different chemicals housekeepers will use in their cleaning tasks. In that training, housekeepers are told which chemicals are used in different parts of different zones. They are told how chemicals are mixed properly. They are introduced to the MSDS for each chemical and where to find the MSDS sheets. They are taught how to read the different chemical labels.

The chemical safety aspect of the zone training was very complex, confusing, and incomplete. Twelve (12) different chemicals were introduced. The MSDS sheets were difficult to find and read—some were missing altogether. The requirements of “Hazardous Communication” were not followed. (This portion of zone training needs significant improvement.)



Housekeepers are introduced to personal protective equipment (PPE) and told how and when to use that equipment. Gloves, goggles, grippers, aprons, and safety shoes are discussed and demonstrated. Housekeepers are taught how to properly wear and use the backpack vacuuming cleaner used across UNC. They are taught how to change filters, and how often to change them. (There was no demonstration of vacuum cleaner maintenance.) The proper use of the Kentucky floor mop is also demonstrated as part of zone training. One areas of discussion that was only glossed over was the frequency of water replacement and steps to be taken to reduce cross contamination when cleaning restrooms.

As part of the 2nd day of zone training, new housekeepers are taught how to properly empty a trash bin. Emphasis is placed on lowering the trash receptacle to the ground, sliding the trash bag out of the container, and lifting the trash bag with use legs more than a bent back.

A general safety film was shown as part of zone training on the 2nd day. The film is generally useful but does not in any part focus on or pertain to housekeeping operations at UNC.

The third day of zone training concentrated on the proper way to strip and wax floors, the use floor scrubbers, high speed and low speed burnishes, and the elements of carpet care. The fourth phase of zone training is an orientation visit to the zone in which the new housekeeper is assigned.

Housekeeper success must be ensured. In the (OS1) system, through focused training and effective equipment, housekeepers are ensured of a high quality cleaning results and subsequent recognition. In zone cleaning housekeepers are left on their own, often not heard, and unsure of cleaning results or appreciation.

(OS1) trains housekeepers in a coordinated and comprehensive manner for the implementation of a specific and effective cleaning system. (OS1) training is far more professionally oriented, science based, safety focused than other training programs found in the cleaning industry including the zone training conducted at UNC. (OS1) training begins with a clear explanation of what cleaning is, why cleanings is important, and the history and importance of the “professional” housekeeper.

(OS1) training is superior to zone training in that it is not generalized and is focused on the housekeeping process.



Safety

Safety is an integral part of (OS1) training throughout all portions of the two-day program. The (OS1) safety documentation is easy to read and understand. Safety information is color-coded for easy identification and access. There is a complete MSDS for all chemicals. Housekeepers are informed of their legal worker-right-to-know rights, how to identify hazardous materials, the use of protective equipment, how to read MSDS labels, how to safely handle materials and equipment they use, and how to respond to various situations.

Safety steps to manage blood borne pathogens are covered in detail in (OS1) training. This aspect of housekeeper safety was not adequately covered in the zone training observed at UNC. Bodily substance cleanup instruction was follow-on to the restroom cleaning instruction. It introduces the housekeeper to “Universal Precautions” for defense against biohazards. The training includes the use of protective equipment, management of sharps, absorbents, disinfectants, and proper disposal of biohazard materials.

Safe lifting and hauling of trash is emphasized in (OS1) of training. In addition the utility specialist training includes the safe and effective use of floor machines and pads, and carpet extractors

Zone cleaning training generalizes housekeeping and safety information without regard to specific housekeeping responsibilities and performance expectations.

Efficiency and Minimizing Waste, Cost and Injuries

(OS1) provides comprehensive and scheduled cleaning coverage by way of an economically efficient and simplified cleaning system. Simplified streamlined processes reduce cost, wastes, and worker injuries. (OS1) employs limited, standardized, quality, tested equipment in the cleaning process with emphasis on cleaning effectiveness, safety, and ergonomics.

(OS1) limits and standardizes cleaning equipment and supplies, thereby reducing material usage and waste. On the other hand, UNC zone housekeeping uses a wide variety of equipment and cleaning technology - mostly untested and ineffective. Many of cleaning chemicals used in zone cleaning are not necessary to accomplish effective cleaning.

Under (OS1) the number of concentrated chemicals has been reduced from an average of 7 to 2 ensuring less unnecessary chemical exposure to housekeepers and building occupants.

System simplicity is a main component of the (OS1) system. There is far more organization and safe and sanitary storage of cleaning equipment supplies in the (OS1) system than in the zone system. (See the attached photos as examples.)



The (OS1) system uses far less chemical than the zone system with less risk for a significant chemical spill or accident. The mops are much easier to use and maintain in the (OS1) system than the zone system. The two-chamber mop bucket reduces cross contamination and provides for significantly higher level of sanitation.

Observations were made of the cleaning equipment and chemicals used in both the zone system and (OS1) system. In the zone system each housekeeper is assigned a closet in which to store equipment, chemicals, and supplies. There are on average, one housekeeper closet for every two floors throughout campus. Typically a UNC zone housekeeper has 5-8 different cleaning chemicals in the closet. Most of these chemicals are in concentrated form, in half-gallon size containers. When the chemical is used, it is mixed by using a manufacturer supplied mixing machine. All zone housekeepers are supplied with a cleaning cart, micro fiber dust cloths, and spray bottles. They typically mop floors with a #12 Kentucky mop. The mop bucket is a single chamber plastic bucket. The bucket is not designed to reduce cross contamination through the separation of fresh water and rinse water.

In the (OS1) system, multiple janitorial closets are replaced with a single, centrally located team room that contains housekeeper lockers, and a constantly inventoried housekeeping supply cabinet. The entire (OS1) housekeeping team operates from this central location. A central “equipment room” provides storage for vacuums and heavy cleaning equipment. Paper supplies are restocked and stored in central “pantry” locations throughout the building.

(OS1) has a research program that constantly assesses the most effective and suitable equipment chemicals; supplies and equipment that are ergonomically improved, provides sanitation and hygiene, and are environmentally sustainable. In the (OS1) system there are only two or three chemicals employed, a general-purpose disinfectant and a detergent.

(OS1) chemicals are in pre-portioned plastic bags and assigned to specialists at the start of each work shift according to their assignment and need. The portion pac chemicals are especially designed to reduce cleaning chemical injuries to housekeepers. The housekeeper carries the chemical packets in a distribution tray and uses them as required. The empty containers are returned to the check-in room and accounted for after each shift.

The manufacturer of (OS1) cleaning chemicals was recently recognized as a leader in environmental protection and sustainability. PortionPac products used in (OS1) are certified and labeled as green cleaning products by Green Seal. Green Seal is an independent non-profit organization dedicated to safeguarding the environment and transforming the marketplace by promoting the manufacture, purchase, and use of environmentally responsible products and services. Green Seal Certification ensures that a product meets rigorous, science-based environmental leadership standards. This gives manufacturers the assurance to



back up their claims and purchasers confidence that certified products are better for human health and the environment. Government agencies increasingly recommend and require that only green certified products be purchased and used in facilities under their control.

In the (OS1) system, the traditional Kentucky mop is replaced with a much lighter flat floor mop. The flat cloth mop head is removed after each work shift and washed and dried. The bucket used with the flat mop has two chambers, one for fresh water and cleaning solution, and rinse section for depositing wastewater. The (OS1) mop system greatly reduced cross or recontamination when mopping an unsanitary floor, especially in a restroom.

The micro-fiber dust cloths used in (OS1) are also washed for reuse after every work shift.

(OS1) cleaning technology has been tested, evaluated and employed for their safety and cleaning effectiveness attributes.

Compliance

(OS1) uses benchmarking and compliance auditing to periodically verify the management process is on track and being properly followed and implemented. It is likely that a high level of environmental quality will be achieved and maintained if the (OS1) management process is followed as designed. Zone cleaning at UNC has no systematic evaluation or environmental quality measure program.

The (OS1) compliance audit and the environmental conditions produced by the system was not statistically correlated or quantified as part of this pilot study. However, it is anticipated that compliance with the prescribed (OS1) management system is a strong indicator of a well managed housekeeping program that produces highly sanitary and healthy environmental conditions. In the first (OS1) pilot study conducted in the UNC Bioinformatics Building, a baseline audit score of 14% was achieved for UNC's standard zone cleaning program. After 90 days of the (OS1) program, the visibly improved environmental conditions in the Bioinformatics building were similar if not identical to those also observed in the Carroll Hall (OS1) Pilot. The (OS1) audit score after 90 days in Bioinformatics was 80% which is considered to indicate a well managed, high performance cleaning program.

Vacuum Cleaner Performance

The (OS1) prescribed vacuum cleaners reduce back strain and injuries, and have much lower particle emissions to the breathing zones of housekeepers than the typical upright machine used in zone cleaning.

In recent years, UNC has begun to issue ProTeam—Green label—Backpack Vacuum cleaners. However, throughout the campus there are a variety of upright, push pull vacuum cleaners used by individual housekeepers. The newly acquired and implemented backpack vacuum cleaners are “Green Label Vacuums”



tested and certified by the Carpet and Rug Institute (CRI). Green Label Vacuum Cleaners are increasingly recognized and recommended by environmental health authorities as useful in maintaining a healthy indoor environment. Households, offices, and institutions such as universities, schools and health care facilities have become more concerned about allergies and health effects exacerbated by exposure to a variety of dusts and particles. Studies show that effective vacuuming makes a big contribution to keeping particle levels sanitary levels indoors. The health science clearly indicates that regularly scheduled vacuuming is very effective in allergen exposure reduction.

The biggest contribution of a well-designed vacuum cleaner is reducing unwanted substances (including common allergens) to concentration levels where adverse or unwanted effects, including damages to valuable materials, are unlikely to occur. The vast majority of matter that can build-up and cause problems indoors can be easily and effectively be removed by a Green Label tested vacuum cleaner.

Prior to the CRI Green Label Program for Vacuum Cleaners, there was no comprehensive test for determining collectively the dust removal efficiency; the amount of particulate matter actually retained by the vacuum cleaner compared to the amount emitted to the indoor air; and the effect vacuuming cleaning has on carpet construction and appearance. To receive a CRI Green Label, a vacuum cleaner must pass test standards in three areas: soil removal, dust containment (IAQ protection), and carpet appearance.

Throughout the pilot study, beginning in the training sessions, measurements were made of particulate matter emissions associated with the (OS1) “green label” backpack vacuums and other vacuums currently in use as part of the zone cleaning system. During the (OS1) training a dust measurement was made on a green label backpack vacuum and an upright vacuum. There was virtually no detectable emission from the green label vacuum (32 ug/m³) compared to a very high emission (240 ug/m³) from the upright. A level greater than 100 ug/m³ is considered unsanitary and potentially harmful to a large segment of the population.

Similar measurements were collected using TSI, DustTrak Aerosol Monitor (model 8520) with 10 micrometer nozzle at various times during May and June. Peak readings at the exhaust of vacuums were taken during initial first few minutes of operation. In addition area measurements were collected around head height (5 to 6 feet) during vacuuming of carpet.



The standard (OS1) vacuuming was found to be vastly superior to the zone vacuum in all measurements particle retention and reduced air emissions.

Building/Location	Date	Vacuum Type	Measurement (ug/m ³)
Carroll Hall	5-3-06	Backpack (ProTeam Super Coach)	30 to 45
Carroll Hall	6-7-06	Backpack (ProTeam Super Coach)	26 to 47*
Gardner Hall	5-3-06	Upright (Advance Carpet win14)	100 to 2000
Dey Hall (Toy Lounge)	6-7-06	Upright (Mastercraft 4th Floor Unit)	15 to 98 (peak) 40-50 (avg.)
Dey Hall (2nd floor Office)	6-7-06	Upright (Mastercraft 2nd Floor Unit)	35 to 150
Dey Hall (1st Floor)	6-7-06	Upright (Eureka)	40 to 50

Measurement Program: Overview

(OS1) produces a measurable cleaning result that is (at least in this study) a factor of 2-5 times more effective in removing unwanted in the form of dust from the building envelope. Cleaning effectiveness is measured in terms of the quantity of unwanted matter removed. To aid in the assessment of cleaning effectiveness, environmental sampling of dusts, fungi, bacteria, and PM 10 air quality was conducted for Carroll Hall prior to and during the (OS1) pilot study. To better compare (OS1) to zone cleaning, samples were taken in Dey Hall, a zone cleaned building adjacent to Carroll Hall.

Studies have shown that cleaning when consistently implemented is cost effective and can lead to measurable environmental improvements. For example, a 1990 EPA sponsored study (“The Total Building Cleaning Effectiveness Study,”) in collaboration with Research Triangle Institute, the University of North Carolina Medical School, and the professional cleaning industry, demonstrated that an organized cleaning program contributes to reductions in particles, volatile organic compounds (VOCs), and biological pollutants in excess of 50%. In the pilot study, comparable environmental quality improvements were found in the (OS1) cleaning system.



Measurement Program: Dusts Removal

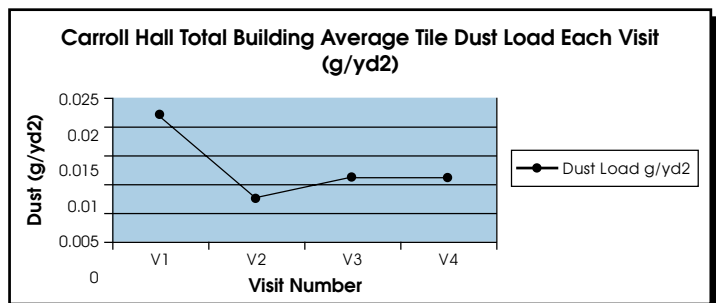
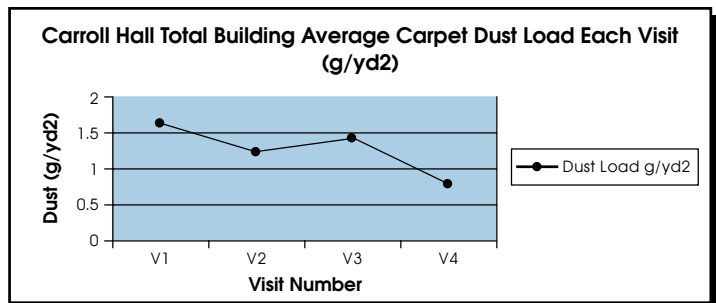
Carpet dusts, hard floor dusts, and dusts on counters/ horizontal surfaces were all measured using the following protocol.

- Carpet dusts were measured using a *Miele Composite Samples Protocol* where five locations on each floor are selected and sampled as a composite. Approximately 10' x 10' (typically 4' x 8')(or other measured) areas are sampled at each location with a pre weighed Miele bag. The traverse rate is approximately 0.38 seconds per foot of travel. Each lane is traversed front to back. Five locations on each floor are consolidated in one Miele bag. Each Miele bag is re-weighed after sampling. On subsequent visits, adjacent areas are sampled. Carpet dusts are listed a grams of dust per square yard.
- Tile floor dusts were measured a *Swiffer Composite Samples Protocol*. Five locations on each floor are selected and sampled as a composite. Approximately 10' x 10' 4' x 8' (or other measured) areas are sampled at each location with a Pre weighed dry Swiffer cloth. The traverse rate is approximately 0.38 seconds per foot of travel. Each lane is traversed front to back. Five locations on each floor are consolidated in one Swiffer cloth. If any dust is collected that does not stay on the Swiffer, it is hand collected for measurement. Each Swiffer cloth is re-weighed after sampling. On subsequent visits, adjacent areas are sampled. Tile floor dusts are listed as grams of dust per square yard.
- Dusts on elevated horizontal surfaces were measured using the following protocol. For each sampling excursion, one pre-weighed Swiffer cloth is used per floor to collect composite surface dust. 25 measured surfaces such as shelves, tables, file cabinets, ledges, etc., are composited on each floor. Surface types and areas are recorded. The composite content dust Swiffer from each floor is then be weighed and divided by the total area sampled. Results are listed as grams of dust per square yard.



Carroll Hall	Pre-(OS1) 4/22/06	(OS1) 6/3/06	(OS1) 6/24/06	(OS1) 7/21/06	Comments
Carpet Dust	1.5	1.23	1.4	0.81	31% average reduction
Hard Floor Dust	0.022	0.008	0.011	0.011	120% average reduction
Counter Dust	0.093	0.025	0.020	0.020	342% average reduction
Dey Hall			Zone 6/16/06	Zone 7/14/06	
Carpet Dust			6.4	2.79	Unsanitary > 2 gm/yd ²
Hard Floor Dust			0.022	0.031	No significant change
Counter Dust			0.043	0.031	No significant change

(OS1) cleaning system reduces dust levels found in cleaned environments by a factor of 2 or more. Carpet dusts were cut in half by the end of the end of the (OS1) pilot study and well within the sanitary zone (< 2 gm/ yd²). Dust levels under the zone system are higher and probably influence/ deteriorate particle IAQ, especially with regard to high loads of carpet dusts. The level of carpet dusts in the zone-cleaned building is judged to be unsanitary (> 2 gm/ yd²).





Measurement Program: Fungal Spores

Fungal spores are a part of all house dusts. Vacuuming is a means of removing most fungal spores. When there are numerous spores indoors, the likelihood of allergic response, to include asthma, increases. Samples of fungi CFU's are too numerous to count (TNTC) are often the indication of problems related to ineffective cleaning or water intrusion.

Fungal spores measures are made using swab and Petri-film method. For each sampling session, there are 25 swabs collected on each of four floors from shelves, tables, cabinets, etc., Total = 100 fungal swab samples. A template of 100 cm² (10 x 10 cm) area is used. Each swab is eluted in two ml of AOAC buffer and 1 ml is pipetted onto fungal Petri strips. Petri strips are then placed into zip lock bags in a 25 C incubator. Results are the Total CFU counts per 100 cm²

Carroll Hall	Pre-(OS1) 4/22/06	(OS1) 6/3/06	(OS1) 6/24/06	(OS1) 7/21/06	Comments
Fungal Spore	15% TNTC	0% TNTC	3% TNTC	3% TNTC	Significant spore reduction
Fungal Spore Average CFU/100cm ²	24.5	55	17	26	Normal seasonal variation
Dey Hall					
			Zone 6/16/06	Zone 7/14/06	
Fungal Spore			6% TNTC	3% TNTC	Unsanitary > 5%
Fungal Average CFU/100cm ²			44	34	Higher than (OS1)

The two highest fungal levels as indicated by TNTC plates were found in zone-cleaned processes. The data suggest that (OS1) systems better manages fungal spores and reduces the risk of allergic reaction of occupants.

Measurement Program: Restroom Bacteria

Bacteria levels are measured as an indication of cleaning effectiveness in restrooms. Both aerobic and e-coli bacteria are sampled using Petri-film. The sampling protocol is as follows: For each visit a total of five swabs for both aerobic bacteria and e-coli bacteria are collected from each of two restrooms on each floor for a total of 40 bacterial swabs for each type of bacteria. A template of 1 in 2 is used. Restroom surfaces sampled are 1) inside door handle, 2) sink basin, 3) sink spigot area, 4) toilet rim, 5) toilet seat. Each swab



will be eluted in two ml of AOAC buffer. One ml is placed onto one aerobic Petri strip, and one ml is placed onto one E.-coli Petri strip. Petri strips are placed in zip lock bags and into 35 C incubators. Results for each will be Total CFU counts per 1 in 2 area

Aerobic Bacteria

Carroll Hall	Pre-Cleaning (OS1) 6/23/06	Post Cleaning (OS1) 6/26/06	Pre-Cleaning (OS1) 7/21/06	Post Cleaning (OS1) 7/24/06	
Door Handel	44	3	36	6	
Sink Basin	31	1	28	1	
Sink Faucet	45	0	33	0	
Toilet Seat	83	4	25	1	
Toilet Rim	48	13	20	0	
Dey Hall	Pre-Cleaning Zone 6/16/06	Post Cleaning Zone 6/26/06	Pre-Cleaning Zone 7/14/06	Post Cleaning Zone 7/17/06	Post Cleaning Zone 7/24/06
Door Handel	171	7	69	1	4
Sink Basin	23	1	129	2	13
Sink Faucet	28	2	65	32	14
Toilet Seat	57	1	408	3	6
Toilet Rim	8	1	1	0	0

A measure of cleaning effectiveness and sanitation in restrooms is aerobic bacteria counts. The data suggests (OS1) cleaning system produces a sanitary result consistently better than zone cleaning. In post cleaning measurements of Dey Hall, it was found that some zone restrooms were not cleaned at all. This is the common consequence of the fragmented cleaning coverage found in the zone system. Another significant difference is that (OS1) produced a sanitary condition using a single portioned disinfectant. No E-coli bacteria were found after restroom cleaning in both (OS1) and zone processes when the restroom was cleaned



Measurement Program: Indoor Air Quality

Indoor air quality as measured by particulate matter can often serve as an indicator and measure of cleaning effectiveness related to house dusts. However, in using IAQ as a measure of cleaning effectiveness it needs to be realized that IAQ is significantly influenced by the quality of ambient or outside air, ventilation, activities of building occupants, and special outside activities and conditions—such as agriculture and construction.

Throughout the pilot study dust tract measures were periodically made of indoor air concentrations of particulate matter (PM10), (airborne dusts in the size range less than 10 microns). These particulate matter measures were not as technically exact as previous measurements made in research projects, but are suggestive of the positive influence cleaning has indoor air quality.

The data tabled below, for both Carroll Hall Library and a Dey Hall lecture room is approximate ranges of particulate matter. It should also be noted that throughout the pilot study, there was building construction adjacent to Carroll Hall. The construction activity added to housekeeping requirements and also affected indoor air quality. In the face of this extra-ordinary and less than desirable outside condition, over the course of the pilot study, the (OS1) cleaning program reduced dust concentration in Carroll Hall as measured as PM10 by more than a factor of 2 or in an improved airborne particulate matter reduction range 40-50%.

The Dey Hall data is related to Zone Cleaning. The contestations of PM10 are similar to the levels of airborne dusts observed in Carroll Hall when it was under Zone Cleaning.

These data are remarkably similar to the data collected in the Frank Porter Graham Child Development Center Study in 1990 that demonstrated that any systematic cleaning program has a positive influence on IAQ, i.e., 40-50% airborne PM reduction.

Aerosol Monitoring (PM 10) Carroll Hall – Park Library (3rd Floor)

Sampling Dates	Approximate PM10 conc
April 20-22	20-40 ug/m3
May 1-2	10-30 ug/m3
June 26-29	5-25 ug/m3
July 13-14	10-25 ug/m3

PM 10 Dey Hall Lecture Room (3rd Floor)

Sampling Dates	Approximate PM10 conc.
June 20-21	15-40 ug/m3