Responses to Key Regulatory Questions Posed by EPA

1. LABORATORY ENVIRONMENTAL MANAGEMENT PLAN

Are certain elements of the NEU Labs XL Project Laboratory Environmental Management Plan key for each of the participants, and if so, which is/are most essential? How did each university approach this/these essential elements? What were common themes at all three schools and what elements were different?

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EMS Basis of EMP

As discussed in the Section 2 of the University of Vermont (UVM) report, one of the key lessons in developing and implementing the UVM EMP was understanding how the various activities described by the EMP relate to the "*Plan, Do, Check, Act*" management cycle that forms the basis of an Environmental Management System. At UVM, we identified the key activities for the proper management of laboratory hazardous chemicals as:

- *training* (the planning stage),
- *waste pickups* (doing),
- *laboratory audits* (checking) and
- *pollution prevention education* and *emergency response* (acting).

We believe that these are essential elements of a successful chemical waste management program.

The XL rule included a variety of other requirements for the environmental management plan, such as:

(ii) An environmental policy, or environmental, health and safety policy, signed by the University's senior management, which must include commitments to regulatory compliance, waste minimization, risk reduction and continual improvement of the environmental management system.

(iii) A description of roles and responsibilities for the implementation and maintenance of the Laboratory Environmental Management Plan.

(iv) A system for identifying and tracking legal and other requirements applicable to laboratory waste, including the procedures for providing updates to laboratory supervisors.

(xiii) The procedures for the development and approval of changes to the Environmental Management Plan.

(xvii) The recordkeeping requirements to document conformance with this Plan.

While these elements provide important context during the writing of the EMP, over time they add little additional value to the EMP. Therefore, the procedures associated with these requirements were not as carefully maintained as the core activities.

This experience of setting and managing program priorities during the implementation of an EMS echoes that found in the United Kingdom, where extensive experience in implementing EMS's resulted in the development of British Standard 8555. This standard outlines the phased development of an EMS within an organization. The phased approach to an EMS allows the organization to prioritize the elements of an EMS, so that a functioning system can be implemented without necessarily achieving complete ISO conformance.

The phased implementation of the EMP is the most important reason that the XL EPI's did not respond as quickly as envisioned when the FPA was signed, but it is also a key aspect of the "performance orientation" of the regulation which allows the chemical waste management program to continuously improve over time.

EMP Response to Organizational Change

Another lesson learned from development and implementation of the EMP at UVM is that the most significant benefits of the performance approach to environmental management are realized as the program evolves in response to learning within the organization. For example, at UVM, the laboratory oversight process began as a conformance-oriented visit to laboratories, focused on "low hanging fruit" associated with poor chemical management practices (e.g. labeling, separation of incompatible chemicals, etc.).

As laboratory worker behavior changed to end these poor practices, the oversight visits became more diversified and individualized, addressing issues specific to a laboratory's work rather than generic concerns about chemical container management practices. This shift in focus led us to rename the preferred form of an oversight visit from an "audit" to a "consultation". Consultations are visits that are an interactive learning process for both the laboratory and health and safety staff rather than an enforcement opportunity.

This shift was enabled by a significant shift in the laboratory safety culture at UVM toward an ongoing partnership between the laboratory workers and the environmental health and safety office. It should be noted that this cultural shift took 4 years to occur, has not occurred at the same pace campus wide, and is continuing to evolve. This is a significantly longer "incubation period" than envisioned when the XL rule requirement for an EMP was written with timelines on the order of 1 year for development and implementation. However, it is this culture shift that has enabled many laboratories to consider "beyond compliance" management of their hazardous chemicals, particularly in the form of Toxics Use Reduction.

Institutional Differences

While the lessons described above seem to be common to the experience of the three pilot schools, differences in the Environmental Management Plans developed at the beginning of the project (see appropriate web references) and the Balanced Scorecards developed this year to summarize the lessons learned were significant, in both content and format. These differences reflect differences in the resources, history, demands (internal and external) and subsequent culture of the environmental management programs at each of the schools. While all three programs share common goals and have demonstrated comparable levels of continuous improvement, the specifics of how they achieved these improvements vary widely, even under the same regulation.

At the University of Massachusetts-Boston (UMB), we have learned, along with other XL pilot schools, that simple is best and there are some key elements that need to be included in any good EMP:

- Organizational responsibility and buy-in
- Clear policy standards and expectations
- Training
- Efficient lab waste management and collection

- Lab audit program
- Pollution prevention education

Organizational responsibility and buy-in coupled with clear policy standards and expectations form the foundation of any good management system.

Training Program

- Provides formal instruction to laboratory workers.

- Informal training interactions provide an important feedback loop so that the training content and methods can be adjusted over time to meet the needs of the laboratory audience

Waste Management and Collection

- Policies and procedures specific to an institution’s activities and resources assures that:

- Waste is stored in a way that minimizes risk

- Waste is removed from laboratories in a timely way

- The proper disposal method for the waste is chosen

Laboratory Audits

- An on-going program that includes:

- Self-inspections

- Periodic reviews by EH&S or some other entity

- Reviews assess laboratory conformance with campus container management and housekeeping requirements and waste minimization program expectations, and include a feedback loop that assures that identified problems are effectively addressed in a timely manner.

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Pollution Prevention Education Program

(ideally an element but should not be required)

- Program will include an ongoing dialogue with laboratory chemical users about how their work impacts hazardous waste disposal and provides an ongoing opportunity for minimizing that impact.

While our XL work has demonstrated that identifying and evaluating specific waste minimization gains as they occur is a challenging and difficult path, we believe that it should be one of the key pillars of the environmental management plan. This allows waste minimization to become an important aspect of laboratory work.

Benefits of the Simplified Model

- Provides internal auditors and external reviewers (including regulatory inspectors) the ability to assess the effectiveness of the program.

•Four main elements correspond to the 4 steps in the “plan, do, check, act” model on which Environmental Management Systems are based, and thus provide the basis for a complete program.

Emphasis on a partnership between the laboratories and the waste management program, rather than the imposition of additional regulatory requirements, is critical to obtaining the buy-in of laboratories to pursue any pollution prevention goals beyond compliance.

BOSTON COLLEGE

At Boston College, emphasis on *management* is the key to the success of our program. The plan-do-check-act cycle provides a useful way to try potential solutions and then evaluate them. We see data collection, training and communication as the most significant elements of our Lab Waste Management program. A continual process of data collection allows us to know in detail the sources of our wastes. We are then able to target those waste generators with training and feedback in order to work with them on methods of waste minimization. Continued research on waste production and normalization may provide us with insights on certain labs or techniques that produce less waste.

As valuable as data collection has been in helping us develop our waste management program, there is no need to make it part of a new laboratory waste rule. However, our experience with data collection may be helpful to others who might want to target waste streams for minimization activities.

One of the things we have learned during the past five years is that each school is different, and what works for one may not work for another. Our annual reports have shown that there are a number of variables that affect waste management. It is most important that a rule provides flexibility to the regulated community. Many of the aspects of the program need to be locally defined based on activities in the labs. Furthermore, it is important to remember that not all labs in a single institution are the same, so even within a single waste management plan there may need to be some flexibility.

2. TRAINING

How did each participant approach training and what were the key factors for success in the training program? Based on the experience, how might a training requirement in a new rule be most effective?

Training the UVM laboratory population in the EMP requirements was handled in two ways: 1) through formal training sessions held for laboratory workers and 2) during laboratory audits. Over time, this combination proved an effective way of providing both training and oversight of the laboratories’ chemical management practices.

These two functions, which were initially managed separately, began to merge as the results of the audits informed the training process and laboratories’ familiarity with EMP requirements increased and allowed the nature of the oversight visits to evolve. As discussed above, this evolution has resulted in a renaming of some of the audit visits to “consultations”. Based on this change, a new audit system is being developed which takes advantage of the strengthening of the laboratory safety culture at UVM.

One of the key points discovered in this process is the importance of peer training and oversight in the laboratories. In few laboratories are all laboratory workers equally responsible for hazardous chemical management practices. Most laboratories have key individuals who take responsibility for monitoring the use of hazardous chemicals and providing guidance to other workers in this respect. This approach is taken because the technical knowledge needed to assure proper chemical management is significant. In a setting, where there is about 40% turnover of laboratory workers each year, training all laboratory workers is an ineffective approach.

For this reason, we believe that the rule should reflect the insight that training requirements that apply “across the board” to an entire population of laboratory workers are likely to be less effective than one that identifies key individuals and assures that they have an understanding of environmental program requirements. This is especially true in the research laboratory setting, where the suite of chemicals used varies widely from laboratory to laboratory. For example, in biomedical laboratories a group of flammable solvents with a few toxic chemicals are likely to be used by career technicians, while chemistry research laboratories a wide variety of highly hazardous materials are used by graduate students overseen directly by faculty. The type of training required by individual laboratory workers in these two settings is significantly different. For that reason, our training and oversight program for the UVM Chemistry Department has been significantly different than for the rest of campus, focusing on consultation visits rather than classroom training.

Our experience at UVM indicates that flexibility in any training requirement that recognizes these differences will enable the implementation of the EMP to be more effective. A training requirement that results in training of laboratory workers on areas outside their research field creates significant barriers to implementing the EMP effectively by creating unnecessary “training fatigue”.

As previously mentioned, both formal and informal training is a key element of any effective program. We have found at UMB that we have the most success when we are flexible and provide a number of training opportunities to the UMB community. Training effectiveness can be measured indirectly through laboratory audits. A minimum requirement for any EMP should be initial training in EMP requirements and individuals’ responsibilities.

At Boston College, training is the foundation on which our laboratory management program is built. The elements of the Laboratory Waste Management Pan are a critical part of initial training for all new employees and graduate students at BC. Training takes several forms: formal training classes, annual safety seminars, informal training (answering questions or discussing activities with lab workers in their labs, by phone or email), and written communication (newsletter, topic-specific emails). In addition, EH&S and the Chemistry Department have worked together and recently introduced web-based training using WebCT, a product used at BC for academic e-learning.

The Office of Environmental Health and Safety approaches training as one of the most valuable investments EH&S can make toward successful implementation of its programs. Our staff has attended train-the-trainer training as well as other professional development programs. We are also developing a more effective training tracking tool (database) that can be used both by ourselves and the departments, and training improvement is one of two special initiatives our department has undertaken in the last year. We strive to provide in-person initial training at the times of year when there is a large influx of new personnel, and to provide alternate forms of training (written and now e-learning) to accommodate new workers in the interim. New graduate students receive training during their orientation.

One of the goals of training is to increase compliance, so training needs to be paired with measurements (audits) to provide reinforcement of training principles. Feedback to lab workers is vital in helping them to gauge their performance. This feedback is provided either verbally through the lab safety contact, or via a written notice from EH&S staff.

I believe an effective training requirement would include, *at a minimum,* initial training in CHP and waste management. A training requirement should be specific to the needs of the trainees. Therefore, lab workers who are preparing waste for removal by a contractor need to supply the information required be the handlers, but not RCRA and DOT classifications. The frequency of refresher training should be determined by EHS in conjunction with the labs, based on past performance and current needs.

3. POLLUTION PREVENTION

The potential for increased pollution prevention was a driving force for the project. What has been learned about pollution prevention in each university and how have purchasing habits impacted the pollution prevention results? Based on experience, how might a P2 recommendation in the rule be most effective?

The primary result of the UVM experience under the EMP has been to confirm the conventional wisdom (see “Laboratory Waste Minimization” article in Appendix 1 of the UVM Report), that good housekeeping and ongoing education is the key to chemical waste minimization in laboratories.

At the beginning of the project, it was hoped that a careful examination of specific process changes in laboratories would yield a variety of hazardous waste minimization opportunities. Efforts to pursue this approach, both in individual discussions with specific laboratories and through a systematic “pollution prevention survey” resulted in the discovery of few opportunities with insignificant pollution prevention potential.

We attribute the observed decrease in the normalized amount of hazardous waste produced by UVM laboratories to two factors:

- improved laboratory housekeeping and chemical inventory control stimulated by the laboratory audit program and supported by the ChemSource chemical supply program; and
- laboratory process changes based on safety considerations raised by improved safety training, which led to the use of fewer hazardous chemicals, both in quantity and type of chemical.

With regard to purchasing controls, our experience indicates that attempts to improve inventory control through this avenue has limited value for waste minimization. In most laboratories, the cost of the space and equipment required to properly store hazardous chemicals creates a significant disincentive for speculative accumulation of these materials. Once the training and audit program raised awareness of laboratory workers as to those storage costs, the desired behavior (a decrease in the amount of hazardous chemicals stored) ensued.

The final key point learned about laboratory pollution prevention is that the largest environmental impact attributable to laboratories is probably related to their energy use rather than hazardous chemical use. Research supported by a Project XL stakeholders technical assistance grant project (*Tracking UVM, http://www.uvm.edu/greening/trackinguvm.html*) found that because of the high ventilation requirements and energy intensive nature of scientific research, the primary environmental effect of laboratory work is its energy use, which is at twice the rate of normal academic buildings. Based on these observations, we believe that if the five program elements identified in the response to Question 1 are in place, “beyond compliance” efforts for energy conservation such as the EPA’s Labs-21 program are the most effective approach to mitigating the environmental impacts associated with laboratory work.

At the beginning of the XL Project, we believed that more flexible regulations would afford EH&S the time it takes to develop and implement large-scale P2 initiatives. What we have actually found is that one-size does not fit all. We conducted two surveys. The first covered 2002-2003. Survey results suggested that P2 is already occurring:

•73% of the respondents indicate that they have already downsized their experiments, substituted chemicals or changed their processes to use less toxic material.

•25% of researchers look to other laboratories if they run out of a chemical.

A second survey conducted in 2004 had similar results:

•100% believed it was the lab workers responsibility to reduce their environmental impact.

•40% believed they could produce 10% less waste.

•95% believed scientists should find safer chemicals to use in experiments.

•92% believed that it was their responsibility to make changes in order to produce less waste.

Our surveys have shown us that P2 is already occurring in most laboratories, regardless of EH&S efforts. Clearly, any pollution prevention prescriptive requirement in a rule would not be feasible.

The best approach therefore, may be to promote a culture of P2 and provide relevant information that enables individual researchers and laboratory decision-makers to make their own, informed decisions.

At the beginning of the project we thought we would be able to significantly influence the use of chemicals by the labs through discussions based on logic and economics. We hypothesized that chemical redistribution would lower the costs of disposal and the costs of acquisition of chemicals. However, the culture of science is a strong force that is not moved by simply by arguments of economics or practical solutions. One of the elements of the culture is the notion of chemical purity and consistency across experiments. Open chemical containers always carry the risk of impurity, so scientists protect their investments by foregoing the use of orphan chemicals (except for non-critical applications). In addition, we learned through discussions with the granting agencies, that there is not likely to be any new economic incentives in the funding process that motivates scientists to use chemicals more cost-effectively.

What can be done? Cultural change can slowly occur as older researchers retire, as long as there is an ongoing effort to educate newer scientists about the economic benefits of pollution prevention. I believe that academic and professional organizations such as the American Chemical Society can impact purchasing behaviors by regularly offering articles on the economics of chemical use and disposal, the availability of less toxic options in research, and promoting Green Chemistry. The potential for funding sources to impact chemical purchasing and use is also possible. Many grants currently require support or certification from internal offices on the humane use of animals, the use of biohazards and the use of select agents. If pollution prevention were an issue sufficiently raised to the consciousness of the public, we might also expect to see responsibility in chemical use built in to grants requirements. While the Office of EH&S at Boston College is a strong advocate of pollution prevention in our labs, additional support would be welcome.

Pollution prevention and waste minimization are important targets for university laboratories. However, for reasons discussed in this report and previous ones, it is not appropriate to attempt to regulate or mandate specific P2 targets at this time. EPA should include discussion of such targets in the preamble.

4. LABELING

How has each participant approached labeling and what are the key elements for making the hazardous waste determination outside of the laboratory? Based on experience, how might a labeling requirement in the rule be most effective?

At UVM, we have developed a system of labels that marks the waste through the waste accumulation, pick-up and disposal process. The most important information on these labels is the laboratory that generated the waste, the date it is ready for disposal, the waste quantity, and the chemical name(s) of the materials that are mixed into the waste. Over the 10 years that UVM has operated a Part B waste storage facility, we have developed a variety of waste classification systems that included information beyond those elements. However, these systems have not been shown to have significant value for the people handling or disposing of the waste materials. In general, Department of Transportation labeling and packaging requirements, combined with disposal facility approval requirements drive the waste management process after the wastes leave the laboratory.

With regard to a labeling requirement in the rule, because higher education campuses vary widely in terms of their facilities available to store and manage hazardous wastes, we recommend a performance-oriented approach to such a requirement that assures that the waste is disposed of in accordance with RCRA requirements when it leaves the institution. This means that the waste labeling procedures before a RCRA waste determination is made should be carefully described by the institution and effectively disseminated to the laboratory population.

At UMB, for the XL Project, we developed Laboratory Waste tags for unwanted laboratory material. On the tag, we asked the lab workers to clearly list the lab, location, PI, the contents by name, the approx. percentage of the total and to circle one of six “classes.” Once a laboratory is finished with a container of laboratory waste, EH&S picks up lab waste, brings it to a central chemical storage area and conducts an evaluation of the material. If it is suitable for reuse, we stock it with other reusable material. If it is determined to be waste material, we determine if it is solid or hazardous. If it is hazardous than it is labeled appropriately, dated and stored with other like materials awaiting disposal.

Based on our experience, the key components for making a determination outside a laboratory are: lab, location, PI, contents by name and the approximate percentage of the total waste.

The label is the means by which the generator (the *person* who generated the waste) communicates to all personnel who may be in contact with that waste either in the lab or downstream in waste handling. The accuracy of the information on the label is vital for worker health and safety as well as finding the most cost effective disposal technologies. RCRA and the Lab Waste Rule both state a waste container must be labeled with the words “Hazardous (or Laboratory) Waste” OR the contents of the container. I believe that both are necessary. In management systems the emphasis is on communication between all the responsible parties. Informative labeling is part of that communication process.

At the same time, a labeling requirement should also be performance based. The generators and EHS know best what needs to be communicated through the internal waste process. At a minimum, a label should include some designation that the material is a waste, and a chemical name. The DOT naming convention (e.g. waste hydrofluoric acid), is simple and communicates clearly. Other label features (generator information, hazard classes) should be defined by the institution.

5. CONTAINER MANAGEMENT

What are the key provisions for container management that had to be addressed in each LEMP? Based on experience, how might a container management requirement in the rule be most effective?

We have found that the key issues in an effective container management program include:

- segregation of incompatible chemicals from each other;
- secure closure of the chemicals containers;
- good housekeeping of the chemical storage areas;
- regular inspections of the area (at least monthly); and
- prompt removal of accumulated waste.

With regard to the container management provisions of the rule, we believe that the simplicity is the key to effective implementation of the requirements. A performance oriented approach, such as that found in the regulatory flexibility granted by the XL rule is appropriate for container management. The Minimum Performance Criteria found in the XL rule are probably more complicated than necessary to assure an effective program. Our experience at UVM is that careful development of procedures that reflect a campus' resources and culture, and consistent, ongoing dissemination of these procedures are key to the successful implementation of a hazardous waste program.

At UMB, we have found that the most important provision for container management is a requirement for regular inspections. Our monthly container checklists posted in every laboratory containing chemicals serves as a constant reminder to our PIs and students that it is important to inspect containers' integrity on a regular basis. Included in that monthly inspection is a check on compatibility, storage time, housekeeping (i.e., are containers closed and in good condition), etc.

At Boston College we were able to match the pace of waste management to the needs of our laboratory programs. In the research labs the biggest impediment was Massachusetts' one-container-per-waste-stream rule. Combined with the local limitations on container size (1 gal for Class IA flammables), it meant we would have to remove waste from labs daily. The change to 30-day storage in the rule and the lifting of the multiple containers prohibition means that we are able to efficiently carry out waste transport from the labs to the MAA, by trained hazardous waste personnel, with a minimum amount of exposure to workers. There is no tendency to "horde" waste to take advantage of the extension because of limited storage space in the labs, and the fact that we have weekly waste service. Labs know that it is an easy and regular process to have waste removed.

Our teaching labs have a different container management challenge. In this case there are several labs (rooms) where the same work is being conducted and waste being generated. Our goal in defining the point of generation was to efficiently manage a limited number of SAAs while having trained laboratory personnel (not students) in labeling and container management. What we found effective in this case was making the point of generation the prep room for the course. All materials are dispensed from this location for each lab period, and all remaining chemicals and wastes are returned to the same location. At this point it is possible for the trained technician to appropriately combine and label waste streams and schedule waste pick-ups.

The 55 gallon limit for waste stored in labs has never been an issue for us. There are space restraints that prevent this, as well as local fire regulations which prevent the storage of flammables in containers greater than 1 gallon, or storage beyond a certain capacity on each floor. The weekly waste pick-ups are successful at keeping the waste volumes down to a manageable level (from a space perspective) in the laboratories.

Once again, I believe that a rule should give institutions some flexibility to manage containers according to their own circumstances.

6. LABORATORY CLEANOUTS

How are laboratory clean outs handled under in the EMP? How often are they done per laboratory? What are the situations that trigger a clean out? Does the timeframe differ between a teaching laboratory or a research laboratory?.

Under the UVM EMP established for the Lab XL pilot project, there is a specific clean-out procedure described. This procedure requires laboratories to notify ESF staff of impending cleanouts so that the clean-outs can be properly planned within the scope of other ESF activities. Over time, we have found that this procedure is most important during periods of extensive laboratory renovation and/or moving, such as when a new laboratory building is being opened and many labs are moving at the same time. In general, this notification procedure is not as important in single lab clean out situations, because the ESF technicians are able to work directly with the lab workers to organize the cleanout of a particular lab within their normal work routines.

It should be noted that it is likely that UVM's Part B permit for a TSDF facility at the Environmental Safety Facility makes the lab cleanout process significantly simpler at UVM than at campuses that don't have a Part B facility. Because of the extended storage time available at the ESF (up to one year), even relatively large laboratory clean-outs (up to 75 containers) can be handled within the scope of normal activities. One exception to this is that during cleanouts involving more than about 15 containers, ESF staff do not require laboratory workers to fill out Laboratory Waste Tags for single waste containers, but rather one tag for each waste class established by the final disposal facility. This reduces the amount of paperwork necessary for both parties to handle without losing the information necessary to assure proper disposal of the chemicals.

Laboratory cleanouts are most likely to occur when a research laboratory is assigned to a new primary investigator, which is not likely to occur more than every few years for a particular laboratory room. In our experience during the XL pilot period, teaching laboratories have not collected large enough numbers of hazardous chemicals to require a laboratory clean out approach to disposal of waste chemicals.

At UMB, clean outs per laboratory are not done on a regular basis. Clean outs in research laboratories are only triggered when a PI indicates that he needs one done or a lab is decommissioned. In those cases, laboratories are evaluated in advance by EH&S personnel. If the laboratory has a lot of excess material, EH&S will use a hazardous waste vendor to move materials out of the laboratory. Materials are moved to a central storage area where they are either placed into our reuse stock material or deemed hazardous waste and lab packed for off-site disposal. In research laboratories that do not have a lot of material, EH&S moves the material to the central storage area. Teaching laboratories are handled differently. Most teaching laboratories at UMB do not contain excess chemicals beyond what is normally used. In laboratories that are busy, such as general chemistry, organic chemistry, etc. EH&S goes to the laboratory on a weekly basis to remove laboratory waste. Waste is generated in these areas based on scheduled experiments that only last for one week. Clean outs, if they happen at all, usually happen at the end of a semester based on requests by Departments. In most cases, EH&S removes material because in these laboratories quantities are much smaller.

Originally lab clean-outs were the source of chemicals we would offer for redistribution. However, many of these chemicals were discarded from labs when they moved to temporary spaces during renovation. In other words, they weren't valuable enough to the owner to move, and generally weren't attractive to potential takers. Chemical redistribution is managed on a local level now. Labs with similar activities are offered the opportunity to take available chemicals, but once the cleaned-out material is "picked over," the remaining chemicals are discarded.

Laboratory clean-outs are triggered by a number of events and are of a variety of scopes. In 2005 a PI from the Chemistry Department left BC, taking all the chemicals they were safely able to ship. (These chemicals were packed and transported by a vendor.) The chemicals that were left behind were temperature sensitive, reactive, highly flammable, or unwanted. Very little was taken by other labs, and the rest became waste.

Another clean-out was triggered by the passing of a PI. The main issue that arose was who would make the clean-out determination, and when. A colleague from another university and the PI's graduate students oversaw the clean-out after the students had completed research necessary for the completion of their PhDs.

Researchers have a considerable investment in their chemical stores and resist what they perceive to be unnecessary clean-outs. However, our Chemistry Department is undergoing continual growth, so some clean-outs are undertaken to simply make more space. In one case, a PI's stockroom was dismantled to provide room for another lab, which provided an incentive to dispose of old chemicals.

Teaching labs may necessitate clean-outs on a more frequent basis. This depends, in part, on changes in personnel and curricula. These factors will be especially variable at universities due to the nature of lab teaching assignments. Boston College has had stability in its teaching labs over the course of the Project. However, one stockroom manager undertook a clean-out process where he marked all chemicals used in the lab with a colored dot, and after two years disposed of all chemicals that had not received a dot. This reduced his chemical inventory by approximately one-fourth.

Clean-outs arise from a number of events, and are as variable as the labs that are cleaned out. It is again important, I believe, that a rule provide as much flexibility as possible. If EPA spells out certain goals to be achieved in a clean-out (e.g. within a certain period of time, or maximizing the amount of chemicals redistributed), the institutions will have the ability to make decisions based on waste minimization and cost effectiveness.