NEW ENGLAND UNIVERSITY LABORATORIES' PROJECT XL

THIRD YEAR PROGRESS REPORT

June 11, 2003

For

BOSTON COLLEGE
UNIVERSITY OF MASSACHUSETTS BOSTON
UNIVERSITY OF VERMONT

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Introduction

The principal objective of the New England Universities Laboratories' Project XL ("Lab XL") is to pilot a flexible, performance-based regulatory model for managing laboratory waste. The purpose of this Progress Report is to summarize environmental performance data and evaluate results based on the agreed upon Environmental Performance Indicators (EPIs), per the terms of the Final Project Agreement signed September 28, 1999.

Performance reports have been completed by each of the New England Universities Lab Project XL participants: Boston College, University of Massachusetts Boston and the University of Vermont. Their reports are included at Tabs A, B, and C, respectively.

As described in the FPA, the Lab XL participants track and evaluate their institution's "environmental performance" with nine EPIs. These metrics were selected to measure the effectiveness of the Environmental Management Plan (EMP) at each institution. Nine indicators were selected because of the complexity and the interactivity of the waste management activities, the multiple outcomes sought and uncertainty with respect to the selection of the perfect indicator for this project. Over the course of this project, we have gained considerable insight to the strengths and weaknesses of these metrics. The EPIs are classified by type. Five indicators measure pollution prevention activities or outcomes. Two indicators evaluate compliance, and two indicators measure environmental training/awareness activities and outcomes. The emphasis on pollution prevention reflects the collective desire to minimize the chemical impacts associated with laboratory research, to the extent practicable, as measured by laboratory waste generation and reuse of waste chemicals.

Activity Since Last Report

It was another busy year for the institutions and the Environmental, Health and Safety (EH&S) staff. The departments and staff charged with laboratory waste management responsibilities continue to build upon previous program successes, incorporate "lessons learned" into management efforts, and identify key priorities in an effort to continuously improve the system for managing laboratory wastes. Additionally, the XL participants interacted with a broader set of stakeholders, including EPA Headquarters, as national efforts gain momentum to fully explore and address hazardous waste regulatory reform issues pertaining to laboratory activities.

Major activities are identified below:

- Representatives from Boston College, the University of Massachusetts Boston and the University of Vermont participated in the 2002 meeting of the Howard Hughes Medical Institute (HHMI) in the development of its "Report on Consensus Best Practices for Managing Hazardous Wastes in Academic Research Institutions."
- The New England Universities Laboratories Project XL Second Year Report was submitted to EPA on May 30, 2002.

- Faculty, staff, graduate students and three institutions participated in the Spring 2002 in EPA's mid-term evaluation of the New England Universities' Laboratories Project XL. This report is further described below.
- Tom Balf, on behalf of the Project XL participants, met in Washington on September 23, 2002 with the EPA Office of Solid Waste staff to discuss the Project XL and the results to date.
- Boston College hosted a workshop on November 12, 2002 entitled "Pollution Prevention and Green Chemistry Workshop for Colleges and Universities." The successful workshop was co-sponsored by the Campus Consortium for Environmental Excellence, Environmental Protection Agency, Vermont Department of Natural Resources, and the Massachusetts Department of Environmental Protection.

Lessons Learned from the Project

Two important documents have become available over the last year that provide, in addition to the annual reports, important information and analysis with respect to the Lab XL project.

EPA's Mid-term Report

The U.S. EPA, Office of Environmental Policy Innovation, with assistance from Industrial Economics, Inc, interviewed key Lab XL faculty, staff and student stakeholders and visited each of the Lab XL institutions. The fruits of their labor are recorded in a comprehensive, and well-written document entitled "Project In Excellence and Leadership: New England Universities' Laboratories Mid-Term Evaluation: Piloting Superior Environmental Performance in Labs."

The goal of the mid-term evaluation was to "garner lessons learned from the unique approach to laboratory management being tested by the three institutions and to highlight opportunities to improve the overall environmental performance for the universities for the remainder of the project." As noted by the EPA, "the intended users of this evaluation are not the three XL universities, but also the larger universe of academic institutions all grappling with similar environmental management and regulatory issues. This report, available on our web site at www.c2e2.org, is a helpful contribution to this pilot project and to the broader appreciation of the value of a plan-based rule to managing laboratory wastes, rather than the traditional RCRA approach.

CHAS Article

As part of our commitment to this Lab XL project, we have made an effort to draw insights from this pilot project and articulate to interested stakeholders lessons learned with respect to the nature of an EMS-based rule and the implementation of Environmental Management Plans. We believe that these insights and experiences are important considerations as alternatives to RCRA are considered for application in the laboratory setting.

Attached with this package (Tab D), we have included a copy of the May/June 2003 edition of the Chemical Health and Safety Magazine of the American Chemical Society. The feature article, written by the XL Participant team, is entitled "Piloting an EMS-based regulation for chemical waste in laboratories: A Lab XL progress report." We encourage all stakeholders to review this valuable contribution to the literature. The five key EMS implementation lessons learned, described in further detail in the article, are listed below:

1. *Management flexibility is necessary to effectively implement a program designed to move beyond compliance in complex organizations.*
2. *Implementation takes time and the appropriate indicators of progress change over the course of implementation.*
3. *Objective audit criteria can provide valuable management information.*
4. *Feedback loops from the affected population are critical in maintaining the chain of cultural-behavioral-physical change.*
5. *It is important to work within the institutional culture and mission to implement and environmental management system effectively.*

Communication to Stakeholders

This progress report will be available shortly on the Lab XL web page at http://2www.c2e2.org. Lab XL participants will also post their annual progress reports to their institutional web page. The EH&S web sites are as follows:

University of Vermont – http://esf.uvm.edu/ubemp
University of Massachusetts Boston – http://www.ehs.umb.edu
Boston College – http://www.bc.edu/ehs

The availability of the report will be communicate to potential stakeholders through listings on the Lab-XL, the Campus Safety, Health and Environmental Management Association (CSHEMA), and College/University Hazardous Waste listserves. Ralph Stuart will be discussing the Lab XL results at the CSHEMA annual conference in Nashville, NT on July 15, 2003.

For more information about the Lab Project XL, contact Thomas Balf at the C2E2 at 617-951-1181 or at tbalf@c2e2.org. Interested parties may also communicate with Lab XL University contacts directly at:

Ralph Stuart, UVM, 802-656-5403, rstuart@esf.uvm.edu

Gail Hall, BC, 617-552-0300, hallga@bc.edu

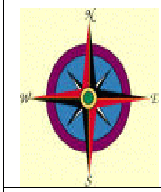
Zehra Schneider Graham, 617-287-5444, zehra@umb.edu

Format of This Report

A summary of environmental performance is described on the following pages. In this year's report, we are presenting the data in a unique format. Past annual reports have summarized progress for each EPI in a narrative format, using summary tables when data was available. In this report, we present the EPI summary data for the three institutions in a more structured format that focuses, in addition to performance data, on lessons learned, the relationship of performance to the rulemaking and the selected EPIs, and the priorities for the future of the project. Icons are used to organize the information. The format and the icons are presented below.

We encourage all stakeholders to carefully review each Project XL institutional report. Each institution has a distinct voice, with a unique story to tell. The lessons learned and the continuous improvement courses for the future vary from institution to institution. Because each institution has developed a waste management program that includes distinct checklists, inspection forms and training approaches tailored to their institutional needs, the data collection and analysis is most appropriately assessed for trends within the institution. Program differences and varied assumptions and perspectives (e.g., audit inspection scoring) can confound our ability to make comparisons across Lab XL institutions.

Environmental Performance Indicator	**Project Goal**
Intent	Text
Results 	Text
Performance	Text/table

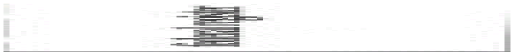
Connection to Rulemaking 	Text
Value of this Metric	Text
Lessons Learned	Text
Areas of Further Inquiry	Text

Environmental Performance Indicators

EPI #1 and #2

Environmental Performance Indicator (EPI) #1	Project Goal: Verify that all HCOCs in a laboratory are within defined "shelf-life."
Environmental Performance Indicator (EPI) #2	Project Goal: Complete HCOC surveys in 100% of laboratories.
Intent	The Environmental Management Plan includes a requirement that each University define a list of "Hazardous Chemicals of Concern" (HCOCs) and annually conduct a risk evaluation of these chemicals in the laboratory. The project designers recognized that the universe of chemicals of concern at a campus will vary depending on laboratory activities and operations, so each university was empowered to develop its own, unique HCOC list, based on the risk-based professional judgment of the health and safety managers. These EPIs were intended to measure the success of the EMP in reducing the amount of hazardous chemicals stored in laboratories in order to reduce the risk of chemical accidents. The intent of EPI#1 was to institute an administrative control that measures the risk of a chemical accident, explosion or spill associated with the extended storage of dangerous chemicals. The measurement, based on the existence of "expired" chemicals, would be considered a "lagging" indicator of poor hazardous chemical management practices. The intent of EPI#2 was to provide a "leading" indicator of good chemical management practice. This indicator was based on the designer's judgment that the process of annually completing the survey reduced the risk of a chemical accident, explosion or spill by forcing review of the chemical stock and encouraging culling of excess chemicals.

Campus Results



EPI #1: Information regarding chemicals that had exceeded their expiration dates was not recorded, by the three institutions, on the inventories/surveys. The researchers at all three institutions resisted making this assessment because of the ambiguity of the concept of "expiration date." Alternatively, each school independently determined that the presence of expired HCOCs was most efficiently and credibly evaluated during laboratory inspections and/or waste pickups.

EPI #2: UVM was able to achieve a 93% response rate, including for the first time, 100% response of the chemistry department. The 93% response rate is a significant improvement over past years. In 2000, the participation rate was 49%.

At UMass Boston and BC, 100% of the laboratories completed a laboratory inventory of all hazardous chemicals. At BC, EH&S evaluated the submitted inventories for the existence of HCOCs and recorded the number of HCOCs found, types of HCOCs and the specific hazards. Very few HCOCs were noted. At UMass Boston, a chemical inventory software system was used which allowed "flagging" and tracking of HCOCs from labs.

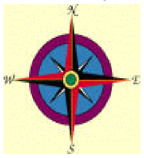
The value of these indicators in assessing the risk associated with hazardous chemical storage is reinforced by the fact that no significant chemical accidents, explosions or spills were reported at UVM or UMass Boston during 2002. BC had one chemical accident in a laboratory. There were no injuries associated with this incident.

Performance

	UVM	BC	UMB
Lab Response Rate	93%	100%	100%

Connection to Rulemaking

The requirement to identify hazardous chemicals and conduct an annual survey is a requirement of the Environmental Management Plan at 40 CFR 262.105(b)(7). Based on our experience to date, it may be more appropriate to require a procedure in the EMP to reduce the risk of a chemical accident, explosion or spill that may result from extended and unattended storage of dangerous chemicals. Such a procedure could rely on a combination of elements, including annual inventories, inspections or audits, an inventory control system, training and information, depending on the level of risk associated with the chemicals and the unique management tools at a particular campus.

Value of this Metric 	We have come to believe that the performance metrics #1 and #2 are of limited future value, as originally defined, to this project. We continue to support, however, the identification of a list of HCOCs that is communicated to researchers and used as part of the training, information and assessment tools to educate laboratory workers about prudent chemical storage practices. All three schools will continue to conduct the inventories/surveys since they have integrated the HCOC concept into existing state and local requirements to conduct inventories in labs. Other metrics, such as the number and quantity of HCOCs in a laboratory, and laboratory inspection scores, may be more effective tools than the annual HCOC surveys at reducing risk of spills and minimizing the risk of dangerous chemicals becoming “dusty/crusty” containers.
Lessons Learned	It is difficult to define what is outdated in the laboratory. Most chemicals are stable, beyond the expiration date established by the manufacturers. However, HCOCs provide important information about a small set of explosive, peroxide forming, reactive or acutely toxic chemicals. Expiration dates applied to a broader set of chemicals causes confusion with trained chemists/researchers who have multiple potential uses for the materials, and potentially hinders continued collaboration with the EH&S department and staff.
Areas of Further Inquiry	Evaluate the emerging use of chemical inventory software at non-XL institutions in reducing chemical accidents, and preventing the storage of expired, dangerous chemicals. Compare the results with the HCOC approach piloted in this project.

EPI #3

Environmental Performance Indicator (EPI) #3	**Project Goal:** Identify one pollution prevention (P^2) assessment per laboratory per year. An opportunity assessment conducted for one lab waste stream may be broadly applied to other laboratories with similar waste generating processes.		
Intent	The Final Project Agreement includes a requirement that each University conduct pollution prevention assessments in laboratories. These assessments are not explicitly required in the Lab XL rulemaking at 40 CFR 262 subpart J. The intent of EPI#3 was to mandate formal evaluations of P^2 opportunities in the laboratory. It is standard industry practice to evaluate waste generating process streams for pollution prevention opportunities. EPI#3 could be considered a "leading" indicator because it tracks the assessment process that may lead to behavior changes or waste reductions measured by other indicators.		
Campus Results	UVM continued to promote and expand its ChemSource program of decentralized distributions of key chemicals and its mercury thermometer exchange program as its primary pollution prevention strategy. In addition, the Environmental Safety Facility (ESF) staff developed new tools (e.g., P^2 surveys as part of the annual compliance audit) that assist in promoting P^2. The results of this survey will provide important data in planning the next steps in developing an ongoing P^2 program for labs. Early results from this survey found that nearly half of the laboratories had already implemented at least one of the major pollution prevention strategies – substitution of hazardous chemicals, use of microscale, change of lab process. Boston College continued to study waste generating practices in order to gain a fuller understanding of the specific steps involved in the process of chemical purchasing, chemical use, and waste generation in the lab. This evaluation has, like UVM's, relied on other XL tools, such as training discussions and lab inspections, rather than written P^2 assessments in individual labs. In order to promote and learn more about P^2 in the lab, BC hosted a Green Chemistry/Pollution Prevention workshop in November 2002. A number of faculty, staff and students at BC attended this event. UMass Boston continued to effectively use its faculty, involved in its Green Chemistry Program, and an active Chemical Hygiene Committee, to search for new pollution prevention ideas and share these with the research community at UMB.		
Performance		**UVM**	**UMB**

	% respondents who have downsized chemicals	43%	38%
	% respondents who have substituted less hazardous chemicals	46%	21%
Connection to the Rulemaking	The requirement to conduct pollution prevention assessments in the laboratory is found in the Final Project Agreement (FPA). The rulemaking, at 262.105(b)(6) requires only that an institution's EMP include a pollution prevention plan, which should identify roles and responsibilities, training, pollution prevention activities and performance review. Based on our experience to date, we believe that a commitment to a pollution prevention program should be a mandatory component of the EMP. However, the reference to specific methods of implementing such a program should be omitted.		
Value of this Metric	The original goal of conducting one P^2 assessment per lab per year was, in retrospect, simplistic. This approach was based on the assumption that campus-wide P^2 programs could serve the needs of many labs. Such a "cookie cutter" approach has not worked in the labs of these institutions, which probably represent a reasonable cross section of higher education institutions. The P^2 surveys already conducted suggest that P^2 opportunities are being identified and seized by health and safety conscious researchers. We believe that an EMS for academic research laboratories should focus on the use of lagging indicators, such as waste generation, survey results and inspection scores, in evaluating the success of pollution prevention efforts.		
Lessons Learned	You can suggest P^2 strategies to researchers, but these are unlikely to be implemented unless they make sense based on other criteria such as process efficiency, health and safety improvements or cost-savings. Because of the diverse nature of chemical use in labs, multiple tools and techniques must be used to promote P^2 in labs. This means that, in general, the researchers themselves are the most appropriate people to conduct do P^2 evaluations. Generally, it is not appropriate for EH&S to conduct the assessments unless it is to see whether campus-wide programs (e.g., substitution of glass cleaning products, use of alternative thermometers) apply to the laboratory. The ability of EH&S staff to conduct P^2 assessments is often limited by resources, technical skills and cultural barriers. We believe that it is also important to consider whether hazardous chemicals represent the most important pollution associated with laboratory work. Because of the strict environmental requirements associated with laboratory work, energy use in laboratories is very likely to have a much more significant environmental impact than chemical waste		

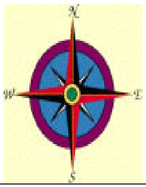
	disposal. EPA's Labs 21 program is aggressively pursuing this issue.
Areas of Further Inquiry	Investigation of receptivity to a green chemistry approach to pollution prevention within the research community. Opportunities to encourage green chemistry/pollution within the research funding community. Development of a clearinghouse of green chemistry/pollution prevention practices relevant to specific chemical activities and methodologies. Further exploration of the frequency of change of chemical activities at a research institution in an effort to know "the lead time" for promoting P^2. Are P^2 opportunities only available at the planning stage of laboratory work, or are some parts of the chemical processes standard enough that opportunities continuously avail themselves?

EPI #4

Environmental Performance Indicator (EPI) #4	**Project Goal:** Increase by 20% (from baseline) the quantity of hazardous materials and waste redistributed to laboratories.
Intent	This metric was developed to measure hazardous materials reuse and redistribution of lab waste materials. This was of interest because some people: (a) interpret RCRA as requiring laboratory workers to make RCRA hazardous waste determinations; and (b) believe that this RCRA laboratory decision may prevent effective reuse of excess chemicals within the broader institution. The intent of this EPI was to: (a) measure the "waste exchange" or the redistribution of useful chemicals that would otherwise be disposed as hazardous waste; and (b) test the assertion that allowing EH&S to make waste determinations could increase the reuse of these "waste" materials.

Campus Results 	UVM has focused its redistribution efforts on the ChemSource program. The program, designed to reduce the amount of excess hazardous materials purchased by laboratories, has been very successful in terms of the delivery of new chemicals to laboratories. Under ChemSource, ESF buys in bulk certain commodity lab chemicals and repackages in smaller containers and passes the savings on to labs. The quantity of chemicals purchased by labs in this way has nearly doubled over the course of the project. At BC, the most common form of chemical redistribution continues to be informal, intra- and inter-lab borrowing. As the number of lab cleanouts has diminished, the quantity of chemicals available for redistribution is small, stable and "cherry-picked." In 2002, with no lab clean-outs, 25 containers of unused chemicals were collected for a total of 35 pounds. Efforts in 2002 at UMB included the publication and dissemination of a list of excess chemicals that were available from EH&S. Chemicals were requested from EH&S and delivered to laboratories on only four occasions. Redistribution of "waste chemicals", while offered at all three institutions, has never been able to achieve a critical mass of supply necessary to make redistribution a reliable option.
Performance	Not available.

	Laboratory waste or excess redistribution or exchange is not a requirement of the rule.

Connection to Rulemaking 	
Value of this Metric	While the three institutions have failed, for reasons described below, to institute successful chemical waste redistribution programs, it is not the fault of the individual programs, but rather the assumptions upon which this metric was based. Our experience (confirmed in discussions with other colleges/universities with similar redistribution program) has demonstrated that the primary hurdle for these programs is cultural rather than regulatory. (see Lessons Learned) It is important to note the success of UVM's ChemSource program in (a) reducing redundant purchasing of chemicals; and (b) changing the nature of the relationship between ESF and researchers from one of waste pickup service to chemical management. Clearly, the effect of this program achieves the intent of EPI#4 (i.e., avoid disposal of usable chemicals), but is not reflected by it.
Lessons Learned	The term "waste exchange" is doomed; programs should focus their efforts and the name on the redistribution of chemicals. Materials from laboratory cleanouts are often cherry-picked by other laboratories before EH&S is involved in the management of excess materials. Redistribution, when it occurs, will be specific to certain chemicals and certain researchers. A "niche market" approach to successful redistribution focuses on understanding key customers and markets (e.g., chemicals) for those instances when the chemicals are available. Such an approach obviates the need for building and maintaining large database of excess materials on hand. Such general databases of generic chemicals typically see turnover rates of much less 10% per year. Excess glassware and laboratory equipment from cleanouts is more popular than excess chemicals. Opened containers, or containers from unidentified labs, are difficult to redistribute because of questions about the quality of the material. Most "successful" programs at non-Lab XL institutions do not redistribute more than 1% of materials shipped off-site for disposal. Some of these programs are maintained because they: (a) are mandated by a state or local requirement; or (b) provide justification for EH&S making the waste determination.
Areas of Further Inquiry	A rigorous benchmark evaluation of chemical redistribution programs at colleges and universities.

	An evaluation of the ability of inventory software systems to enhance the redistribution and "borrowing" of chemicals from laboratories.

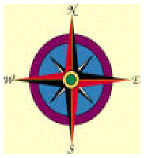
EPI #5

<table>
<tr><td>Environmental Performance Indicator (EPI) #5</td><td>Project Goal: Reduce hazardous waste generation by 10 percent from baseline.</td></tr>
<tr><td>Intent</td><td>The Final Project Agreement includes a requirement that each University track its hazardous waste generation. We intended to achieve reductions in the generation of laboratory waste as a result of improved environmental management program enabled by the regulatory flexibility available under the XL pilot regulation. A reduction in the quantity of hazardous waste generated, a “lagging” indicator, was seen as a demonstration of superior environmental performance by the project designers.</td></tr>
<tr><td>Campus Results
</td><td>At UVM, laboratory generation rates (as measured by waste shipped from UVM) increased substantially in 2001. In 2002, this amount rose by 59% over 2001. This increase is primarily attributed to lab cleanouts in 2001 that were not shipped until 2002 and an additional waste shipment in the 2002 calendar year.

In 2002, BC produced 400 more pounds of laboratory waste than in 2001 (1% increase) and the Chemistry Department produced only 28 more pounds (0% increase). This leveling off of the waste generation rate in Chemistry is important since Chemistry accounts for 96% of the chemical waste volume generated at BC over the course of this project.

At UMass Boston, waste generation volume decreased 11% percent in 2002 compared to 2001. This figure represents a roughly 11% decrease in waste generation rates from the inception of this project.</td></tr>
<tr><td>Performance

Lab Waste Generation for 2002. See table at end of this section for further details.</td><td><table>
<tr><th></th><th>% change from 2001</th><th>% change from baseline</th></tr>
<tr><td>UVM</td><td>59% Increase</td><td>37% Increase</td></tr>
<tr><td>BC</td><td>1% Increase</td><td>50% Increase</td></tr>
<tr><td>UMB</td><td>11% Decrease</td><td>11% Decrease</td></tr>
</table></td></tr>
<tr><td>Connection to Rulemaking</td><td>There is no connection between the requirement to track hazardous waste generation rates and the rulemaking at 40 CFR 262 subpart J. No changes would be sought in a rulemaking. Hazardous waste generators are currently required to track their generation of hazardous waste in order to determine their generator status and ensure that they comply with applicable accumulation time and quantity limits.</td></tr>
</table>

Value of this Metric 	We believe that the current metric and its associated goal is reasonable and important, on an aspirational basis (the ultimate goal of a waste management program is zero RCRA waste). However, our experience is that this metric fails to provide an accurate measurement of what is, or is not, happening in the laboratory with regards to chemical management and pollution prevention. This is because (a) waste generation rates must be normalized to accurately evaluate trends and (b) trends are best evaluated over a period of time greater than a single year. In the absence of a normalized indicator, improvements in managing lab waste may not be reflected in this indicator. EPA's mid-term evaluation of the Lab XL project expressed similar reservations about this EPI (see lessons learned below). The report suggested "for the next 2 years of this project, it may be a better environmental goal for the schools to purse a source reduction strategy."
Lessons Learned	Waste generation rates for a particular campus are affected by a complex array of variables, which are outside the management scope of the waste management program (e.g., increased research grant support, opening of new lab space, retiring or recruiting of researchers). We also note that the simplistic approach of this EPI conflicts with other project EPIs and activities. For example, efforts to remove chemicals from laboratory shelves will increase the generation of laboratory wastes. Therefore, the early stages of the Lab XL implementation are likely to result in increased waste generation. Experience at the three schools indicates that this preliminary "stage" lasts longer than one year and complete implementation depends on competing priorities in the research community (such as an expansion of laboratory space or activities). Reducing hazardous waste volumes from laboratories will take time because (a) waste generating activities must be addressed at the design (i.e., grant writing) stage; and (b) cultural and behavioral changes must precede changes in physical impacts (i.e., waste volume reduction, toxicity reduction).
Areas of Further Inquiry	Waste generation rates are affected by many variables, and we have been unable to account for all of these as part of this project. A comprehensive evaluation of methods to normalize waste data from academic laboratories would be an invaluable contribution to this project and the broader research/EHS community.

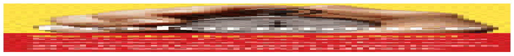
2002 Laboratory Waste Generation Data (un-normalized)

[redacted]	2002 Data (in lbs.)	[redacted]	2000 Data (in lbs.)	[redacted]	Percent Change from 2001	Percent Change from Baseline
[redacted]	34,735	[redacted]	36, 764	[redacted]	1% Increase	50% Increase
[redacted]	4,955.09	[redacted]	3, 710.66	[redacted]	11 % Decrease	11 % Decrease
[redacted]	53,112	[redacted]	38, 269	[redacted]	59% Increase	37% Increase

EPI#6 and #7

Environmental Performance Indicator (EPI) #6	Project Goal: Assess and demonstrate improvement in environmental awareness of laboratory workers.
Environmental Performance Indicator (EPI) #7	Project Goal: Increase the number or percentage of students and lab workers who receive training.
Intent	Since the conception of this project, the project designers have realized the importance of providing relevant and appropriate training to laboratory workers. We believe that raising environmental awareness is the critical task in moving toward the long-term goal of reducing the hazards in laboratories and minimizing the generation of hazardous waste. The intent of these two EPIs is to measure the Lab XL institutions' ability to reach a wider audience with a more effective message than the current RCRA compliance-focused training requirements. These two metrics, while related, are not perfectly aligned. The survey is not provided at the end of a training session. The survey is provided randomly to laboratory workers (faculty, technicians or students) to assess their knowledge of key issues associated with laboratory activities and operations. It was the intent that the Environmental Management Plan's emphasis on training and information would: (a) assist in improving and broadening the working partnership between EH&S and researchers around pollution prevention concepts and practices; (b) encourage the cultural change that will be necessary to achieve sustainable long term behavior modifications and reductions in laboratory environmental impacts; (c) reflected in increased worker awareness scores.

Campus Results



The total average score at UVM climbed another 5% compared to last year. Ninety percent of surveyed people responded that they had attended training.

At BC, only 15% of Environmental Awareness Surveys were returned to EH&S. Scores in container management continued to show improvement, while scores generally declined in other areas. The number of people trained in the EMP at BC increased last year, as expected. Additionally, other specialized training classes were well attended and total universe of laboratory workers trained expanded.

UMass Boston training reached more than 90% of laboratory workers and EH&S instituted a better tracking system to identify laboratory workers. Modest score improvements were observed in some areas (e.g., primary environmental impact), while the overall scores declined slightly. The percentage of survey respondents trained in the EMP grew by 6%.

Performance: Percent of Total Correct Answers on Awareness Surveys

	2000	**2001**	**2002**	**2003**
UVM	47%	61%	62%	65%
UMB	38%	50%	52%	48%
BC	42%	59%	58%	23%*

Incomplete data/survey scores will be updated.

Connection to Rulemaking

There is a strong relationship between these EPIs and the rulemaking. Under 262.104, the Minimum Performance Criteria (MPS), "each university must ensure that laboratory workers receive training and are provided with information so that they can implement and comply with the MPC."

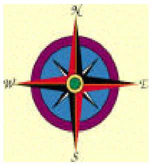
It is important to note that (a) the training requirements have been purposefully designed to be consistent with the OSHA Laboratory Standard language; and (b) there is no requirement for annual training. Competence and understanding are the goals – not requisite annual training. It is not surprising, therefore, that the number of laboratory workers that receive training in a given year is decreasing at the schools, where earlier training reached the stable portion of the laboratory population.

The training requirements in the rulemaking are generally appropriate, although opportunities to streamline language could be sought.

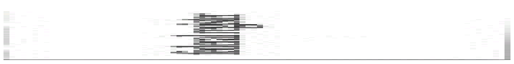
Value of this Metric

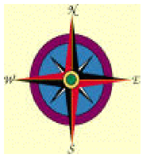
While the awareness scores of laboratory workers continues to be relevant, the "number or percentage of lab workers trained" has served its purpose for this project because the schools have demonstrated the ability to effectively reach the population of interest. This ability has been significantly enhanced by improved cooperation from departments in arranging the training sessions.

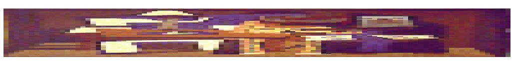
	The survey continues to be a source of useful feedback. Further analysis of survey scores and the background of respondents (e.g., department, years in lab) will provide meaningful insight for improving future training and information efforts. None of the schools have "trained to the test" (that is, provided information only for the purpose of assuring high scores on the awareness survey) and the surveys were not provided at the time of training. It was our assertion, and our hope, that literacy levels would rise through the effective design, implementation and continuous improvement of the EMP. Training efforts are simply one critical component of EMP. The success of this approach has not been uniform, but success is seen in nearly all areas affected by the EMP.

Lessons Learned 	The value of specific performance indicators changes over time, particularly when the indicators measure different aspects of the Environmental Management System as it is implemented. The internalization of knowledge (development of internal standards that replace EPA's externally-imposed standard while meeting the same performance goals) may result in a decrease of scores to certain questions (e.g., Who is EPA?) while other indicators improve. Training classes and the use of an awareness/survey tool provide valuable feedback to EH&S and are important in developing and sustaining the progression of cultural-behavioral-physical change in the lab. Identifying and tracking laboratory workers is difficult and time consuming. While the development of a training database is necessary, partnerships with key staff (e.g., department chairs, lab supervisors) are critical to success.
Areas of Further Inquiry	None proposed at this time.

EPI#8

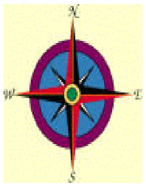
Environmental Performance Indicator (EPI) #8	Project Goal: Achieve objectives and targets defined in the Environmental Management Plan.
Intent	The identification of objectives and targets is a key component of an effective management system. One of the ideas being tested by this project was whether an Environmental Management System approach to a specific regulatory issue would allow for measurable improvements in Environmental Performance around that issue. EPI #8 was designed to assure that the management system approach would be considered as the institutional EMPs were designed. The intent of this EPI was to (a) promote the use of objectives and targets to provide direction for the overall EMP goal of "continuous improvement;" and (b) measure the achievement of stated objectives and targets as a proxy for EMP effectiveness.
Campus Results 	All three institutions met the intent of this EPI. They monitored and measured performance against objectives and set interim goals, as necessary, to improve programs in pursuit of enhanced performance, as measured by the nine Lab XL EPIs. Some of the EPIs are on track. Others program elements need more time and attention to fully mature to give a meaningful reading of the value of the EMP approach.
Performance	Refer to a discussion of the other EPIs. "Cultural" EPI's are showing significant success. "Compliance" EPIs are beginning to show more of the desired behavior. "Physical" EPI results are still mixed.
Connection to Rulemaking	In 40 CFR 262.105 (c)(2)(i), it makes clear that an organizational requirement for each university is to identify annual environmental objectives and targets. The requirement to set objectives and targets is a necessary component of an effective plan. We support this language, although we see limited value in EPI#8 within this project because the other EPI's effectively serve this function.

Value of this Metric 	The Lab XL institutions will continue to assume that this EPI is achieved based on performance as measured by the eight other EPIs. We do not see value in including in this report other potential EHS indicators (e.g., # of indoor air complaints) which may distract from the chemical waste issues at hand, or the identification of interim objectives and targets which may weigh down this report.
Lessons Learned	EPIs should be carefully selected and allowed to change over the course of a project. It is frustrating to design and implement a continuous improvement system and be unable to discard measurements or reporting requirements that provide little additional value. A project can have too many indicators. In this case, a "summary EPI" provides little value because it weighs all things equally and can not accurately account for priorities, challenges or differences.
Areas of Further Inquiry	A more complete review of the full environmental impacts of laboratory work (including energy use, materials use and water use) would enable the EMP to set broader aspirational goals.

Environmental Performance Indicator (EPI) #9	Project Goal: Record improvement on conformance with the Environmental Management Plan.
Intent	The intent of this EPI was to evaluate laboratory conformance with the EMP. This metric was designed to test certain fundamental underpinnings of this project: (a) better management = improved conformance; (b) more sensible expectations = improved conformance; and (c) internal standards = improved conformance. In 2001/2002, the schools and the regulatory agency stakeholders redesigned the inspection tool so that audit “scores” would be appropriately aligned with key lab issues: (a) chemical container management; (b) housekeeping; (c) pollution prevention; (d) self-inspections; and (e) training and awareness. Where possible, historical inspection records were re-graded based on the new scorecard.
Campus Results 	The second year of audits at UVM showed a 75% increase in the average overall score, with the greatest improvements in housekeeping and pollution prevention. The average score for container management in labs was 1.9 out of a possible 2.0 At BC, audits focused on container management and the variation of scores between science subdisciplines. Scores continued to improve in the chemistry department. Scores at UMass Boston continued to show a steady increase, as seen below in the scores.

Performance: **% Improvement in Total Score (2002 to 2001)**

	UVM	UMB
Housekeeping	200%	12%
Container Management	36%	54%
Training	78%	67%
Pollution Prevention	250%	N/A
Self-Inspections	N/A	39%

Connection to Rulemaking 	The rulemaking references inspections in two locations. Under the Minimum Performance Criteria at 262.104 (e)(4), "containers of laboratory waste must be inspected regulatory (at least annually) to ensure that they meet requirements for container management. The EMP must also include "procedures for regulatory inspecting a laboratory to assess conformance with the requirements of the Environmental Management Plan." As noted previously, we continue to support the use of inspections (see lessons learned) and find the language in the rulemaking to be satisfactory. We do believe, however, that requirements with respect to the minimum performance criteria should be modified. For example, the requirement to identify hazard class should be omitted, as it adds little value to the label and is the source of confusion. Furthermore, we believe that the entire minimum performance criteria could be rewritten in a simpler and more general format, or key elements could simply be incorporated into the requirements of the EMP.
Value of this Metric	We believe that this EPI effectively measures whether behavior change is occurring in the laboratory. The use of this lagging indicator, and the associated checklist, provides a great deal of information that enables EH&S staff to tailor information and training to the needs of the lab community and the institution.
Lessons Learned	Objective audit criteria can provide valuable feedback and management information to the EH&S professional staff and faculty, as well as administration. The highest audit scores generally reflect the most recent priorities. Only time will tell us whether all scores can be maintained at high levels, or whether a cycle of scores increasing/decreasing should be expected. Not all labs are equal in terms of activities and operations. An inspection schedule should prioritize high use or high hazard labs. There are pros and cons to the presence of people in the lab during inspections. For example, container management can be effectively inspected without anyone in the lab. On the other hand, scores for pollution prevention or training are difficult to assess in the absence of people. It is important to coordinate inspections with departments and faculty to ensure that the results can be effectively used and program improvements and corrective actions, as necessary, taken. While inspections are often seen as a nuisance, appropriate inspections can show that we (e.g., EH&S, Dept. Chair) care and that we listen.

Areas of Further Inquiry	None at this time.