

Environment, Health, and Safety Office

The Environment, Health and Safety Office (EHS) is an institutional compliance office as well as a service and operations department. It supports the Institute's environment, health, and safety mission associated with education, research, and the operation of MIT's endeavors in Cambridge, at Lincoln Laboratory, and worldwide.

During the past year, there continued to be a national focus on environment, health, and safety issues at academic institutions. This was the result of several tragedies that occurred at universities in recent years: the death of a laboratory researcher at the University of California, Los Angeles, with subsequent criminal charges settled with the university and principal investigator (PI); the death of an undergraduate student in a departmental machine shop at Yale University; a laboratory explosion and injury to a graduate student at Texas Tech University; a laboratory explosion at the University of Hawaii that resulted in the loss of an arm by a graduate student; the loss, and improper handling, of anthrax at several government and university laboratories. The US Chemical Safety Board released a report and video identifying some of the root causes behind these tragedies and asking universities to review and strengthen their EHS programs. In 2014, the National Academy of Science published a study, *Establishing and Promoting a Culture of Safety in Academic Laboratory Research*, that emphasized the responsibilities of all university community members for the safety and health of their colleagues as well as themselves. In 2016, the Association of Public & Land Grant Universities (APLU) issued a challenge to all university presidents to create and foster a culture of safety on their campuses. In view of these events, EHS has continued its efforts to review and strengthen the Institute's EHS Management System (EHS-MS) with a focus on the 20 recommendations in the APLU report.

To reduce the risks that are inherent to new and innovative research, EHS must be able to guide the Institute in early risk assessments to embed mitigation practices and designs into the research proposals. EHS programs have helped to identify predictive indicators that mean the Institute could be put at risk if the research being assessed is not done carefully, with safety considered early in the planning stages. Over the past few years, for example, there have been significant increases in battery research, which typically uses highly reactive and energetic materials; in the conversion of traditional machine shops to digital fabrication studios (so-called makerspaces) that present new types of hazards to shop users; and in the use of unmanned aerial vehicles (drones). EHS anticipates future advancements in autonomous underwater and on-road, off-road vehicles that will require assessment of the hazards and risks imposed.

EHS has a history of planning for safety by following the scientific literature, tracking what the sources of funding and current research trends are, interacting with the office's peers, and interacting with MIT's leading faculty members. For example, EHS recognized 11 years ago that nanotechnology was a growing area; nine years ago, that synthetic biology was a growing area. In both cases, EHS developed the necessary safeguards before regulatory agencies promulgated rules. More recent trends have seen engineering moving into the biological sciences and undergraduate students conducting more hands-on activities with hazardous materials and equipment. This requires EHS to reevaluate design requirements for engineering facilities and the training needs of engineers and students.

Enabling MIT's Mission

Development of Safety Culture for Laboratories

Laboratories at MIT have unique cultures with one common theme: they are places of academic and research excellence. A subset of this theme of excellence is superior safety performance, although many times this aspect is not explicit. Clarifying the importance of a strong culture supporting safety is important and has been mentioned in at least two departmental visiting committee reports. EHS has launched programs to increase safety performance and cultural awareness, including campaigns, awards, awareness-building events, and a commitment by department, laboratory, and center (DLC) leaders to a high awareness of safety and caring.

Systems Approach

EHS has been exploring a systems approach to laboratory operations and to the link between laboratory quality, productivity, and safety. These management aspects are taught at MIT's Sloan School of Management and EHS is receiving guidance from various Sloan School faculty members. Along with understanding laboratory operations in the context of various systems, EHS sees a strong link between productivity, quality, and safety at MIT and can assist laboratories to increase performance in these areas. EHS is moving from the pilot-testing stage to implementing tools such as "5-S" techniques and application of an "A-3" improvement framework in laboratories and programs at MIT. EHS will increase the number and impact of these programs in the future.

Faculty Members' and Principal Investigators' Responsibilities

In FY2011, EHS began to conduct EHS orientation for new faculty members and PIs. This was later expanded to include an overall EHS presentation and discussion for all faculty. This is an effort to help faculty members understand their EHS responsibilities and become aware of the resources available to assist them. The presentation is made either at departmental faculty meetings or in one-on-one meetings. The orientation has been completed by 183 out of 460 PIs who are working with hazards, according to the EHS Space Registration database. In FY2017, EHS plans to continue this outreach as part of the safety culture initiative.

Emergency Preparedness Planning

In FY2015, EHS made significant strides in verifying that approximately 95% of DLCs have a completed emergency preparedness plan (EPP). EHS used a new model for all-hazards EPPs to be used by DLCs across the Institute in collaboration with the Office of Emergency Management and Business Continuity. The new model involves an all-hazards [emergency preparedness plan template](#) that consolidates evacuation procedures, communications protocols, shelter-in-place measures, and Occupational Safety and Health Administration (OSHA) fire prevention requirements into a five-worksheet Excel document. This is an improvement over conventional EPPs, which tend to be Word documents that are 25 to 30 pages long. The new template has been designed to be imported into a database or web-enabled platform.

Machine Shop Program

The Yale fatality also spurred EHS to do a complete review of the machine shop program. To date, EHS has assessed approximately 70 individual machine shops at the Institute, convened a Machine Shop Safety Forum of machine shop supervisors or representatives that meets quarterly for the past two years to share and review practices and working-alone policies, and successfully completed a shop safety video contest to engage the community about shop safety. EHS documented approximately 643 machine tools and assessed their safety features and identified where improvements were needed (in roughly 80% of them). Upgrades have been completed in 59 shops (578 tools; about 94% complete). EHS expects to complete the remaining three shops (many are small with minimal risk) in FY2017. MIT's executive vice president and treasurer has co-funded these upgrades with the associated departments.

Makerspace

In keeping with MIT's motto, *mens et manus* (mind and hand), several campus initiatives have recently been completed that have advocated for more hands-on learning at MIT (Future of Education) and better access to shops by students during off hours and outside course curricula (Innovation Initiative). These studies, coupled with the exciting new developments in digital fabrication, have led several student groups to gain momentum in their requests for student-run shops. One has been completed in Building 35 for Mechanical Engineering. New House has done considerable work in putting together a governance charter and funding for a space serving three dorms. There are several EHS-related challenges that have to be addressed, including supervision, training, access restrictions, rules on working alone, hours of operation, the design and layout of shop spaces, and the safety features that are needed.

EHS is working closely with Professor Culpepper, the makerspace leader, and his team to develop facility design standards and training programs. The provost announced that this year's incoming freshman class would all be trained to use the makerspace; together, Professor Culpepper and EHS have developed an educational curriculum and assembled a training facility to accomplish this feat.

Comprehensive Laboratory Hazard Assessment

The lack of a comprehensive hazard assessment before starting a procedure has been identified as a cause of tragic incidents that have occurred in universities in recent years. Several programs currently assess a specific hazard in a laboratory, or register or document conditions in the laboratory, or both. However, there is no comprehensive assessment of each laboratory on the basis of the complete information available. Review of specific activities performed in the laboratory typically is limited to required reviews (i.e., biosafety protocol reviews and radiation authorizations). The laboratory hazard assessment (LHA) program that was started in FY2013 was well received and expanded in FY2014 and FY2015. EHS has conducted LHAs in more than 60 PI groups in 12 DLCs to date.

EHS has also reviewed a total of six undergraduate courses. In the coming year, EHS plans to expand the program with more LHAs done in laboratories, including new DLCs, and hopes to have additional DLCs sign up for review of all of their laboratories.

EHS is also working with more of those responsible for undergraduate courses to perform a hazard assessment and develop tools for faculty members to use.

Establish an Accident and Injury Reporting System for Students

In collaboration with MIT Medical, EHS expanded the current system, required by OSHA to document and track employee injuries, to include students. This has allowed EHS to follow up on incidents involving students more thoroughly and to identify trends and opportunities to intervene in activities to eliminate or minimize the risk of accidents and injuries. In FY2013, there were 41 reported incidents. In FY2014, there were 22 reported incidents. In FY2015, there were 19 reported incidents. In FY2016, there were 10 reported incidents.

International Agreements

Two major efforts by EHS this year were to support the Singapore–MIT Alliance for Research and Technology (SMART) and the agreement between the Department of Mechanical Engineering and King Fahd University of Petroleum and Minerals (KFUPM). Support for SMART has focused on implementing the Institute’s EHS-MS for adoption by SMART and providing technical support for some of the more hazardous operations. The EHS collaboration with KFUPM, which was completed, included both help in developing an EHS management system that is consistent with the principles adopted by the Institute’s EHS-MS and the development of EHS training materials that can be used in the KFUPM undergraduate engineering curriculum.

In addition, EHS has provided assistance to other collaborators, including the Masdar Institute Cooperative Program and the Singapore University of Technology and Design. Further, EHS has offered advice to its international colleagues in Japan, Brazil, South Korea, and Turkey who look to MIT as a world-class EHS program.

Laying the Foundation for the Future

Significant Laboratory Design Reviews

EHS has been an active design team member during the programming and schematic design phases of [MIT.nano](#). EHS considerations are significant for this clean-room building, which will have significant effects on campus during construction and significant use of hazardous materials when opened. EHS has been advocating the consolidation of similar research equipment that uses highly toxic gases into the MIT.nano facility so that the expensive engineering controls required for these systems can be shared. Laboratory ventilation, hazardous gas monitoring, chemical storage, hazardous waste handling, and wastewater treatment are just some of the areas addressed. Minimizing community impact during construction is another area of focus.

In FY2015, EHS began a transition to a new organizational structure intended to allow more efficient support of the design review and construction safety process. The addition of two new full-time equivalent employees and the repurposing of some of the time of several current employees to support this function has been completed. In FY2016, Campus Engineering and Construction and EHS finalized the process that is now used to ensure adequate EHS support.

Updating the Master Plan for Campus Waste Water

EHS, Campus Planning, Campus Engineering and Construction, and Utilities Operations worked together on the Notice of Violation for mercury and FY2013's Notice of Noncompliance for copper from the Massachusetts Water Resources Authority. These notices, and future needs for MIT.nano, brought all to agree that a study to update the campus wastewater master plan is necessary and that expansion of the system may well be necessary. This began in FY2015 and is a continuing project.

Integration of Biological and Radiation Protocol and Authorization Processes

Many research governance approvals share an approval route through various Institute committees for biological work, or for working with animals, or for research with humans as experimental subjects. Collaborative efforts, such as common questionnaires or predesigned formats, could enable a laboratory to prepare one set of approval protocols that could satisfy multiple levels of governance. EHS is investigating this potential further.

EHS is continuing a discovery effort this year to determine the feasibility of, and barriers to, automating and integrating the process of approving and authorizing biological research protocols and the use of radiation in MIT laboratories. Hundreds of these approvals are currently managed each year with a largely manual process that costs laboratory personnel significant amounts of time.

Transforming Experiences through Collaboration

eShipGlobal Software Project Pilot

After careful evaluation, EHS believes that eShipGlobal software can simplify the shipping process for the MIT community, reduce overall costs, and enhance compliance for shipping of hazardous materials and export controls. This has been a collaboration between Procurement, Information Services and Technology, the Office of Sponsored Programs (OSP), several DLCs, and EHS. By the end of FY2016, eight DLCs and 384 users had implemented the system; it is expected that eShipGlobal will be fully implemented in all DLCs by the end of FY2017. Goals include increased compliance with US Department of Commerce export restrictions and US Department of Transportation hazardous materials regulations. This system will reduce risk to the Institute. Added benefits are a simplified shipping process and reduced shipping costs.

Chemical Inventory

During the fall of 2012, the EHS Inventory Team spearheaded the process of identifying a new chemical inventory vendor to replace the current centrally provided platform (ChemTracker). The goal for the new platform is to offer a solution that better supports laboratories' need for effective management of their inventories while providing EHS staff with the ability to meet MIT's chemical regulatory reporting and oversight requirements.

Working in close partnership with MIT Sourcing and Procurement, EHS developed the detailed specifications grid, project goals, and platform requirements that were issued to

the seven vendors who were invited to respond to the request for proposal. Stakeholder laboratory personnel from seven key DLCs participated in the vendor review and selection process. EHS secured faculty endorsement FY2015 funding. A vendor (BIOVIA) was selected and implementation is under way. More than 3,000 users were authorized to use the system in 153 PI groups and more than 90,000 individual containers have been uploaded. The goal is to continue implementation through FY2017.

Outreach

EHS has continued its efforts to reach out to key groups at the Institute to communicate emerging EHS issues and obtain feedback regarding barriers they face and how best EHS can help to maintain safe and healthy conditions and compliance with regulations. The approach is to identify people at the Institute who face similar EHS challenges and bring them together periodically to discuss the issues. There are currently five groups meeting at least quarterly: machine shop supervisors, laboratory managers, DLCs' EHS coordinators, Department of Facilities Repair and Maintenance custodial and utilities managers, and DLCs' building and facility managers. These have been very effective in establishing two-way communications and solving difficult problems.

Compliance-Related Activities

EHS assisted Haystack Observatory site personnel with preparations for an inspection from the Massachusetts Department of Environmental Protection (MassDEP), including auditing records, setting up files and a database to track environmental data such as fuel oil usage for fossil-fuel-burning equipment, emergency generators' run times, and hazardous waste shipments. The MassDEP inspection in August 2015 resulted in no findings.

EHS oversaw a compliance assessment of the management of underground storage tanks at the Central Utility Plant. The Central Utility Plant currently has five underground storage tanks for the storage of both #2 diesel and #6 heavy oil. Commonwealth of Massachusetts oversight of underground storage tank management was transferred from the Department of Public Safety to MassDEP in 2015; this transfer resulted in new regulations and increased scrutiny of underground storage tank systems across the commonwealth. EHS partnered with Central Utility Plant personnel and a third-party environmental consultant to conduct the assessment. A final report has been issued and a follow-up action plan developed to address observations and recommendations for achieving compliance with the regulations. EHS assisted Central Utility Plant staff to prepare the required compliance certification filing with MassDEP and coordinated with the Office of the General Counsel to gather self-insurance financial responsibility documentation to be included as part of the submittal.

In preparation for upcoming stricter stormwater regulations, the Department of Facilities and EHS worked to prepare a scope of work and select a consultant to revise the 2000 wastewater master plan for the Cambridge campus. This plan will assess current conditions, define regulatory requirements, and prepare both a draft study and treatment equipment standards and procedures.

The MIT Cambridge campus has an air quality operating permit (Title V permit) from MassDEP. Such a permit is required if the facility is a major source emitter of any criteria pollutant (in this case, nitrogen oxides).

Regulatory Interactions

Regulatory interactions with OSHA included the following:

- In FY2015, OSHA investigated an employee complaint that exposure could occur from exhaust fans located in the fifth-floor mechanical rooms in Building 13. EHS was fined \$5,500 fine for electrical violations and then initiated a major project with facilities to inspect all mechanical spaces on campus and correct any deficiencies. This was completed in FY2016 and OSHA closed the complaint.
- An inspection at New House (Building W70) in FY2015 occurred because of a contractor's accident. Inspection of the facility revealed openings in the electrical panel. This was considered a repeat violation because of the Building 13 inspections. EHS received a fine of \$9,000 and agreed to expand and accelerate the inspection program. This was completed in FY2016 and OSHA closed the complaint.

The Nuclear Regulatory Commission's annual inspection was routine; it resulted in no citations or fines. Cambridge Inspectional Services made its annual inspection of campus buildings. EHS and the Facilities Department are working to correct the 281 findings identified in 250 buildings or spaces inspected.

Accomplishments

During the past year, EHS continued its strong collaboration and service to the Institute through its interactions with faculty, postdoctoral associates, graduate students, and undergraduate students and staff. EHS also collaborated closely with other administrative offices, particularly the Department of Facilities, the Division of Student Life, the Office of Sponsored Research, Sourcing and Procurement, the Office of General Counsel, the Office of Emergency Management and Business Continuity, the Office of Risk Management, the Office of International Agreements, and Information Services and Technology to support their efforts to meet the Institute's mission.

Waste Management Program

The Radiation Protection Program continued the successful implementation of the regulated medical waste management system; the program was extended to all DLCs that generate biologically contaminated waste. There was a 30% increase in the number of requests for waste collection from laboratories. The number of bio burn-boxes collected and shipped for disposal was 11,975. The number of pathological waste burn-boxes generated by the Division of Comparative Medicine increased by 2,209. The number of reusable sharps containers disposed of was 171. All regulated medical waste is shipped to Stericycle, Inc., for processing and final disposal. Most regulated medical waste is transformed into reusable plastic. Pathological waste is incinerated.

The Institute-wide implementation of these biowaste management practices has reduced disposal costs, eliminated 12,000 autoclave cycles per year for in-house waste processing,

and eliminated the time spent by researchers in autoclaving waste. The program continues to be well received by the DLCs. EHS is working with several researchers in the Koch Institute for Integrative Cancer Research to develop an online training video on the handling of regulated medical waste. It should be completed by the third quarter of 2016.

The Radiation Protection Program continued to collect and process low-level radioactive waste collected from radiation laboratories. The total amount of waste managed has remained constant this past year (Figure 1).

Figure 1. Radioactive Waste Disposal, FY2012–2016

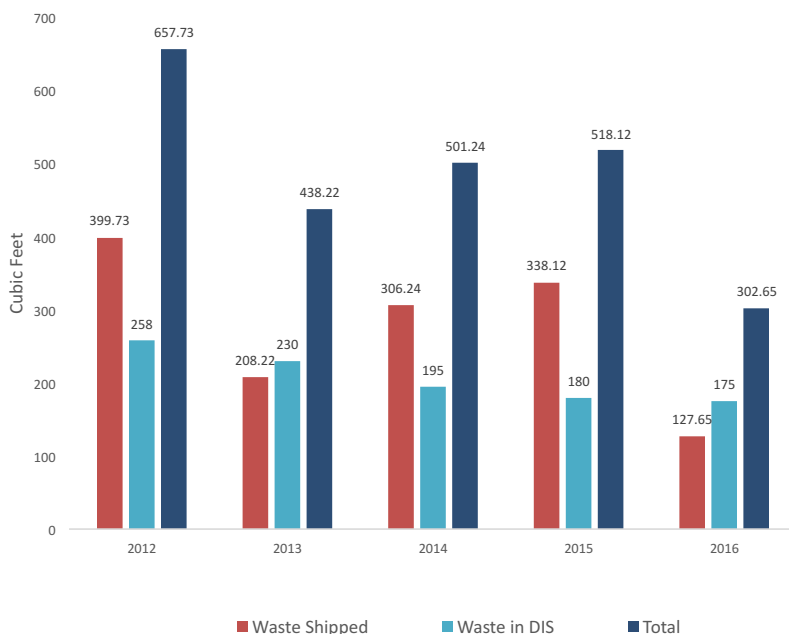
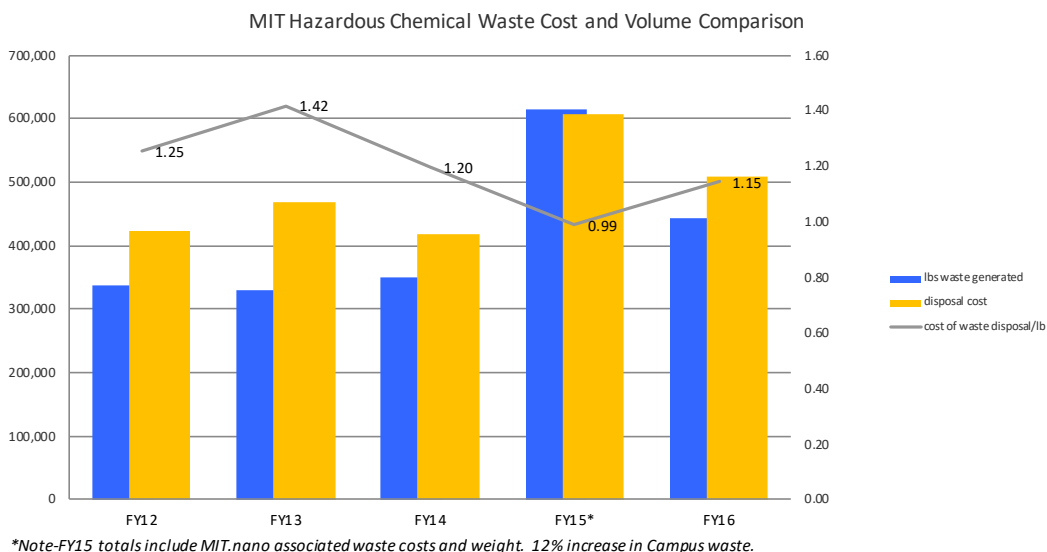


Figure 1. The chart represents the total low-level radioactive waste volumes collected and disposed of over the past six years. Low-level radioactive waste shipped represents dry active waste and liquid scintillation waste contaminated with long half-lived radionuclides. Decay-in-storage waste represents dry active waste and radioactive sharps that were contaminated with short half-lived radionuclides and were managed in-house. (Units are cubic feet.)

Hazardous chemical waste volumes stayed relatively constant over the past five years, even with the increase in research and chemical use. The cost of waste (expressed in dollars per pound of waste disposed of) was reduced from \$1.72 in FY2004 to \$1.15 in FY2016. EHS continues to seek operational changes that will reduce costs and increase legal compliance.

Figure 2. MIT Hazardous Chemical Waste Disposal Cost and Waste Generated, FY2012–FY2016



Training

Development and delivery of EHS training is a major effort; it is a regulatory requirement and, more important, it is a risk-reduction leading indicator. Two new online courses were developed this year—one on static magnet field safety and one on cryogenic safety. This brings the number of EHS’s web-based courses to 22. In FY2017, EHS plans to add at least two more web-based courses.

Overall EHS Training Metrics

Some trends in EHS training are:

- Average EHS classroom attendance for FY2016 was 20 students, compared with 20 students in FY2015, 21 in FY2014, and 19 in FY2013. This is a metric EHS uses to measure the efficiency of delivery.
- The number of total training seats for EHS’s core courses has remained relatively stable, but the number of overall training seats (31,860) has increased by 7% as EHS has added some new courses and conducted outreach to potential users of some of its more narrowly focused courses.
- The percentage of EHS session delivered by web was 33% in FY2016; the average for the past three years was 31%.
- There are no external costs for web course hosting as everything is hosted internally.

Table 1. Training Statistics for Common EHS Courses, FY2012–FY2016

Course	Completion rates (%) and number of total trainees				
	FY2012	FY2013	FY2014	FY2015	FY2016
First-time trainees	1,935	1,683	1,904	2,025	1,953
General Chemical Hygiene and Hazard Communication	97% 4,994	97% 5,741	97% 5,243	98% 5,728	98% 5,684
Lab-Specific Chemical Hygiene and Hazard Communication	88% 3,794	84% 3,236	85% 3,592	85% 3,241	86% 3,282
DLCs: Lab-Specific Training	94% 1,393	87% 1,825	88% 1,508	87% 1,803	88% 1,693
Bloodborne Pathogens	92% 1,461	92% 1,298	93% 1,220	92% 1,292	91% 1,336
General Biosafety	97% 2,626	99% 2,806	97% 3,111	98% 2,814	98% 2,883
Radiation Safety	96% 706	95% 767	95% 765	94% 638	95% 601
Laser Safety	94% 1,091	96% 1,651	94% 1,364	95% 1,535	93% 1,530
Managing Hazardous Waste	91% 5,621	87% 5,219	89% 5,210	90% 5,115	87.5% 4,908
PIs who completed Hazardous Waste Training	75%	67%	77%	73%	76%
Total EHS web and classroom trainings (includes Lincoln Laboratory)	26,796	25,553	29,050	29,883	31,860

Note: EHS believes that all those who need specific training before working with hazardous materials and equipment have completed that training. The data does not reflect those who have left MIT and have not been added to the archive, or those who signed up to take a course out of interest or future need but have not taken it yet.

Injury and Illness Report

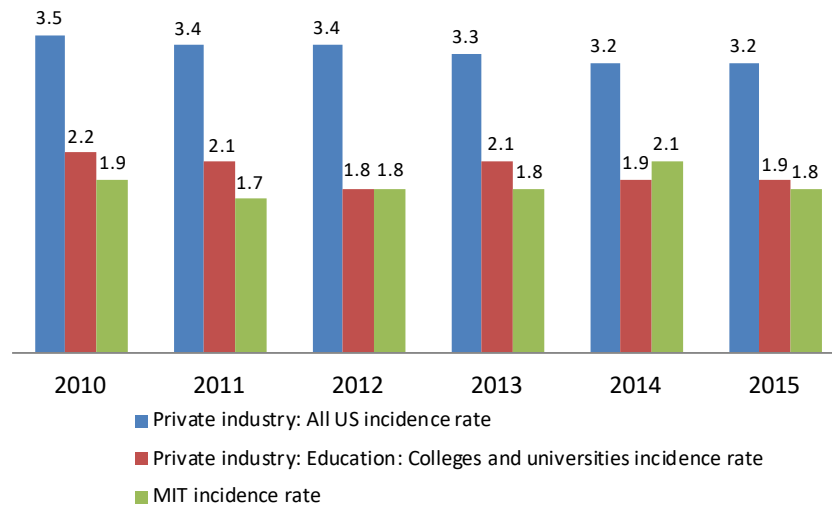
Incident Reporting and Investigations

The EHS Office works with DLCs to use the incident reporting and investigation system, which centralizes and electronically links all information related to an incident. It also provides online access to report injuries to Department of Facilities management, EHS staff, and DLC EHS coordinators.

As of January 1, 2015, OSHA updated the recordkeeping rule, so that in addition to work-related fatalities, employers are required to report all work-related inpatient hospitalizations of one or more employees, all work-related amputations, and all work-related losses of an eye. In 2015, there were two cases that EHS had to report to OSHA. Both cases involved employees who were hospitalized as inpatients overnight.

The incidence rate of total recordable injury and illness cases for calendar year 2015 (1.8) is shown in Figure 3, along with data for the previous five years. This rate is below the calendar year 2014 (latest available data) incidence rate for private industry: education: colleges and universities (1.9) and the all US private industry rate (3.2). The 2015 incident rate is also below the 2014 MIT incident rate that was reported last year. The OSHA recordable incident rate describes the number of employees per 100 full-time employees that have been involved in a recordable injury or illness. Table 2 contains a peer review of MIT's 2015 illness and injury data compared with the most recent Bureau of Labor Statistics data (2015).

Figure 3. OSHA Recordable Incident Rates of Recordable Injuries and Illnesses



Note: The 2015 US private industry rate is the 2014 rate (most recent data).

Table 2. MIT 2015 Injury and Illness Data Compared with 2015 Bureau of Labor Statistics Data

Case type	MIT	Universities, all US
Total rate (total recordable injury and illness cases)	1.8	1.9
Days away rate (cases involving days away from work)	1.1	0.5
Job transfer/restriction rate (cases involving job transfer or restricted work activity)	0.1	0.3
Days away, restricted, and/or transferred rate: (cases involving days away from work, days of restricted work activity, and/or job transfer)	1.2	0.8

Note: The incidence rate of injuries and illnesses is computed from the following formula: number of injuries and illnesses X 200,000/ employee hours worked = incidence rate. The 200,000 hours in the formula represents the equivalent of 100 employees working 40 hours per week, 50 weeks per year, and provides the standard base for the incidence rates.

Following is a breakdown of the top five most commonly recorded incidents at MIT in 2015:

- 25% – Overexertion in carrying, lifting, pushing, or pulling objects (54)
- 19% – Falls (to lower-level stairs and ladders) (41)
- 13% – Injury caused by improper handling of object (27)
- 13% – Struck against or by an object (27)
- 6% – Repetitive motion (14)

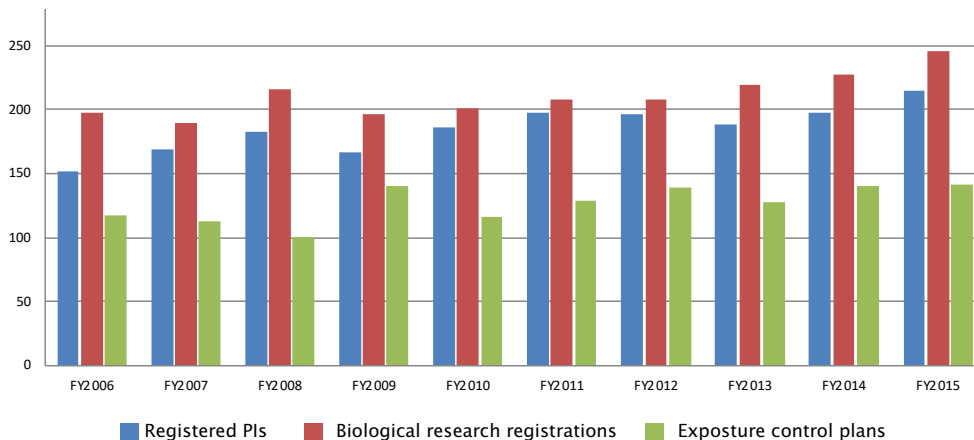
Biological 2015

Increase in Biological Research at MIT

Over the past 15 years, there has been continued growth in the number of faculty members engaged in biological research and participating in the work of the Committee on Assessment of Biohazards and Embryonic Stem Cell Research Oversight (CAB/ESCRO) and in the Biosafety Program (BSP). This growth is a reflection of the increased funding in biological research, the fundamental applicability of ongoing MIT bioresearch, and the use of new technologies in life science research at MIT.

Much of the EHS oversight program is built on the relationship between EHS staff, the PIs, and their laboratory groups. EHS meets with PIs to discuss their research and the risks inherent to the work and procedures, to assist with registrations, to conduct live trainings at laboratory group meetings, and to inspect (and just visit) the laboratories. EHS intends to remain a highly visible and easily approachable resource for researchers.

Figure 4. Volume of Biological Research Registered with the Committee on Assessment of Biohazards and Embryonic Stem Cell Research Oversight, FY2006–FY2016



Another indication of the shift in biological research is the shift in the required containment levels of the biological research done at MIT. The number of biological research registrations (BRRs) considered to be research requiring biosafety level 1 containment measures has dropped as a percentage of the reviewed and approved registrations over the past 14 years. Approximately 65% of the biological research conducted at MIT required the higher biosafety level 2 or biosafety level 2+ containment levels; this is probably because of the large number of laboratories that use human materials and the increase in the number of laboratories using various viral vectors, bacteria, or viruses.

Oversight Programs

CAB/ESCRO Oversight Program

As of April 2013, the NIH Guidelines were amended to extend the purview of all institutional biosafety committees to include responsibility for oversight of research involving synthetic nucleic acids. This was done because of the fast growth in research involving synthetic nucleic acids and the high dual-use potential of this particular area of research, and because, before this change, this research was not within the scope of any federally mandated committee. The Biosafety Program brought synthetic nucleic acid research into the CAB/ESCRO review and approval process some nine years ago, well before the regulations required it. The change in the regulations did not necessitate any changes in the EHS oversight program.

Office of Sponsored Programs Collaboration on Human Embryonic Stem Cell and Induced Pluripotent Stem Cell Research

The BSP within EHS has an effective collaboration with OSP to ensure that copies of all CAB/ESCRO approval letters for use of human embryonic stem cells are sent to OSP as needed. BSP also includes OSP on state and federal assurance letters. Beyond the need to ensure appropriate funding for human embryonic stem cell and induced pluripotent stem cell research, access to the OSP grants database is helpful in understanding future areas of research growth.

Coordination of Research Compliance: CAB/ESCRO, IACUC, and COUHES

All three committees carry federal-level oversight documentation responsibilities, provide assurances to different agencies, and must be registered with those agencies. Their compliance programs involve approvals with various levels of review depending on risk. In several instances, there is overlap in committee responsibilities.

The deputy director of the BSP is the only person who is a voting member of all three committees, and, as a voting member, reviews all research protocols for all three committees. This amounts to review of several thousand protocols per year. It has allowed the deputy director to identify overlapping areas and work with the various committees to have one take primary responsibility for oversight, with the other committees developing mutually supporting policies.

Trends in Biological Research

The recent trend in which nonmicrobiologists work with biological materials has continued to increase. The newest trend in biological research of the past fiscal year was an increase in artists wanting to perform wet laboratory procedures in biology and microbiology. These projects, although generally on the lower end of the spectrum when it comes to biohazards, do present a challenge in that most of these groups are not equipped to perform this work, have little or no previous experience or training in the techniques, and almost all the projects are developed with the goal of public exhibition.

To address some of these challenges, BSP has made efforts to connect artists with trained researchers to build collaborations that offer laboratory space as well as mentorship in development of the project and performance of laboratory techniques. Most research groups use their laboratory space to full capacity, however, and it is often difficult to find laboratories that are willing to share precious space, especially if the research goals are not clearly aligned. Some design groups (e.g., Dr. Neri Oxman, Media Lab) have gone so far as to build their own biological laboratories.

Although this meets the challenge presented by research groups who have to find an appropriate space in which to perform their work safely, it still leaves the challenge of how to ensure that these researchers have the correct level of training to use their new laboratories. When building a special-purpose laboratory is not feasible, BSP has offered laboratory space in Building N52 for short-term projects where biosafety level 1 containment is suitable. The researchers receive hands-on training from BSP staff as needed, in addition to all formal EHS training courses and laboratory-specific training. Development of programs to help train nontraditional wet laboratory researchers will be needed to meet this demand in the future.

Public exhibition of biological projects adds another layer of risk. An exhibition requires the transport of materials, the creation of laboratory-like environments outside the laboratory, and the introduction of a new population (the public) that is less tightly controlled than trained researchers. Risk assessments for the few instances of public exhibition have included a case-by-case analysis of risks and of what might possibly go wrong. MIT Medical and Occupational Medicine Services and the Office of General Counsel are consulted as necessary. Future development of laboratories with glass walls or windows that allow projects to be viewed without having to be transported or involve direct interaction with the public may be a desirable design consideration.

Research Using Radiation-Producing Materials and Equipment

During the past year, the campus, Bates, and reactor radiation protection programs (RPPs) continued their strong presence in the Institute with the continued implementation of numerous service programs and interactions with faculty, postdoctoral associates, students, and staff. RPP staff performed radiation hazard risk analysis for proposed and continuing uses of licensed material and machine-produced radiation in radioactive materials authorization, analytical x-ray machine registration, accelerator registration, experimental use and operations of the MIT research reactor,

laser registration and safety, and radio frequency (RF) source registration and safety. The demand for RPP services remained strong, with an increased need for experimental reviews involving higher-powered laser and RF sources at the Lincoln Laboratory and the Haystack/Millstone Hill Observatory, and routine and nonroutine outages at the nuclear reactor. RPP professionals met with faculty and senior research scientists on approximately 110 different occasions and continued to serve the Institute in leadership positions within the EHS-MS.

RPP continues to provide radiation safety and emergency response training to the Cambridge Police and Fire Departments. RPP also continues the quarterly security and alarm testing program for the four gamma irradiator facilities. RPP works in collaboration with the MIT Police, the Security and Emergency Management Office, and the Facilities Operations Center to manage these secure facilities and implement new federal requirements promulgated this year.

In the ionizing radiation protection programs, RPP staff have worked closely with faculty and staff in the Koch Institute for Integrative Cancer Research and the Whitehead Institute for Biomedical Research to design and implement a new positron emission tomography facility in the Koch Institute's animal facilities. This facility is expected to be used extensively in the coming years. For the Kavli Institute for Astrophysics and Space Research, RPP staff built the radioactive reference sources that are integral to the spectrometer that will be launched into space as part of a landing on an asteroid. There has been an increase in the use of high-energy accelerators in several northwest campus facilities, with the addition of three new accelerators during the past year. RPP worked closely with staff from the Department of Nuclear Science and Engineering and the Plasma Science and Fusion Center in refurbishing the Building NW13 basement accelerator facility with shielding and dose assessment calculations. RPP refurbished the x-ray irradiator system in Building 6-017 for use by the academic community.

The safety culture at the MIT Nuclear Reactor Laboratory continues to be strong. Two safety culture training courses were developed and delivered to the laboratory's staff and users of the facility. The trainings covered basics of safety culture and examples of good and bad safety culture, at MIT and across industry.

As part of its agreement with the US Department of Energy, the Bates Linear Accelerator Center continued its clean-up of those accelerator systems not required for the future Bates mission. The Bates RPP staff assisted in the planning, monitoring, and removal, and the segregation for future disposal, of approximately 150 tons of surplus hardware from these areas. These efforts resulted in an estimated savings of \$200,000 for the laboratory.

Table 3. Radiation Sources Requiring MRCP (Radiation Control Program of Mass), Registration and Approval

Radiation Source or Equipment Program	Number	RPP Requirements
Radioactive Material Authorizations	125	New or biennial review, risk assessment, audit with approval by the RPC. Protocol amendments during renewal periods
Generally Licensed Registrations	10	One-time registration with RPP until source disposal
Generally Licensed Sources (Lincoln Laboratory)	225	Registration with RPP; leased sources require annual exchange with vendor.
Irradiator Registration	36	Registration with RPP and annual review
Analytical X-ray Machines	33	Registration with RPP and MRCP, and annual safety review
Medical and Dental X-ray Machines	6	Registration with MRCP and annual safety review
Accelerators	12	Registration with RPP and MRCP and annual safety review
Lasers (Class 3b and Class 4)	1,500	Registration with RPP and MRCP and annual safety review
RF Sources	30	Registration with RPP and annual safety review
Magnets	40	Registration with RPP and annual safety review

Note: Authorizations and approvals require a risk assessment, experimental review, completions of radiation safety training and routine inspections by the RPP.

Major Initiatives for FY2017

- Review and assess the EHS-MS with respect to the APLU report.
- Support the dramatic increase in design and construction projects.
- Complete the rollout of the eShipGlobal Program.
- Continue to roll out the Chemical Inventory Program.
- Increase support to Lincoln Laboratory and other offsite facilities.
- Develop new and update existing EHS training courses.
- Develop and communicate standard operating procedures; this includes streamlining existing documents and developing new laboratory safety procedures.
- Support the increased requirement by funding agencies for EHS review and input into funding proposals.
- Assess EHS requirements for international campus activities.

- Develop talent management roadmaps to support the staff's professional development.
- Develop new initiatives to enhance and add to MIT's culture of safety.
- Develop capability to develop new ideas and innovate present EHS programs.
- Continue and expand engagement with groups who have similar responsibilities within the DLCs, including machine shop supervisors, laboratory managers, facility managers, DLC EHS representatives, and student groups.
- Develop and implement an unmanned aerial vehicle program.
- Assist the Institute in implementing a makerspace program.
- Investigate the risk of field work conducted by MIT personnel.
- Enhance the Emergency Preparedness and Response Program.

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