

**ISO 14001 ENVIRONMENTAL MANAGEMENT SYSTEMS
IMPLEMENTATION PROJECT: CHEMISTRY DEPARTMENT
MAY 7, 2013**

**TEXAS A&M UNIVERSITY - CORPUS CHRISTI
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Executive Summary

In January 2013, an Environmental Management System (EMS) implementation project was initiated for Texas A&M University - Corpus Christi (TAMUCC) for the Chemistry Department. The EMS was developed in congruence with ISO 14001 and the University's Environmental Policy statement. A top priority of the Environmental Health and Safety Department's EMS Advisory Team has been to provide recommendations for the improvement of the environmental quality within the University's Chemistry Department. Based on initial assessments, the introduction of an EMS will be vastly beneficial to the environmental performance of the department and their operating and management efficiencies as 26 activities have been identified. The highest ranking environmental aspects were developed to improve issues with protocols and the generation, storage, and disposal of solid wastes and hazardous substances. Recommendations in this report address all of these concerns to promote an increased environmental awareness and performance.

1.0 Purpose and Scope of Environmental Management System (EMS)

1.1 Purpose

The purpose of an EMS is to achieve environmental excellence by assessing and controlling the impacts of activities on the environment. This EMS is the initial and benchmarking foundation of a cycle of continuous environmental improvement to progress Texas A&M University - Corpus Christi (TAMUCC) towards mitigating its significant environmental aspects. This annual summary will provide a roadmap for year to year changes in the significant aspects, objectives, and targets tracked by the TAMUCC EMS Advisory Team. An EMS Advisory Team, functioning as consultants to the TAMUCC Environmental Health and Safety Department, assists a University Department in improving its performance by recommending environmental goals. This provides consistency, continuity, and connectivity between objectives and targets for the previous, current, and upcoming years.

1.2 Scope

In 2012, an important environmental change occurred within the Texas A&M University System. All campuses were mandated to develop EMS programs. EMS was to be used as a platform for Site Sustainability Plan (SSP) implementation and for programs with objectives and measurable targets that contribute to the University meeting its sustainability goals. At TAMUCC, President Killebrew developed an environmental policy consistent with the Texas A&M System's goals. The intent is to execute an Environmental Management System utilizing the Environmental Health and Safety (EHS) Department's expertise in implementing, supporting, reviewing, and auditing departments throughout the University.

In creating an EMS, all departments within the University's property boundary must be evaluated. The University's property occupies all of Ward Island (Figure 1) and includes but is not limited to the following buildings/services: research laboratories, conference centers, art studios, cafeterias, student housing, power plants, sports facilities, fleet maintenance, incineration, wastewater treatment, construction, demolition, grounds maintenance, and drinking water supply. Other University owned properties include the Momentum Campus, the Flour Bluff Center, the Corpus Christi Art Museum, the Garcia Center, and Hamlin Center.



Figure 1. TAMUCC Campus Map

The overall goal for the University is to have the EMS implemented campus-wide. It has been determined by the EMS Advisory Team that the EMS implementation will be completed in phases. In the current phase, the project's fenceline will be the *Chemistry Department*. While the department is centrally located in the *Center for the Sciences (CS)* building, it controls several labs and offices in the *Center for Instruction (CI)*, *Carlos Truan Natural Resources Center (NRC)*, and *Harte Research Institute (HRI)* buildings (see Appendix).

2.0 Procedures

2.1 Background

In 2012, an Environmental Management System (EMS) implementation project was initiated for Texas A&M University - Corpus Christi. The EMS was developed in accordance with an ISO 14001 foundation and the University's Environmental Policy statement as the underpinning edict.

The first phase of implementation in 2012 involved five departments at the University: the *Motor Pool*; *Purchasing, Receiving, and Shipping*; the *University Police Department*; *Printing Services*; and the *Boat Barn*. In 2013, a review of the initial implementation was conducted as well as further implementation of the EMS into the *Chemistry Department*. As in 2012, environmental aspects, impacts, objectives, and targets were set based on a risk-ranking matrix to initiate the EMS process within the *Chemistry Department* (see Figure 2).

2.2 Implementation Procedures

Designing and implementing an EMS to conform to the Environmental Policy of the University and the Texas A&M System called for a project-oriented approach. This type of approach was determined to function best as a group effort. A new EMS Advisory Team was developed in 2013 to review the program established in 2012 and to develop a preliminary EMS for the TAMUCC Chemistry Department. Project tasks were divided among the EMS Advisory team members. Tasks were carried out on a weekly basis. Assigned tasks were then reviewed the following week by the Team and further implementation tasks were subsequently assigned.

2.3 Environmental Policy

TAMUCC's Environmental Policy was developed on August 1, 2007 by the TAMUCC Environmental Advisory

Council. The policy was signed and approved by Dr. Flavius Killebrew, TAMUCC President, on December 12, 2012. The policy is intended to follow all of the required elements of what is specified within ISO 14001. The EMS Advisory Team provided a copy of the environmental policy to the Chemistry Department Chair and appropriate personnel within the department. The policy will be reviewed with the department at a minimum of once a year by the EHS Department and/or subsequent EMS Teams.

2.4 Structures, Roles, and Responsibilities

Dr. Eugene Billiot is the Chemistry Department Chairman. His role is to provide top management oversight to the Chemistry Department. Gaylen Nuckols, who reports to Dr. Billiot, serves as the Environmental Management Representative (EMR). This role was assigned during the development of the EMS in February 2013. It is important for the EMR to be knowledgeable about the laboratories, chemical storage, and other Chemistry related matters.

2.5 Evaluation of Environmental Aspects and Impacts

The EMS Advisory Team conducted an initial review of all aspects and impacts with the Chemistry Department. The Team utilized a standardized risk-ranking matrix provided via Intellex by the Texas A&M University System. Each aspect was ranked based on seven factors: severity of the impact, scale of the impact, frequency, worker exposure, practicability, mitigation cost/benefit, and legal (Figure 2). The standardized risk-ranking matrix assigns weights to each category. Aspects are weighted for each factor with a maximum score of 5. Aspects are ranked to assist in determining the most significant impacts, and to evaluate areas where the most environmental improvement could be accomplished. The EMS Advisory Team assigned the threshold value to be set at 3.2. This value was determined based on overall ranking of all items and developing an initial plan that would be feasible for the Chemistry Department to undertake. A list including aspects, impacts, and overall scores was developed and provided to the TAMUCC EHS Department for inclusion into Intellex.

Scale	Severity of Impact 'A'	Scale of Impact 'B'	Frequency 'C'	Worker Exposure 'D'	Practicability 'E'	Mitigation Cost/Benefit * 'F'	Legal 'G'
weight factor	0.15	0.15	0.15	0.15	0.10	0.15	0.15
1	Trivial, impact likely to reverse itself naturally	Impact only felt at small controlled area	Occurs rarely, if ever	No risk to health	Impossible or impractical to implement	cost prohibitive; can't change; no payback	Unregulated
2	Small, impact reversible w/ minor effort	Impact felt in small area and immediate vicinity	Occurs yearly	Minor risk to worker health; short term irritation, no permanent affects	Difficult to implement	high cost; long or questionable return on investment (>10 yr)	Unregulated but University/Agency Policy
3	Moderate, impact reversible w/ moderate effort	Impact felt in a large area within the fenceline	Occurs monthly	Moderate risk to worker health from short or long-term exposure	Hard but not unreasonable to implement	moderate cost; difficult to afford; fair return on investment (>5 yr)	Likely to be regulated in the future
4	Large, impact reversible w/ substantial effort	Impact felt within all fenceline	Occurs weekly	Risk to worker health from long-term exposure w/out proper precautions	Can be implemented w/ minimal to moderate effort	moderate cost, affordable; good return on investment (2-5 yr)	Regulated
5	Very large, impact irreversible	Impact felt within all fenceline and beyond the fenceline.	Occurs daily	Immediately dangerous to life and health w/out proper precautions	Easy to implement	low cost; rapid return on investment (<2 yr)	Specific University/Agency permit restriction

* This factor can include lifecycle cost analysis, payback period, relative efficiency gain, and material life expectancy

Figure 2: Risk Ranking Matrix

2.6 Checking and Corrective Action

Any student, faculty, or staff may request a Corrective Action Notice (CAN) or Preventive Action Notice (PAN). The person requesting a CAN or PAN is responsible for bringing the issue to the attention of the Environmental Management Representative (EMR). The EMR is subsequently responsible for investigating the notice and determining the appropriate action. Responsibility for resolving the problem is assigned to a specific individual or individuals.

2.7 Management Review

A successful EMS is one in which those in leadership positions promote positive environmental awareness that permeates throughout the department. Several protocols already exist in the Chemistry Department that encourage environmental stewardship. A review of these existing protocols would benefit the environmental performance of the department. A role of the EMR is to communicate with the Chemistry Department Chair and provide feedback on the status of environmental progress.

3.0 Environmental Aspects and Impacts

3.1 Administrative Procedures

3.1.1 Protocols

The primary goal, with a significance score of 4.1 out of 5, is implementing pre-existing protocols. Protocols are in place for clothing requirements in labs, the use of vent hoods, the incorrect disposal of hazardous substances, and documented end-of-day safety and security checks. Inspections conducted prior to each lab session, will increase safety and financial savings for the department by ensuring all functions of the lab are in proper working order. On the scale of practicability, protocols are easy to implement as they are pre-existing.

3.3.2 Paper Consumption

Paper consumption was ranked as a significant aspect with a score of 3.5 out of 5. Currently, paper is consumed daily to provide lab manuals, handouts, and tests to students. Switching to electronic devices, a plan currently underway, will combat paper consumption. Posting files and handouts on Blackboard will give the students the ability to print them out if they chose, but only if conducive to their learning. The reduction of paper can be easily implemented and will decrease the amount of waste generated.

3.2 Facility Activities

3.2.1 Solid Waste

Solid waste was ranked as a significant aspect with a score of 3.75 out of 5. The Chemistry Department purchases disposable items that are used once and thrown away. The EMS Advisory Team was not informed of quantities of disposable equipment purchased, but this should be determined and monitored annually. The measurable reduction of disposable equipment use will save money for the Chemistry Department while decreasing the amount of solid waste.

3.2.2 Electricity Use

Electricity use was ranked as a significant aspect with a score of 3.35 out of 5. The potential impact of electricity use is resource consumption contributing to air pollution and global warming. Conservation of electricity is easily implemented by turning off lights in laboratories and shutting down/unplugging equipment when not in use. This is a low cost, rapid return on investment, that will save the Chemistry Department money and reduce environmental impacts.

3.3 Research/Teaching Activities

3.3.1 Emission of Vapors

The emission of vapors was ranked as a significant aspect with a score of 3.5 out of 5. Vapors derived from volatile chemicals that are used for research and other laboratory activities may lead to air contamination, typically limited to the lab room and the area in close vicinity. The impact frequency from this aspect is daily and worker exposure poses minor risk to health and short term irritation with no permanent effects. Proper handling of chemicals to reduce emissions of vapors, such as the utilization of vent hoods, will aid in decreasing air contamination. The introduction of small, portable vent hoods is a positive contribution already in place to reduce emissions, and should be utilized on a regular basis for experiments that produce vapors.

3.3.2 Chemical Life-cycle Management

Chemical life-cycle management was ranked as a significant aspect with a score of 3.65 out of 5. This aspect involves teaching staff and students about management of chemical use. The potential positive impact of this aspect is the conservation of nonrenewable resources. Hazardous Waste Operations and Emergency Response (HAZWOPER) training on proper chemical management to appropriate faculty and staff would allow improved conservation and handling methods in the department.

3.3.3 Hazardous Waste into Sinks - Education/Outreach

The environmental aspect, Hazardous Wastes into Sinks – Education/Outreach, was ranked with a score of 3.5 out of 5. Inconsistencies have been noted as to whether or not disposing of neutralized chemicals down laboratory sinks is an acceptable practice. The potential impact is determined as negative if inconsistencies continue due to lack of education/outreach. The impact is contamination of surface water due to potentially incorrect disposal procedures. Actions to clarify appropriate methods for disposal of hazardous waste would benefit the environment.

4.0 Development of Objectives and Targets

4.1 Background

Objectives and targets were developed by the EMS Advisory Team for each of the significant aspects. A list of objectives and targets were developed and has been provided to the TAMUCC EHS Department. It should be noted that the EMS Team did not conduct a measurement relating to the actual consumption rates for each of the significant aspects identified. Objectives were based on an assumption of current usage and a review of the actual usage should be determined before the objectives are finalized. The objective completion dates are recommendations made by the EMS Team and should also be reviewed for practical implementation timeframes.

4.2 Administrative Procedures

4.2.1 Protocols

After significant consultation with the Chemistry Department leadership and staff, and based on the significant aspects previously identified, the Team has recommended the following objectives for the Chemistry Department Administration:

- Implement previously developed lab and staff protocols regarding hazardous substance disposal and storage by May 2014. Assess progress quarterly.
- Require all Chemistry lab coordinators attend 40-hour HAZWOPER and annual refresher training by May 2014.
- Conduct a Management Review meeting at the beginning of the Fall and Spring academic semesters.

Meetings should address suitability, adequacy, and effectiveness of the EMS; status of corrective and preventive actions; results of any EMS audits conducted since the last Management Review meeting; suitability, adequacy and effectiveness of training efforts; and results of any action items from the previous Management Review meeting. The EMS Advisory Team will meet with the EMR and Chemistry Department management on a yearly basis.

4.2.2 Paper Consumption

Based on the significant aspects previously identified the Team has recommended the following objectives for the Chemistry Department Administration:

- Reduce paper consumption by 10%.
- Purchase 125 tablet computers for lab use within the next academic year. This will aid the Chemistry Department in meeting their established paper reduction goal.

4.3 Facility Activities

4.3.1 Solid Waste

Based on the significant aspects previously identified, the Team has recommended the following objectives for the facility activity within the fenceline:

- Decrease solid waste generation by 5%.
- Purchase reusable or recyclable items for lab use as needed.

4.3.2 Electricity

Based on the significant aspects previously identified, the Team has recommended the following objective for facility activity within the fenceline:

- Decrease electricity use by 5%.

4.4 Research/ Teaching Activities

4.4.1 Emissions of Vapors

Based on the significant aspects previously identified, the Team has recommended the following objectives for Researchers/Teachers:

- Reduce emission of vapors into the environment by implementing protocols to use vent hoods during all experiments that emit noxious vapors or fumes.
- Test vent hoods to determine functionality prior to the start of each Fall and Spring semester.

4.4.2 Chemical Life-cycle Management

Based on the significant aspects previously identified, the Team has recommended the following objectives for Researchers/Teachers:

- Incorporate Environmental Education into the Safety PowerPoint at the start of each semester.
- Fully implement and maintain tracking procedures for all chemicals with the newly developed barcode system.

4.4.3 Hazardous Wastes into Sinks

Based on the significant aspects previously identified, the Team has developed the following objectives for Researchers/Teachers:

- Incorporate Environmental Education into the Safety PowerPoint at the start of each semester.
- Eliminate any hazardous substances from being poured into sinks. Implement established alternative procedures.

5.0 Summary

An EMS Advisory Team was established to assist the Chemistry Department in identifying environmental activities, aspects, impacts, objectives, and targets. Recommendations were developed to reduce the environmental harms caused by the Chemistry Department inside and outside their fence line. The fence line includes all Chemistry Department classrooms, labs, and storage locations under the purview of the Department Chair.

The EMS Advisory Team discovered several areas of opportunity for environmental performance improvement such as resource consumption, protocol implementation, and environmental education. In the past, the Chemistry Department lacked organization and control of the chemical inventory. Presently, the primary concern is to reorganize and inventory all chemicals within the Chemistry Department. This massive, time consuming task is in progress with the installation of a new barcode tracking system. Due to a lack of personnel available to work on the project, the task will take a significant amount of time to implement unless new staff or fully qualified graduate-level students are hired to assist.

With the support of top management within the department, a champion for the environment to lead the way, additional personnel employed to ensure protocols are followed, inventory control maintenance, and hazardous waste minimization, the implementation of an EMS in the Chemistry Department will prove to be an effective means of reducing the environmental impacts determined by the EMS Advisory Team.

6.0 Recommendations

6.1 Administration

Recommendations for the Chemistry Department's administration include providing 40-hour HAZWOPER training for all chemistry lab coordinators. As of now, only one chemistry lab coordinator has the HAZWOPER certification and the training of the second coordinator will be beneficial to the department. Additional encouragement and communication from the University's Environmental, Health, and Safety Department (EHS) is recommended for continual progress to be made towards environmental targets. This can be achieved through quarterly monitoring by EHS.

The EMS Advisory Team encourages the in-progress plan of purchasing 125 more tablets for use in teaching laboratories. The intended purpose of the tablet purchase is to deter cheating, but would subsequently reduce the amount of paper used significantly. Students will use the tablets to take quizzes and will have electronic versions of lab manuals. For the paper that is used, it is recommended that recycling bins be placed in classrooms and labs and used for all paper products.

6.2 Faculty & Staff

The Texas A&M System's commitment to the implementation of and conformance to the EMS program is extensive, and promotes training sessions at the base level. In April 2013, the Texas A&M System Environmental Manager led a chemical waste seminar at TAMUCC; all of the Chemistry Department's in the System attended this training except representatives from the TAMUCC Chemistry Department. The faculty of the Chemistry Department would benefit from receiving a review of environmental regulations and the effects of the Chemistry Department's activities on the environment. It is also recommended that the faculty continue to review the academic laboratory procedures in addition to the general chemistry labs that have already been started. The review aims to ensure that lab procedures produce minimal amounts of hazardous waste during experiments. The EMS Advisory Team also recommends that environmental issues be brought up at department meetings at least once a semester to encourage involvement from the faculty in achieving

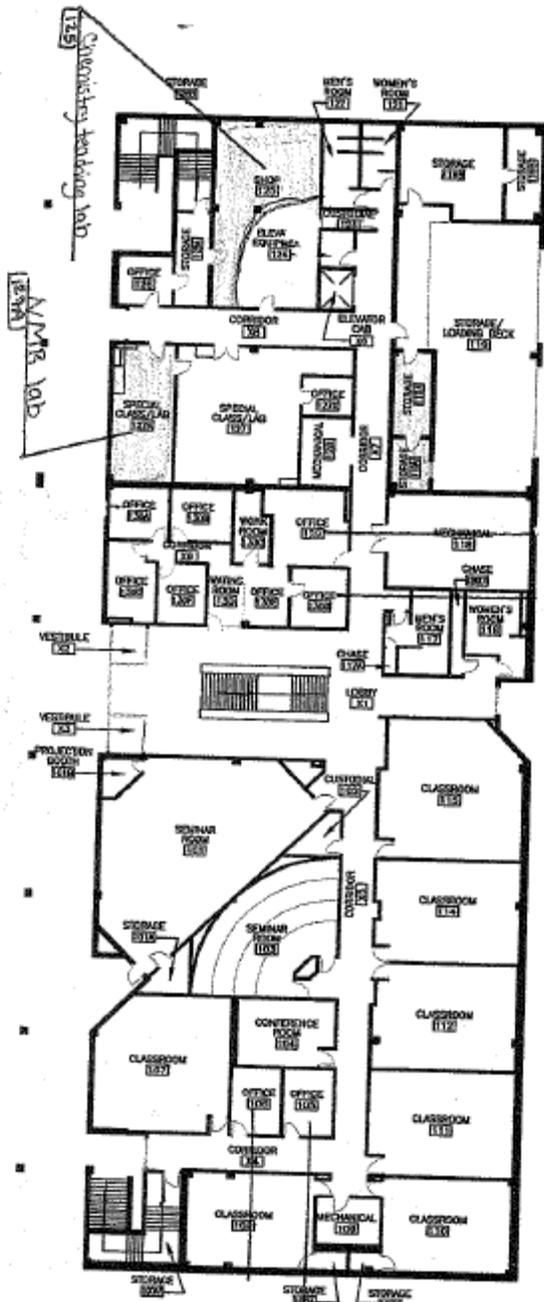
environmental goals and targets. The dedication of additional personnel resources to chemical supply and resource management, and compliance with internal policies would be beneficial to the economic and environmental sustainability of the program. Assistance is greatly needed in monitoring students' hazardous waste generation, storage, and disposal.

6.3 Research/Teaching

It is recommended that environmental education be incorporated into the Safety PowerPoint presented to students at the beginning of the semester. By encouraging environmental friendliness at their level, it is more likely the students will abide by waste storage and disposal protocols. Environmental education should include the affects of the chemicals used during the laboratory experiments on the environment and an overview of the regulations that govern such actions. Recommendations for the reduction of electricity used include turning off the lights and unplugging equipment when not in use. The lights that remain on for safety and security purposes do consume energy, but the EMS Advisory Team determined that the safety factor involved in keeping certain lights on outweighs environmental necessity.

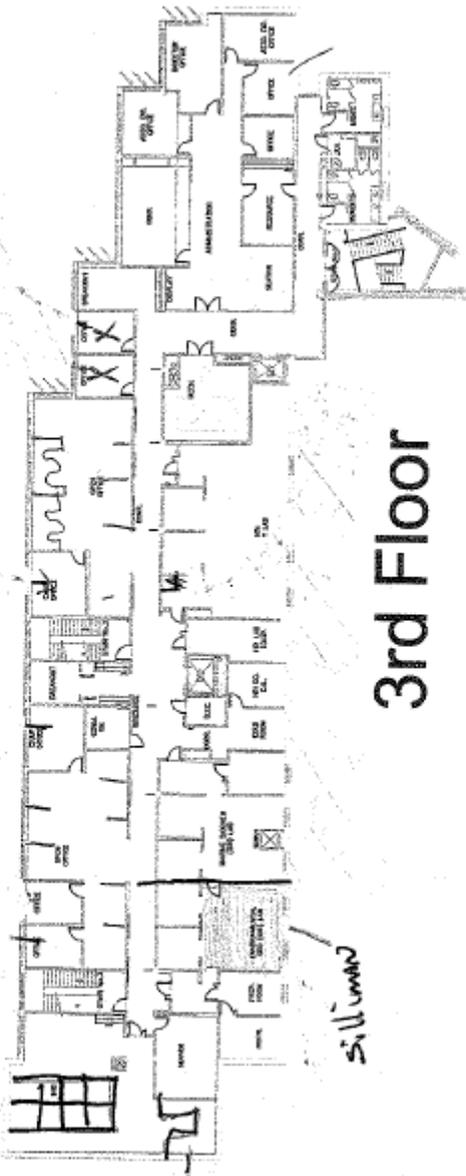
Appendix: Fence-line Schematics

Center for the Sciences: First Floor



2
FIRST FLOOR
SCALE: 1"=30'-0"

Harte Research Institute: Third Floor



3rd Floor

HRI