PROCESS WASTE ASSESSMENTS FOR THE EVALUATION OF WASTE MINIMIZATION TECHNOLOGIES

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ABSTRACT

In order to implement a cohesive waste minimization plan, it is important to have an initial assessment of the various waste streams at the facility. At a facility such as Los Alamos National Laboratory (LANL) where the waste streams typically are small but diverse, the best assessments would be done by the generators of the waste streams since they are, in most instances, the only people who have the process knowledge necessary to make a thorough assessment. Software developed at LANL will help waste generators make waste assessments and evaluate potential waste minimization technologies. Included in the assessments are a complete mass balance to ensure that the process is being modeled completely; a trackable history of selected wastes (graphically displayed); cost, energy, and manpower considerations such as hours worked or hazardous exposures. The system also provides the opportunity to evaluate potential waste minimization solutions (either through a Best Available Technologies database or through graphical input) and determine any downstream ramifications of implementing these solutions. The software used to implement these assessments will be discussed along with practical considerations and results of testing performed at selected Laboratory facilities.

INTRODUCTION

In the last several years, waste minimization and pollution prevention have become part of the national vernacular. As more people are becoming aware of waste minimization as a solution to the generation of large quantities of hazardous and radioactive wastes, the need to assess and evaluate waste streams for waste minimization opportunities has become increasingly more important. The approaches to making waste minimization assessments depend greatly on the size and scope of the waste stream as well as the degree of regularity in waste generation. Production facilities that generate the same wastes on a regular schedule can assemble a team of technical personnel with the necessary knowledge-of-process to perform the process waste assessments and make the important waste minimization decisions based upon the assessments. However, laboratory facilities do not typically have the type of process waste streams for which external audits would be productive. In order to obtain useful waste assessments that can be used to help evaluate waste minimization opportunities at laboratory facilities, work has been ongoing at Los Alamos National Laboratory to develop a user-friendly program that will allow waste coordinators (vide infra) and/or waste generators to perform self-assessments on their individual waste streams.

At Los Alamos National Laboratory, each waste-generating group assigns one or several waste coordinators whose primary responsibility is the oversight of storage and disposal of waste from their facilities. They also are instrumental in developing waste minimization programs for their groups. As part of this function, training for the use of the waste assessment software will be concentrated on waste coordinators. There will also be data entry supplied by various waste generators at Los Alamos depending upon the volume and type of waste stream being addressed.

Los Alamos National Laboratory developed the model under funding from DOE-Albuquerque initially to model the Rocky Flats Plant production processes. Since the initial effort, the model has been extended to DOE's Pantex facility to study material flows and processing. Los Alamos National Laboratory is also starting several projects with New Mexico industrial partners to use the code to model electroplating processes and a green field electronics manufacturing facility which will be built in New Mexico.

The program defines locations, process steps, equipment, and the relationships between them. Mass balance is one of the requirements for the equipment definitions. This ensures that the complete waste stream (comprised of the defined equipment as well as locations and process steps) also maintains mass balance. The generation of the model waste stream with these features dramatically helps the waste coordinator and the waste generator (who ultimately is responsible for waste minimization) to gain the knowledge-of-process needed to make the waste minimization decisions. Once the model has been generated, the program user can then modify the process with newly defined equipment and/or process steps and monitor the degree of waste minimization that would be attained if the new process were to be implemented. The program will also track other important variables such as cost, energy consumption, and radiation exposure which should also be included in waste minimization assessments since it is the overall efficiency of the process that needs to be addressed.

Since laboratory-type waste streams are often quite diverse in terms of volume as well as constituents, the level of detail needed to properly model these waste streams should be flexible as long as the integrity of the self-assessment program is maintained. The program being developed at Los Alamos allows the waste coordinator or waste generator to control the level of detail and the manner in which the waste stream is modeled. This greatly helps waste generators make some of the initial decisions regarding waste minimization opportunities. For example, if a certain procedure for cleaning equipment is always being used, it probably would not be necessary to model every step in that cleaning process for all applications. Therefore, the entire cleaning operation (perhaps comprising many individual steps) could be modeled as one large process. The program also allows for the program user to change the level of detail from specific to general or vice versa as needs warrant. This feature would be helpful if environmental reports that require a certain degree of consistency (such as air emissions or liquid discharge) are requested of the waste coordinators.

PROJECT STATUS

The project has been divided into eight major steps:

1. Development of code,
2. Testing of code at selected sites,
3. Evaluation of test results,
   a. Success of code,
   b. Comparison with other pertinent data,
4. Modification of code based on test results,
5. Training of waste coordinators,
6. Maintaining program (consulting, etc.),
7. Compiling information from waste coordinators,
8. Generating Laboratory-wide waste assessment reports.

Development of Code

The software is primarily comprised of three components: the program, the interface, and the database. The program being used is written in common LISP language. A graphical interface package, INFOCAD, will be implemented to allow the program to be more user-friendly. Other interface packages will be developed as needed. Databases such as ORACLE will be used to compile data from the program and generate standard reports for waste minimization activity or other environmental reporting requirements. Prioritization algorithms are being developed to weight various waste minimization options if more than one scenario is being considered. The program runs on SUN workstations, McIntosh's, and PC's.

Testing of Code at Selected Sites

Selected sites have been chosen at the Laboratory to test the program. These sites contain a variety of waste streams with many processes involved in the generation of hazardous, radioactive, and mixed wastes. Waste coordinators at these sites are being trained on the purpose and scope of the waste assessments as well as the utilization of the program to perform the assessments and the eventual evaluations of waste minimization technologies. The test sites include electroplating and metal finishing facilities.

Evaluation of Test Results

The testing phase consists of several components: 1) success of the code in properly modeling laboratory-type waste streams, and 2) comparison with other pertinent data. The success of the code will be based on both the accuracy in modeling the various waste streams and the user-friendliness of the program as determined by waste coordinators and waste generators. Comparisons with other data will concentrate on waste tracking information that is currently maintained by the waste management facility at Los Alamos and chemical tracking information which will be primarily used for inventory control. These tracking systems only monitor either waste volumes or types or chemical storage information (as opposed to process flow information) and therefore are not sufficient for waste assessments and evaluations for waste minimization.

Modification of Code Based on Test Results

Based on the testing data, modifications to the program and interface will be made. These modifications will include generation of ad hoc reports from graphical displays, improved connectivity between various equipment in a particular waste-generating process, and graphical tracking of particular components of a waste stream.

Training of Waste Coordinators

During the testing and modification phases, waste coordinators at the Laboratory will be notified as to the progress in program development. Once the testing and modification phases are complete, waste coordinators will be trained as to the use of the program and the type of assessments that would result in waste minimization opportunity. Documentation of assessments and evaluations will also be discussed as well as future environmental reporting requirements that could be handled by the application of this program.

Maintaining Program

The program and database will be maintained by Laboratory personnel both in terms of software and hardware maintenance and consultation with Laboratory waste coordinators. A BAT (Best Available Technology) database will be provided to allow program users to access new waste minimization technology information and assess these new technologies as part of their waste-generating processes. Ratings of these new technologies will be determined and evaluated for waste minimization potential. Factors such as cost and potential risk to human health or the environment will be weighted as part of the waste assessment process. Periodic reviews of the utilization of the program will be performed to ensure that the program is being used to its maximum efficiency.

Compiling Information From Waste Coordinators

At regular intervals (monthly, quarterly, etc.) data will be compiled by the Los Alamos National Laboratory Waste Minimization Program Office. This data will include a graphical representation of the waste streams being modeled as well as evaluations of potential waste minimization solutions. Recommendations from the Waste Minimization Program Office will be made to waste coordinators when appropriate. Comparisons will be made between various Laboratory waste stream models as well as between the data collected through these assessments and waste tracking data. Potential improvements in the use of the program as determined by evaluating the general success in waste assessments will be presented to waste coordinators.

Generating Laboratory-Wide Waste Assessment Reports

Once the data have been compiled and evaluated, Laboratory-wide waste assessment reports will be available to internal and external readers. Periodic reports will be submitted to DOE for review.

CONCLUSION

The approach being taken at Los Alamos National Laboratory to comply with the Department of Energy regarding Process Waste Assessments involves the use of a user-friendly program and database that will allow waste coordinators and waste generators to perform self-assessments of their particular waste streams. This program will help waste generators acquire knowledge-of-process which is becoming increasingly important in environmental awareness programs. The database will allow a greater degree of flexibility both in terms of level of detail needed for a successful model and also in

terms of modifying the model to account for major changes in waste streams that typically occur at the Laboratory. It will also be used to evaluate potential waste minimization opportunities before major investments would usually be made. This program can also be used to comply with new environmental reporting requirements dealing with various aspects of waste characterization. Overall, this user-friendly approach to waste assessments should provide more benefit to those who inevitably have the task of modifying their processes in order to address waste minimization concerns than other standard approaches would provide.