PERSONAL COMPUTER INTEGRATED PROGRAMS - EFFECTIVE TOOLS FOR PLANNING COMPREHENSIVE RADIOLOGICAL SURVEYS

Fred F. Haywood
Eberline Analytical Corporation

Radioactive material processing facilities now abandoned or placed on inactive standby require periodic maintenance and surveillance. Institutional arrangements frequently become ineffective and result in the migration of radioactive materials to areas beyond site boundaries. In order to comply with current regulations regarding environmental degradation, various response actions are available to correct and limit future migration. Decisions on specific remedial measures must be based on sound engineering evaluations. In addition to site specific physical features, these engineering studies require, as input, a thorough description of the areal distribution of radioactivity outside site boundaries as well as a description of the radioactive source term. These data can only be obtained through the completion of a comprehensive radiological survey of facility (and vicinity) grounds, buildings, process equipment, sewers, sumps, tanks, drains, and facilities used to handle and store residual radioactive wastes. For facilities with 20 - 50 buildings and which cover over 100 acres, a comprehensive radiological and chemical characterization represents an immense undertaking. Determining an optimum distribution of labor and other resources can be a difficult and time consuming task. The purpose of this paper is to describe the use of an electronic spreadsheet to determine, on the basis of prescribed measurement and sampling intervals, parameters such as total number of measurements and samples, total time required for specific tasks, the total time in days, given the number of personnel available and realistic performance efficiency, and an estimate of the cost.

One of the most innovative and useful developments in personal computer software is the integrated program. For this work, the author chose Symphony, by Lotus Development Corporation, and all work was performed on a COMPAQ Portable Computer. This combination can be used by the novice with limited experience. Instruction may be accomplished in a few hours through review of Symphony documentation (Refs. 1,2) and other tutoral manuals (Ref. 3). Symphony's spreadsheet module is a powerful tool, an electronic grid of columns and rows which is ideal for planning sequential or integrated activities. In addition to the spreadsheet, word processing and graphics environments in Symphony offer flexibility in data presentations. Specific mathematical relationships between tasks and required labor may be applied to individual cells formed by the intersection of rows with up to 256 columns. There are a total of 8192 rows, hence a fully utilized spreadsheet would contain over 2 million individual cells.

Before one can apply the spreadsheet to the requirements of an actual survey, a site specific characterization plan must be prepared. Such a plan requires the careful review of historical information as well as an evaluation of data obtained during site visits (Ref. 4). The scope of any characterization is influenced by project objectives, existing criteria for measurements and sampling, and available labor forces. Electronic spreadsheets facilitate the coupling of these latter considerations with facility size to establish overall project scope and budget. Furthermore, the spreadsheet may be used to monitor project performance so as to predict non-conformance with cost and schedule criteria.

Symphony was used to plan an actual survey of a facility formerly used to process radioactive material. For this discussion, the facility will be treated generically. It consisted of 33 structures with moderate to high levels of surface radioactivity (Category M,H) and 14 structures thought to be free of radioactive contamination (Category N), all situated on a fenced site of about 150 acres. The intervals for measurements and samples in the two categories were dictated by respective measurement and sampling criteria and were tied to a fixed grid system on floors, walls, ceilings, and flat roofs. Results of the survey of Category M,H structures were to be used as an aid in planning remedial activity and to establish areas where specific controls would be required to protect workers and to prevent the spread of radioactivity. For this reason, survey intervals were larger than for Category N where results could be used to base decisions regarding the demolition and disposition of those buildings. In addition to a greater number of measurement points per unit of inside area, the outside walls of Category N structures required survey. The spreadsheet was also used to plan measurements and sampling (surface and subsurface) activity on open land at specific points on a site-wide grid system.

Following is an explanation of the spreadsheet organization and execution for measurement and sampling activity in Category M,H structures. Column headings accross the spreadsheet's width provided details of each structure, specific tasks to be performed, the number of person-hours required to complete each task, the total person-hours for groups of tasks, and the total person-hours for each structure. Columns of the spreadsheet are identified by letters, and rows by numbers thus giving each cell an alpha-numeric code. For Category M,H the sheet was composed of 61 columns and 34 rows (2074 cells). Manual entry was limited, for the most part, to column headings, structure number in Column A, structure description in Column B, floor area in square meters in Column C, wall area in Column Z, and formulae for mathematical relationships in other cells along the first row of data. In a few cases, certain other data required manual entry because no real relationship existed with respect to building size. For example, the time required for a pre-entry radiation survey was a variable function based on the building's physical condition (some with no lighting, some with structural damage, etc.). The number of equipment items to be surveyed, the number of sumps and floor drains, and the time required for personal protective measures varied from building-to-building. An estimate of the number of person-hours for each of these was made initially and updated as necessary to provide an accurate estimate of total labor hours. Once the number of above items were determined and entered manually, sheet calculations were used to estimate the number of measurements, samples, and respective labor. Individual tasks associated with floor area were as follows:

- Number of grid points to be marked a 2 m intervals
- Number of directly measured alpha readings at 2 m intervals on floors
- Number of directly measured beta readings at 2 m intervals on floors
- Number of pressurized ion chamber readings (1 m above the floor) at 4 m intervals on floors
- Number of bulk samples collected at 6 m intervals on floors
- Number of swipe samples at 4 m intervals on floors.

Tasks associated with wall area included:

- Number of grid points to be marked at 4 m intervals
- Number of directly measured alpha readings at 4 m intervals on walls
- Number of directly measured beta readings at 4 m intervals on walls
- Number of swipe samples at 4 m intervals on walls.

Ceiling and floor areas were the same for each building level, therefore ceiling grids were not established physically. Measurements and swipe samples were based on the floor grid, but with intervals of 4 m. Measurement and sampling intervals for roofs (flat roofs only) were the same as for floors, and grids were installed.

Structures in Category M,H contained areas (in square meters) of 51,000 for floors and ceilings, 47,300 for walls, and 28,300 for flat roofs. In addition, these 33 structures contained over 1400 pieces of equipment and 150 floor sumps and drains. Once the column headings were entered, column width was established and the cells in each column were formatted in accordance with the type data to be included (for example, fixed decimal, number of significant figures, currency, etc.). Starting with the first row of data (call it Row 10) in the spreadsheet, move right to Column E where the heading reads "Person-hours to Grid Floor". On the video screen, Cell E10 will be highlighted. Either a value or a formula must be entered in this cell. Because establishing a floor grid is related to floor area, a formula is typed and entered. Two people are needed to measure grid intervals, mark grid intersections, label the the grid, and document the grid on drawings. Approximately 1.5 minutes are required per grid node at 2 m intervals. The actual formula is as follows:

(C10/4)*1.5*2/60

where C10 is a cell which contains the floor area in square meters, 4 refers to 1 grid intersection per 4 square meters, 1.5 minutes to install each grid node, 2 persons, and 60 minutes per hour. The same formula applies to all 33 structures, therefore it is required in all Column E cells in Rows 11 - 42. The formula need not be entered manually however. Using Symphony's Copy Command, the task can be accomplished with 7 key strokes, or by executing a previously determined macro, a procedure which Symphony can perform automatically upon command. As one progresses through the spreadsheet, similar procedures are applied to the leading cell in each column and copied to cells in Rows 11 - 42. In addition to determining the number of alpha, beta, and gamma-ray measurements, the number of swipe samples, bulk residue samples on floors and roofs, sump and drain liquid and sediment samples, the sheet also determines for each structure the number of measurements on items of equipment, samples from that equipment, the number of boreholes drilled through the floor at regular intervals, the number of profile measurements in boreholes, and the number of profile samples collected from boreholes. Labor requirements are also determined, as shown in the example above, for the installation of floor, wall, and roof grids, to perform each type of measurement, to perform quality control (duplicate) measurements, to collect and analyze each of the several types of samples, to label, photograph, and perform measurements on equipment items, and to document all field data records.

Similar operations were carried out to prepare the total scope of work for Category N structures and for open land areas. Once the total labor (person-hours) is obtained for all tasks, the number of days required to complete the characterization may be calculated on the basis of available personnel and their probable efficiency. The actual number of hours worked per day is governed by the time required to check and standardize radiation measuring instruments, to put on and remove protective clothing, for mandatory rest and heat stress monitoring, for measuring radioactivity on personnel upon exit from controlled areas, and for other administrative functions. In most projects of this type, one can assume a productive work period of 6 hours per day.

The Symphony spreadsheet is well suited for project control applications. Once the total scope of work and estimated project costs have been determined, a project cost plan and work schedule can be prepared in the spreadsheet format. Through the entry of a few values following the weekly (or monthly) closing of cost collection, automatic features built into a spreadsheet may be used to monitor actual performance and to spot trends in the different project activity codes. This latter feature is useful in identifying potential problems before they occur thus permitting corrective measures to maintain project objectives.

REFERENCES

1- Lotus Development Corp. Symphony How To Manual, 1985.
2- Lotus Development Corp. Symphony Reference Manual, 1985.
3- Weber Systems, Inc. Staff, Symphony Users Handbook, Ballantine Books, New York, NY, 1985.
4- Haywood, Fred F., "Radiological Characterization - Strategy to Avoid Surprise", Proceedings of the 1987 International Decommissioning Symposium, Pittsburg, PA, October 4-8, 1987.