COST-TIME MANAGEMENT: A POWERFUL TOOL IN A NEW APPLICATION -- CLEANING UP THE WEAPONS COMPLEX

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ABSTRACT

Westinghouse Electric Corporation is aggressively applying cost-time management to bolster timely, cost-effective cleanup and waste management activities at sites it manages for the U.S. Department of Energy (DOE). Cost-time management is a diagnostic technique which is applicable to virtually any process. It identifies opportunities to reduce cycle-times and costs. When applied to cleanup and waste management at DOE facilities, cost-time profile analysis helps identify actions to improve productivity and quality. Moreover, by reducing cycle-times and costs, it achieves significant savings to taxpayers.

INTRODUCTION

Cleaning up the DOE's nuclear complex and ensuring compliance with today's environmental laws and public expectations is an enormously complex and challenging undertaking. Getting the job done also will be time consuming and expensive. Recent independent estimates put the full cost to American taxpayers as high as $240 billion.

Creating taxpayer value for those dollars will require applying innovative technological approaches and management techniques to meet increasingly demanding goals. Leo Duffy, DOE's assistant secretary for environmental restoration and waste management, recently challenged DOE contractors to perform their work "better, safer, faster and cheaper."

Powerful cost-time management techniques developed by the Westinghouse Productivity and Quality Center can, if diligently pursued and applied, meet Mr. Duffy's challenge. They can dramatically improve operations and the quality, responsiveness, and overall performance of environmental restoration and waste management activities at DOE sites.

Cost-time management techniques can reduce overall costs of any given activity, an important attribute as Congress pulls our nation's purse strings tighter. Typically, a ten percent reduction in cost is a modest objective through cost-time management. Broad-based cost-time management approaches to environmental activities could, therefore, reduce overall DOE site remediation costs by as much as $24 billion.

The techniques can prove valuable when used in conjunction with other productivity and quality tools, such as value engineering. Recent DOE orders mandate application of value engineering throughout the weapons complex. Value engineering is a set of disciplines and methodologies applied to measure and improve products and processes in the areas of conformance, efficiency and appropriateness. Westinghouse's use of cost-time management techniques will enhance its ability to meet these requirements. The corporation is now integrating cost-time management and value engineering processes at the West Valley Demonstration Project, near West Valley, New York, and at the Hanford Site, near Richland, Washington.

As many DOE weapons-related sites move from production to environmental remediation, versatile management models must address these changing priorities and needs. Cost-time management is one such model.

The Cost-Time Profile: A Snapshot

Cost-time management gives a snapshot of any business or activity from both a time and money perspective. That snapshot provides a measure of the effects of time on day-to-day operations or on long-term strategic planning.

Westinghouse calls the snapshot a "cost-time profile." The profile graphically shows the buildup of cost over time. Analysis of the cost-time profile is the basic diagnostic tool of cost-time management.

In the cost-time profile (Fig. 1) the vertical lines represent the cost of purchased materials and services. These include raw materials, outside supplies, services and information. The horizontal lines represent wait times -- when nothing is happening in the process, but time is passing. In factories, this occurs when material sits in storerooms or in aisles. In offices -- both government and private -- reports and other information rest, unread and unevaluated, in computers or in-baskets. It's important to note that when nothing is happening, investment builds up, but products or services gain no value.

The diagonal lines represent the cost of work. The slope of the lines is dependent on pay rates and how many resources the work consumes over time.

The basic aim of cost-time management is to reduce the total investment in a process by shrinking the cost-time profile both horizontally and vertically (see shaded area in Fig. 2). When you reduce the profile, you cut unnecessary costs and non-productive wait time.

Industry applies a variety of remedial measures to reduce the cost-time profile. In the manufacturing example shown in Fig. 2, these could include just-in-time inventory management, computerization of manual administrative tasks and the application of robotic systems. Other potential remedies include automated order-entry systems and processing capabilities that send verified design, scheduling and shipping data directly to the shop floor. Management's critical task is to identify solutions that are the most appropriate and will have the greatest effect on shrinking the cost-time profile.

Note that Fig. 2 includes both traditional "visible" inventory as well as "invisible" inventory. Invisible inventory is the cash value of all the information needed to complete an activity. It builds up from *the time* a business receives an order until the customer receives the product or service.

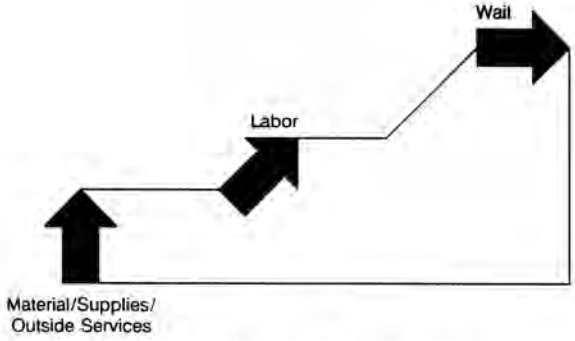

Fig. 1. Cost-time profile components.

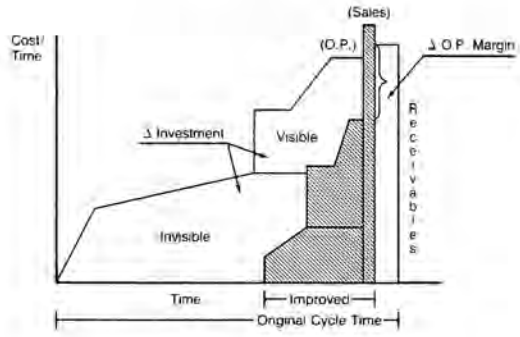

Fig. 2. Objective: shrink the profile.

Shrinking the Cost-Time Profile: Rewards and Lessons Learned

The real advantage of the cost-time profile is its simplicity. It conveys, in graphic images, information and concepts that are often too subtle or complex to communicate through words alone. Moreover, and most important, the profile reveals "hidden" and strategic relationships that might otherwise be missed.

A reduction in costs decreases the height of the profile. For manufacturers, it increases operating profit. For DOE contractors, it frees taxpayer dollars for other projects. For taxpayers, it means money saved and faster cleanup.

A reduction along the time axis of the profile results from improved quality and customer service. Reduction in time and/or cost results in lower investment or, in DOE contract work, fewer taxpayer dollars and less time required to complete an environmental cleanup task.

Westinghouse has performed hundreds of analyses of shrinking real-life cost-time profiles. These analyses show that:

- Actual value-added work (represented by the diagonal lines in the profile) generally are only ten percent or less of a process's elapsed time. The other 90 percent is wait time -- or *wasted* time -- that adds *no* value. It only increases customer impatience and anxiety.
- Time *really* is money and is a competitive weapon in the global marketplace. Westinghouse has found that a 50 percent reduction in cycle time is a reasonable cost-time management objective. Once achieved, costs come down by as much as 25 percent, too.
- Cost-time profile analysis helps to identify and quantify the correct actions needed to improve productivity, customer value and quality. You shrink the cost-time profile by driving down cycle time toward zero and pushing product or service quality toward 100 percent. Cost-time management identifies where the biggest payoffs exist for the least effort, while documenting ongoing improvement.

Cost-Time Management in the Commercial Sector -- A Success Story

Cost-time management was instrumental in helping the Westinghouse commercial nuclear fuel division (CNFD) earn the first Malcolm Baldrige National Quality Award in 1988. CNFD supplies 40 percent of the U.S. market for light-water reactor fuel and 20 percent of the global market for reactor fuel assemblies.

When a nuclear plant is ready for refueling, the fuel manufacturer must design the refuel load. This process involves hundreds of people and costs millions of dollars. Before CNFD performed a cost-time profile analysis of the reactor core reload design engineering, the process took three years to complete.

The division applied cost-time management to a variety of discrete processes in core reload design. These included revising office procedures, reducing bureaucratic inertia, developing software and new products and processing raw zirconium sponge into finished zirconium-clad fuel assemblies.

CNFD generated separate cost-time profiles for each of the division's three manufacturing operations, analyzing each operation as an independent, free-standing business. "Value enhancement" teams were then assigned to assess each facility to find improvement opportunities and develop applicable action plans.

Figure 3 depicts the cost-time profile for the entire core reload design process. By systematically analyzing the process, drawing the profile and finding the leverage points, the division:

- Reduced division-wide cycle time by 40 percent to 18 months.
- Improved on-time deliveries to utility customers to 99.5 percent.
- Reduced costs by 20 percent.

The separate cost-time analyses described earlier also yielded impressive results, including a product reliability

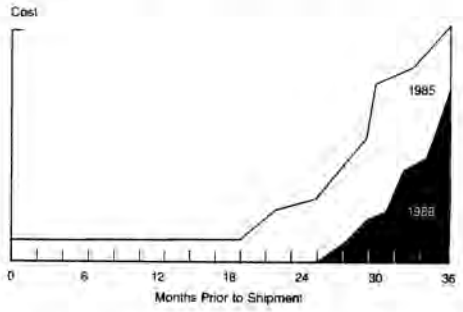

Fig. 3. Fuel reload design process cost-time profile.

rating of 99.9995 percent. Improved efficiencies in the bidding process resulted in an average reduction in Request for Quotation response times of between 50 and 70 percent. Elimination of "invisible" inventory items cut zirconium processing cycle time by nearly 75 percent. In the fuel reload design area alone, CNFD captured noteworthy improvements. These included a 16 percent increase in once-through yields of fuel tubing and a 48 percent increase in once-through yields of completed fuel assemblies.

Moving Cost-Time Management into the DOE Arena

Westinghouse is now systematically applying the same techniques to cleanup and waste management programs at DOE facilities. The corporation spearheaded the effort with a pilot program at the DOE's Fernald Environmental Management Project (FEMP), near Fernald, Ohio. Following successful results there to streamline the document review process, Westinghouse began rigorous application of the techniques at each of the sites it manages for the DOE.

Cost-Time Management at FEMP -- Improving Removal Actions

FEMP, formerly known as the Feed Materials Production Center, covers 1,050 acres 20 miles northwest of Cincinnati. The government built the plant in the early 1950s to produce uranium metal for the weapons program. Past management practices at the site over the years left a legacy of difficult radioactive and hazardous waste challenges. DOE estimates it will need $2.2 billion for cleanup costs at the site over the next six years alone.

DOE named Westinghouse as the management and operations contractor at the site in January 1986. Uranium metal production at the site ended in 1989 and, in 1991, DOE redesignated the site mission to one of environmental remediation. Westinghouse performs this work through a wholly-owned subsidiary, the Westinghouse Environmental Management Company of Ohio (WEMCO).

A DOE consent agreement with the U.S. Environmental Protection Agency identifies 18 "removal actions" at FEMP -- actions which eliminate or reduce hazardous substance releases into the environment. Under the agreement, the specific work plans for removal actions are due by legally binding dates.

Customer expectations about environmental remediation and management at FEMP are high. Both EPA and DOE want good technical solutions to environmental problems there. DOE expects WEMCO to meet schedules specified in the consent agreement. Site neighbors want to be kept informed. All want visible progress made toward site cleanup.

WEMCO formed a removal action cost-time management team in the fall of 1991 to set specific removal action goals aimed at meeting customer expectations. The team consisted of WEMCO employees with expertise in varied site remediation areas. WEMCO also included a representative from Parsons, the prime remedial design contractor.

The team established four goals to be reached through the cost-time management process: 1) meet legal milestones required under the consent agreement; 2) complete removal actions better, faster and cheaper than any potential competitor; 3) streamline removal action document preparation and approval; and 4) identify cost-time management action plans by the end of 1991 for new removal actions.

Next, the team used "Primavara System" software to complete a generic baseline removal action process map. WEMCO entered estimated hands-on hours, cycle time and wait-time for each removal action process step into the database. This data then was used to plot the cost-time profile of the process. Major action components analyzed included site evaluation, development of workplans, design, contractor bid and award, and development of final reports (see Fig. 4). The baseline process for field construction is unique to each removal action, so WEMCO did not initially analyze its cycle. This put the baseline cycle for the other major components at 33 months.

The cost-time profile analysis showed that reducing cycle-time would create the greatest added value to the removal action process. WEMCO placed primary emphasis on the extensive internal and customer reviews applied to each of the critical path activities in the process. In addition, WEMCO is working to write more generic documents, develop specialized review teams and to overlap low-risk process activities.

WEMCO expects these changes to improve the cost-time continuum significantly. By shrinking the cost-time profile, WEMCO expects to achieve a 35 percent reduction in cycle-time and a 10 percent cost reduction (Fig. 5). WEMCO began executing the identified improvements to existing removal actions during the last quarter of 1991. Other improvements are scheduled for the first quarter of 1992.

WEMCO has targeted other areas in the overall Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) process for application of cost-time management. For example, cost-time management teams are now working to apply cost-time management to safe shutdown and low-level waste shipping activities.

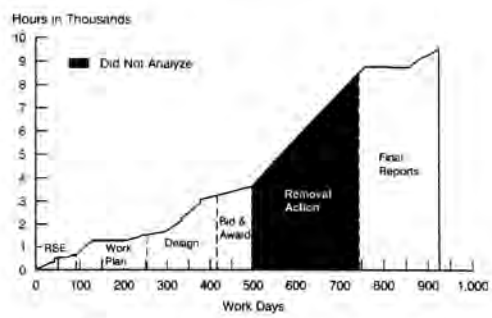

Fig. 4. Generic removal action process cost-time profile (baseline).

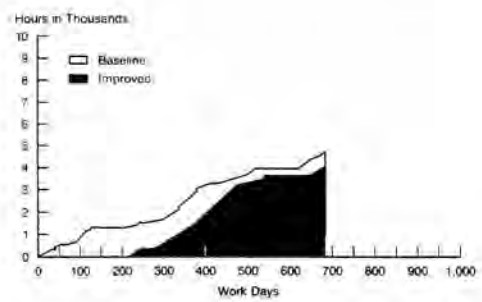

Fig. 5. Generic removal action process cost-time profile (baseline + Phase I improvements).

Cost-time management will help DOE meet EPA consent agreement milestones, thus bolstering customer satisfaction while stretching taxpayer dollars. Significantly, WEMCO has found that cost-time profiling is a participative process, bringing together customers, employees and subcontractors to meet site remediation challenges.

Streamlining the CERCLA Process at the Savannah River Site

The Savannah River Site (SRS) is the country's primary nuclear defense materials plant. Located 20 miles southwest of Augusta, Georgia, near Aiken, South Carolina, the site is home to the only operating tritium production reactor in the U.S. DOE named Westinghouse as the site management and operations contractor in 1989.

The aftermath of nearly four decades of SRS operations left several challenging environmental problems throughout the 300-square mile complex. Westinghouse Savannah River Company (WSRC) began applying cost-time management techniques to SRS environmental management tasks in 1991.

At SRS, the CERCLA process requires WSRC to prepare and submit nine regulatory documents for each of 51 major environmental cleanup projects. These documents include workplans, risk assessments, characterization reports, proposed plans and records of decision. An early analysis showed that without cost-time management, document preparation alone for the 51 projects could take more than nine years and up to $850,000 per project. Elements of the process are shown in Fig. 6.

WSRC worked with the EPA and state regulatory authorities to streamline the process. The authorities agreed that two reports could be eliminated from 20 of the projects without compromising effective cleanup. WSRC continues to further streamline this process.

As shown in the cost-time profile illustrated in Fig. 6, removing two reports from the CERCLA process promises to yield significant returns. Simply eliminating the preparation and review time associated with the reports will shorten the document submittal schedule for each environmental remediation project by two years. That will result in total savings of about $3.9 million. Moreover, WSRC expects the agencies will agree with its proposal to drop the same two documents from most of the remaining 31 environmental management projects.

WSRC has expanded its cost-time management program to analyze an improved document review process called the Technical Review and Acceptance Committee (TRAC). Initial cost-time profiles for TRAC show that review times for individual reports can be reduced by five months, or 50 percent, for each document through this coordinated and focused review process (see Fig. 7). Document preparation and review processes were consistently identified as common opportunities for improvement at each of the sites Westinghouse manages for DOE.

Shrinking the Cost-Time Profile at the Hanford Site -- Trenching Vs. Drilling

The Hanford Site, a 560-square mile complex in southeastern Washington state near Richland, has met national defense and research needs for nearly a half-century. DOE considers Hanford its flagship environmental restoration site. Westinghouse Hanford Company received the DOE management and operations contract in 1987.

The DOE announced in February 1989 a landmark 30-year agreement with the EPA and the state of Washington to clean up the site. The plan, called the Tri-Party Agreement, earmarked nearly $3 billion for environmental remediation over the first five years alone.

Westinghouse Hanford first applied cost-time management to the remedial investigation/feasibility study (RI/FS) process associated with the 300 Area of the site. The area is contaminated with uranium and heavy metals and received emphasis because remediation work there is behind schedule and over budget.

A baseline cost-time analysis of the existing RI/FS process for the 300 Area showed that the total process, from initiation of the work plan to the record of decision, would take 74 months at a cost of $19.6 million (see Fig. 8). Westinghouse Hanford found that drilling activities accounted for 31 percent of the total costs but only 15 percent of the total time involved. Data evaluation, report preparation and review accounted for 79 percent of the total time involved but only 22 percent of the total costs. Based on this analysis, Westinghouse set out to find ways to 1) reduce drilling costs; 2) reduce data evaluation, report preparation and cycle times; and 3) reduce analytical cost and turnaround times.

Westinghouse Hanford Company, with full concurrence of EPA and state officials, directed its initial focus toward reducing drilling costs and cycle-time. It began by trenching within the 300 Area to show that significant savings could accrue through the reduction of costly borehole drilling. Cost-time management then was used to quantify the potential net cost and time savings through trenching in lieu of drilling

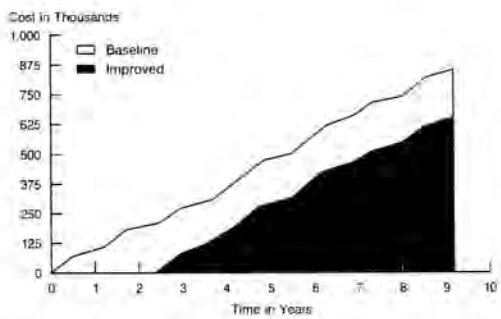

Fig. 6. Cost-time profile for streamlining CERCLA process at Savannah River Site.

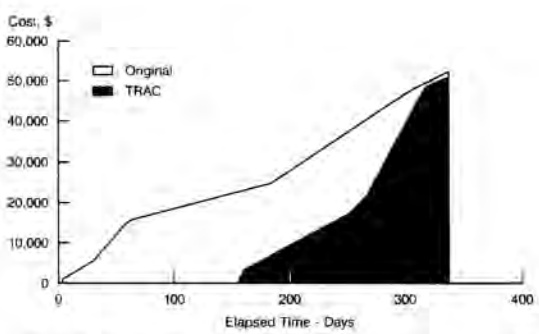

Fig. 7. Reducing document review time at SRS.

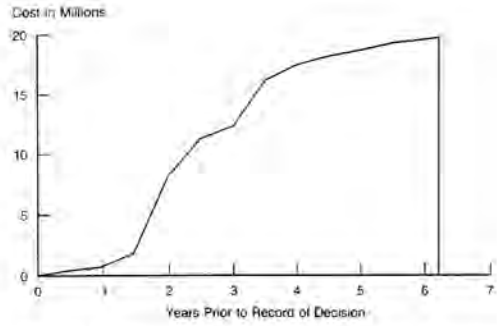

Fig. 8. Current operable unit RI/FS process.

shallow boreholes (less than 50 feet deep). The cost-time profiles in Figs. 8 and 9 show a dramatic difference between non-recurring costs (permits, safety assessments, etc.) for trenching versus drilling. Net estimated cost avoidance based on the original baseline is approximately $3 million. The RI/FS schedule is projected to be reduced by three months.

Cost-time management efforts at Hanford are also being applied to document preparation and review processes, analytical costs and turnaround times for off-site laboratory analytical tasks.

Cost-Time Management at the Idaho National Engineering Laboratory

At the Idaho Chemical Processing Plant at the Idaho National Engineering Laboratory (INEL) near Idaho Falls, Idaho, Westinghouse stores and reprocesses spent fuel from U.S. Navy and government experimental reactors for the DOE. The DOE selected Westinghouse in 1983 to manage, operate and maintain the plant through a wholly-owned subsidiary, Westinghouse Idaho Nuclear Company (WINCO). WINCO also is responsible for processing and storing nuclear wastes at the site.

Remediation activities at INEL are governed by the EPA, the Idaho State Department of Health and Welfare, and DOE. An interagency agreement known as the Federal Facilities Agreement guides the environmental cleanup processes at the site.

WINCO is performing cost-time analysis for Track 1 processes at the site, which are defined as evaluations of *existing* data. Approximately 33 Track 1 evaluations were performed in 1991. These lead to a determination that no environmental actions are warranted or, barring that, a more detailed Track 2 study. Track 2 studies, in turn, can lead to no further action, an interim action or RI/FS scoping.

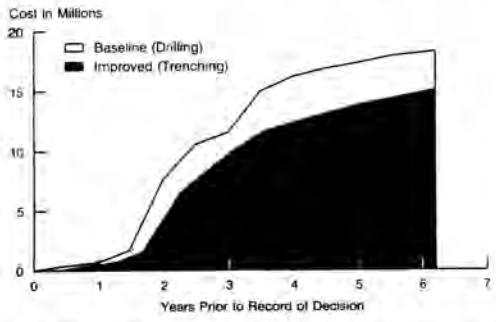

Fig. 9. Operable unit past practice strategy with trenching.

As shown in Fig. 10, WINCO's cost-time analysis of a typical Track 1 investigation showed that it could take up to 40 weeks at a cost of nearly $20,000. However, by reducing wait times for data collection and evaluation, risk assessment processes and technical editing, WINCO found it could significantly shrink the cost-time profile. That cut typical Track 1 cycle-time by approximately 56 percent and costs by more than 42 percent (Fig. 11).

During 1992, WINCO will apply cost-time management to about 16 Track 2 field investigation activities.

Beyond CERCLA -- Cost-Time Management at the Waste Isolation Pilot Plant

Located near Carlsbad, New Mexico, the DOE's Waste Isolation Pilot Plant (WIPP) will provide a safe, long-range solution for the disposal of transuranic defense wastes. Westinghouse's waste isolation division, the WIPP management and operating contractor, will store the waste in deep underground salt formations at the plant.

As there are no CERCLA sites at WIPP, Westinghouse applied cost-time management to the facility's Change Control Board (CCB) activities. The board evaluates two types of engineering change proposals: Class I proposals are those that must go to the DOE for signature. Class II proposals require approval from division personnel. The board returns proposals failing to receive approval to the originating engineer for "rework."

Westinghouse's decision to apply cost-time management to the CCB process grew from a general dissatisfaction with cycle-time. The division also viewed as too high the number of proposals the board returned for engineering rework. A cost-time management team collected data on actual hands-on time and total elapsed time for both Class I and Class II

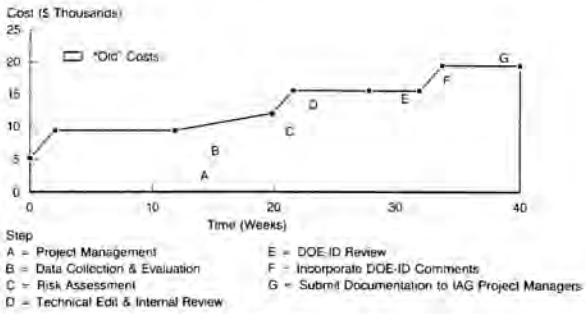

Fig. 10. Cost-time profile Track 1 investigation.

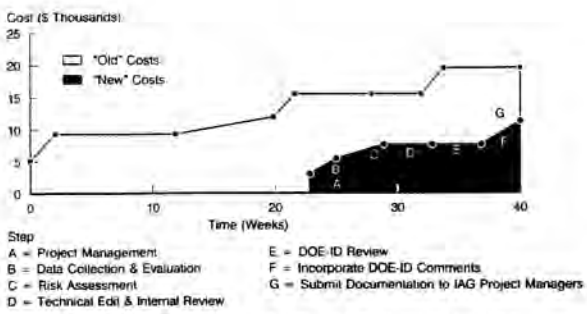

Fig. 11. Cost-time profile Tract 1 investigation.

processes. The team did not include costs in the analysis because all related to fixed labor expenses.

Team analyses of the cost-time profiles generated for both proposal classes led to the decision to eliminate one major process delay point and to modify another. Figures 12 and 13 present the dramatically reduced profiles for both classes of proposals. Westinghouse cut total elapsed time for Class I proposals from 168 hours to 92; actual hands-on time fell from 4.4 hours to 3.4 hours. For Class II proposals, the division reduced total elapsed time from 132 hours to 124, and cut actual hands-on time from 23.4 hours to 8.4.

During 1992 the division will create a new Class III proposal category. It will include about 50 percent of all the engineering change proposals submitted. The total elapsed time for processing proposals falling under this category are expected to be only one hour per proposal, with actual hands-on time of only 10 minutes. The division also expects to apply cost-time management to a host of other processes at the plant.

CONCLUSIONS

Cost-time management is a powerful management tool. Westinghouse has demonstrated that the technique reduces cost and cycle-times within its own commercial operations, as well as for those of outside clients.

The corporation began a coordinated effort to apply cost-time management techniques within the DOE weapons complex in 1991. Although the full benefits of the technique have yet to be realized, the corporation has already logged impressive results. Cost-time management has not only dramatically reduced cost and cycle-time where applied, but also forged better internal teamwork and interaction with DOE and the regulatory agencies involved.

Meeting regulatory requirements and ensuring that the DOE complex is in compliance with present and emerging environmental standards is an enormous challenge. Through broad application of cost-time management, DOE contractors will be able to add value to the work they perform and the taxpayer dollars that pay for it.

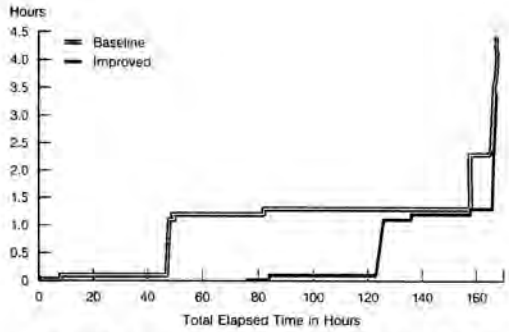

Fig. 12. Time-time profile, Class I ECPs.

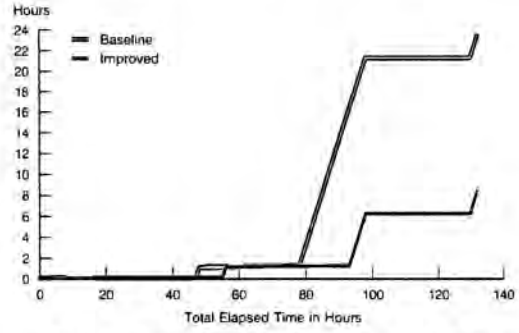

Fig. 13. Time-time profile, Class II ECPs.

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