ESTABLISHMENT OF VALUE ENGINEERING IN THE DEPARTMENT OF ENERGY'S FORMERLY UTILIZED REMEDIAL ACTION PROGRAM

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ABSTRACT

It has been estimated that tens of billions of dollars will have to be spent over the next three decades to achieve and maintain compliance with environmental, safety, and health requirements for the Department of Energy's (DOE) defense complex. To date little information on the application of value engineering (VE) to environmental cleanup programs has been published, and the author suspects that VE has not played a part in this nontraditional construction effort. Considering the magnitude of the effort involved - hundreds of billions may have to be spent in the restoration of our environment nationwide - the author believes that failure to apply VE methodology to this major undertaking will result in the expenditure of hundreds of millions of taxpayer dollars in unnecessary costs.

This paper describes the method being used by DOE to incorporate requirements for a formal VE program into the Formerly Utilized Sites Remedial Action Program (FUSRAP), an environmental restoration program committed to the implementation of the Environmental Protection Agency's remedial investigation and feasibility study (RI/FS) process. The paper is written for both the VE and RI/FS practitioner. It describes the approach to environmental remediation decisionmaking currently followed on FUSRAP and summarizes the basic steps in the VE process. The two methods are then compared and their close similarities identified; the concept of the VE "baseline study" a VE study for which cost savings cannot be quantified is introduced.

The author comments on the manner in which successful merging of the two approaches can be successfully achieved on FUSRAP and identifies the need for VE for cost avoidance as well as cost savings studies. The conclusion reached is that Value Engineering and the CERCLA process are complementary and that successful merging of the two processes is dependent upon adequate training of the project team.

INTRODUCTION

It has been estimated that between now and the year 2045 approximately $40 to $70 billion may have to be spent at facilities comprising the U.S. Department of Energy's (DOE) defense complex to clean up environmental contamination and to achieve and maintain compliance with environmental, safety, and health requirements (1). While these expenditures represent new initiatives, DOE has for over a decade been conducting several environmental restoration programs. The Formerly Utilized Sites Remedial Action Program (FUSRAP) is one such program, dedicated to evaluating and remedying radioactive and chemical contamination conditions at sites across the nation. FUSRAP includes properties where contamination exceeding current guidelines remains from the early years of the nation's atomic energy program or from commercial operations that resulted in conditions Congress has mandated DOE to remedy. FUSRAP was initiated in 1974 and now comprises 30 sites in 13 states. To date, 218,000 m^3 of contaminated materials have been removed from private properties during remedial action and placed in storage on government property.

Bechtel National, Inc. (BNI), is the project management contractor to DOE, responsible for planning and implementing FUSRAP activities. BNI analyzes site conditions and evaluates, recommends, and implements the appropriate remedial actions; it also conducts environmental monitoring of FUSRAP sites. BNI administers subcontracts, coordinates the sequence of operations, and ensures execution and documentation of project work in accordance with DOE guidance. FUSRAP is organized in multidisciplinary project teams representing specialties such as management, engineering, environmental health and safety, cost and scheduling, and procurement. The teams are assigned full-time to specific FUSRAP sites located in various parts of the nation and grouped on a regional basis.

On January 26, 1988, the Executive Office of the President, Office of Management and Budget (OMB) issued Circular No. A-131 (2), requiring the use of value engineering (VE) by federal departments and agencies to reduce nonessential procurement and program costs. The circular requires agency heads to establish and improve their use of VE programs. On February 17, 1989, DOE issued Order 4010.1 (3) to implement the OMB's Circular A-131. The provisions of the order applied to both the department and contractors performing work for the department.

The author is a senior BNI engineer assigned to FUSRAP and was initially responsible for evaluating the impact of implementing VE on the program and for recom-

mending to project management the process by which VE was to be integrated with project activities. Subsequently, the author was appointed the FUSRAP project value engineer, responsible for the development, maintenance, and monitoring of an active VE program within the framework of existing procedures. This paper describes how the VE method is being incorporated into an ongoing environmental remedial action program.

THE INTEGRATED CERCLA/NEPA PROCESS

At the time when DOE 4010.1 was issued, FUSRAP had been conducting remedial actions in accordance with a process that integrated the requirements of the National Environmental Policy Act of 1969 (NEPA) and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (4).

The basic components of this integrated CERCLA/NEPA process (hereinafter CERCLA process) are the remedial investigation (RI), the feasibility study (FS), and the environmental impact statement (EIS). The RI is the mechanism for collecting data to characterize site conditions, determine the nature of the waste, assess risk to human health and the environment, and conduct treatability testing necessary to evaluate the potential performance and costs of treatment technologies and remedies being considered. The FS serves as the mechanism for developing, screening, and evaluating in detail alternative remedial actions. The EIS details the environmental impacts and human health risks of each remedial action alternative deemed feasible by the FS.

The RI and the FS are conducted concurrently; Data collected during the RI influence the development of remedial alternatives in the FS; Similarly, information needs identified during the FS may affect the scope of treatability studies or necessitate additional field investigations.

A final EIS need not be prepared until DOE makes a recommendation or proposal for remedial action. However, NEPA requires all federal agencies to consider environmental impacts at every important stage in the decision-making process.

Because of the iterative and interactive nature of the CERCLA process, the sequence of the various phases presented in Fig. 1 will frequently be less distinct in practice. The actual timing of individual activities may vary case by case. The phases of the RI/FS-EIS process are briefly described below.

1. Scoping/Planning is the initial planning phase. Scoping activities typically begin with collection of existing site data. On the basis of this information, preliminary study area boundaries are identified and an overall management strategy is agreed upon.
2. Site characterization is the phase in which field sampling and laboratory analyses are initiated. A baseline risk assessment is developed to identify existing or potential risks to human health or the environment posed by contamination at the site.
3. The development of alternatives requires identification of remedial action objectives and of the technologies which will be used to satisfy these objectives, evaluation of those technologies, and selection of potential alternatives for further study.
4. Initial screening of alternatives may be necessary to conserve resources, through evaluation of their effectiveness, practicality, and cost. Screening is usually done on a general basis and with limited effort, because the alternatives have not been fully developed.
5. Treatability studies may be performed to evaluate technologies and provide sufficient performance and cost data to allow detailed analysis of alternatives.
6. During detailed analysis, alternatives are evaluated based on nine evaluation criteria, developed by the Environmental Protection Agency (EPA), to address the statutory requirements and preferences of CERCLA (5).
7. The CERCLA process documentation is based on requirements of both CERCLA and NEPA. CERCLA identifies specific documents that must be generated to provide decisionmakers with a complete record of the RI/FS process. RI documentation provides evidence of the thoroughness of field investigations and associated analyses. The FS documentation presents and analyzes information necessary for decisionmakers to effectively compare alternatives, select an appropriate remedy, and demonstrate satisfaction of CERCLA selection requirements.

NEPA requires federal agencies to consider the environmental consequences of federal actions before they are taken and to document this evaluation in an EIS. The EIS must detail the environmental impacts and human health risks of each remedial action alternative deemed feasible by the FS.

VE PROGRAM REQUIREMENTS

To address the requirements of *DOE Order 4010*, Value Engineering, BNI has reviewed the components of a formal VE program as defined by the Federal Acquisition Regulation (Part 48 and Part 52.248, Value Engineering)(6), Military Standard MIL-STD-1771 (Value Engineering Program Requirements)(7), and additional reference material provided through the Society of American Value Engineers (SAVE). That review has shown that

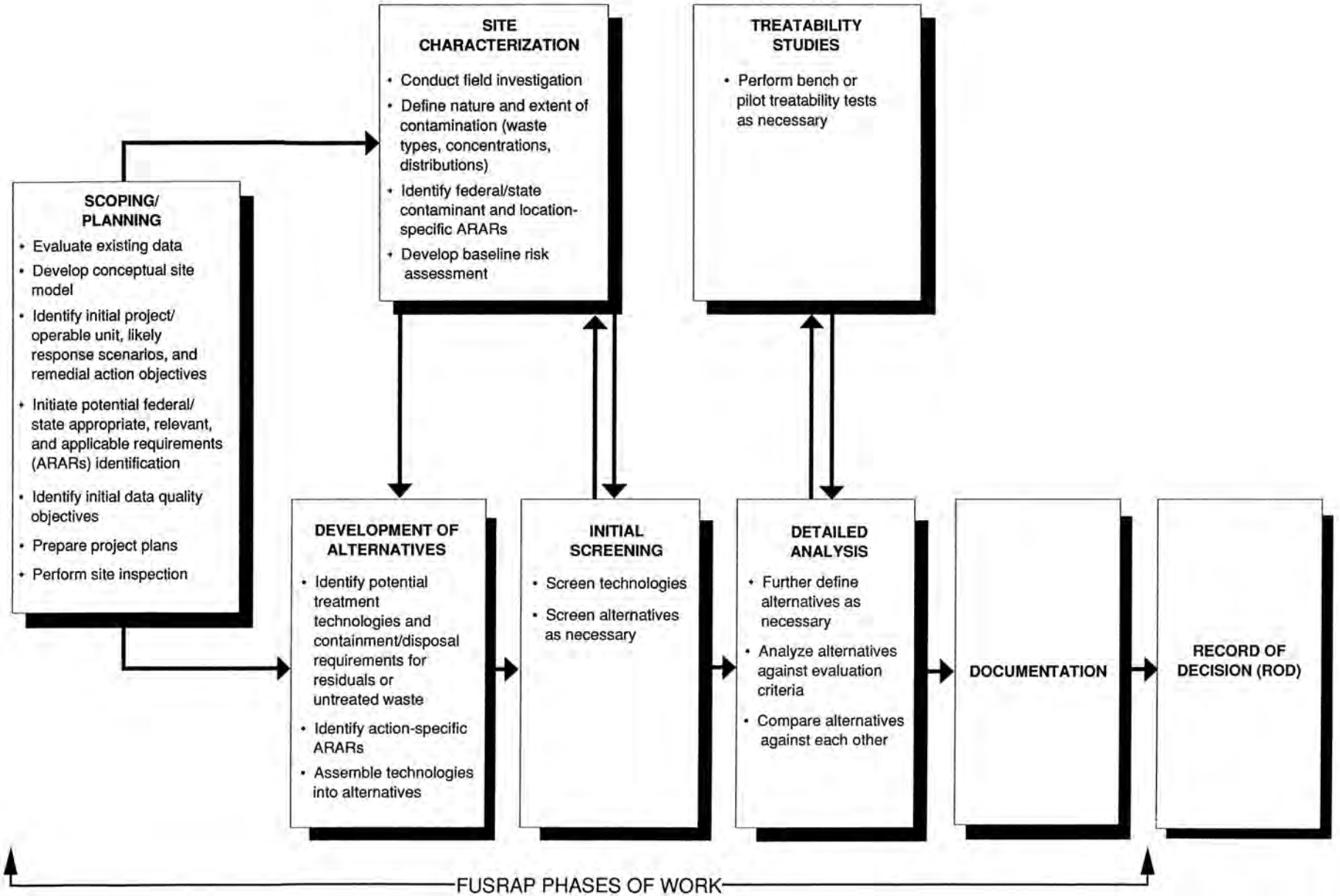

Fig. 1. The FUSRAP CERCLA Process.

a number of the features of a VE program already exist on FUSRAP. To show where those features exist some definition of VE terminology is required.

DOE Order 4010.1 defines VE as "[an] organized effort directed by a person trained in VE techniques to analyze the functions of systems, equipment, facilities, services, and supplies for the purpose of achieving the essential functions at the lowest life cycle cost consistent with required performance, reliability, quality, and safety." A more pragmatic definition is that "VE is a disciplined process based on a job plan that will force a team through separate and distinct phases of their investigation"(8)(see Fig. 2). Although a systematic approach is a vital component of the VE process and each phase must be performed in sequence, in actual practice it is often necessary to return to previously completed phases and repeat the sequence in order to pursue new avenues of investigation that reveal themselves during the process.

Literature on VE describes a variety of job plans, some with as many as nine phases. In each of those versions, however, the heart of the process is a systematic approach using at least the five core phases described below. This paper presents a five phase job plan because the primary product of the CERCLA process is documentation for decisionmakers. Implementation and followup phases (9) are not included as they are beyond the scope of the CERCLA process.

1. The information phase involves defining the task, and obtaining background information that leads to design solutions, limitations on the project, and the developing of a sensitivity to the costs involved in accomplishing the task goals. During this phase the object of study is defined by means of function description, and an estimate of the worth of each basic function is developed.
2. During the speculation phase, ideas are formulated in an open atmosphere of a free flow of information. Alternative means for accomplishing the basic functions are identified. Function may be defined as the basic purpose of the component, assembly, system, or procedure. Speculation should not begin until the basic functions have been fully identified. Critical thinking or analysis of the ideas generated is prohibited during this phase.
3. The analysis phase is used to evaluate the ideas generated during the speculation phase to see if they can be developed further for recommendations resulting in increased value. During this phase, the criteria or standards are developed by which ideas are judged. The ideas are screened to provide a preliminary ranking and a shortlist of ideas (alternatives) that will undergo further development.
4. In the development phase, the remaining alternatives are developed into specific recommendations for change. Detailed technical, cost, and schedule information is generated. Experts or consultants outside the team may be consulted to resolve technical problems. Finally, one alternative is selected for resentation as the VE team's recommendation, although one or more backup proposals may be available in case the first is rejected by approval authorities.
5. In the recommendation phase, the VE team's proposals are summarized, documented, and presented to approval authorities. The presenter(s) should bring to the presentation sufficient backup material to answer all questions. The presentation should also a plan for ensuring implementation of the recommended alternative should it be approved.

An effective VE training program is essential to the success of any VE effort. "It is significant to understand that training is mandatory because value work is based on the use of different sets of techniques in a special way and on the use of special knowledge" (10). Because VE training is not yet a part of the curriculum at a significant number of colleges and universities, it is incumbent upon an organization that wishes to develop a VE program to provide training for the personnel who will perform and direct that program.

A COMPARISON OF THE CERCLA PROCESS AND THE VE JOB PLAN

When the phases of a VE job plan are compared with the phased CERCLA process, as shown in Fig. 3, the similarities are evident. The job plan's information phase and the CERCLA process scoping/planning and site characterization phases contain the initial fact gathering and planning activities. During these phases, available data are collected and analyzed and additional information requirements are identified. Planning for the conduct of the study is performed and the goals of the study (ie., functions to be achieved, regulatory requirements to be satisfied, etc.) are established. Site visits are a fact gathering activity.

The speculation phase of a VE job plan is quite similar to the development of alternatives in a feasibility study. Both are brainstorming activities in which potential treatment technologies and alternatives for achieving the desired basic functions are identified. In the VE job plan, all ideas are acceptable and criticism is not permitted. The RI/FS process does not prohibit criticism during the brainstorming.

Evaluation and initial screening of the alternatives developed during brainstorming is the next phase of both the VE job plan and the CERCLA process. Technologies and

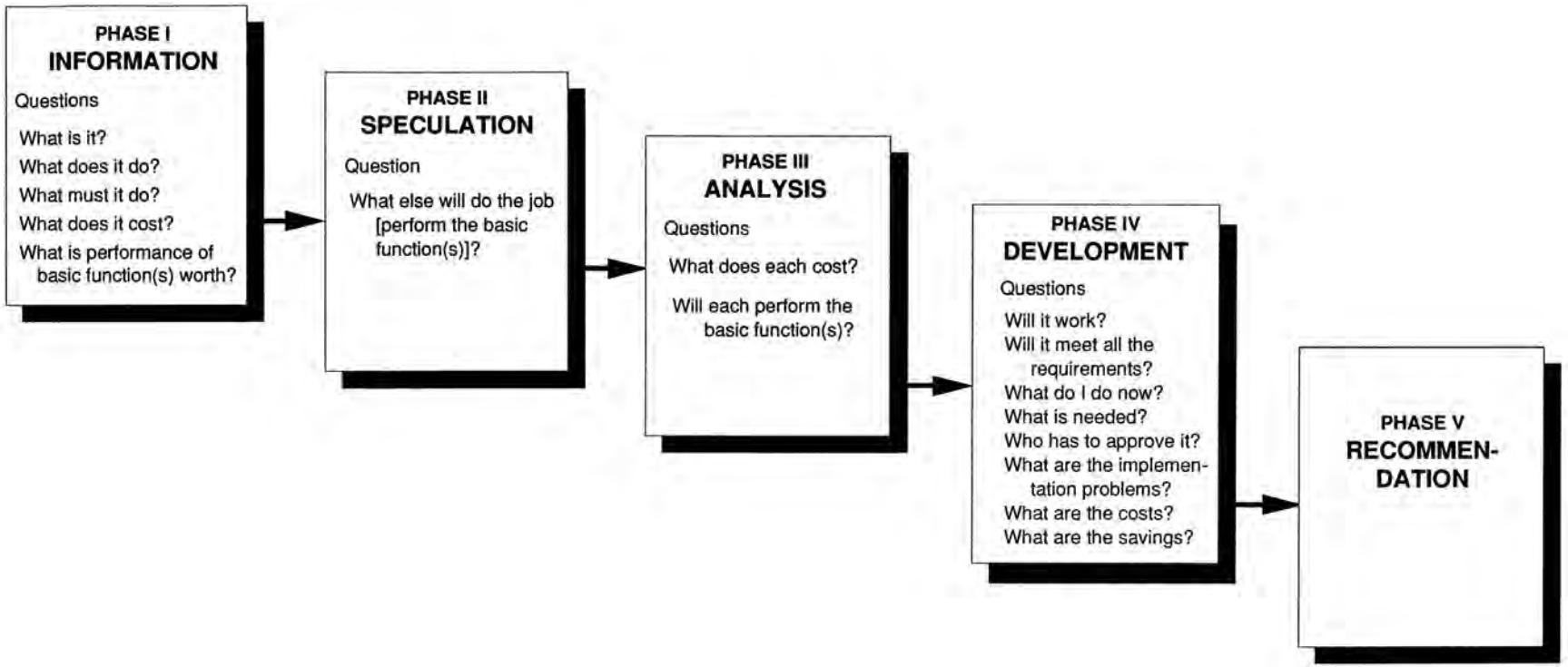

Fig. 2. The Five-Phase VE Job Plan.

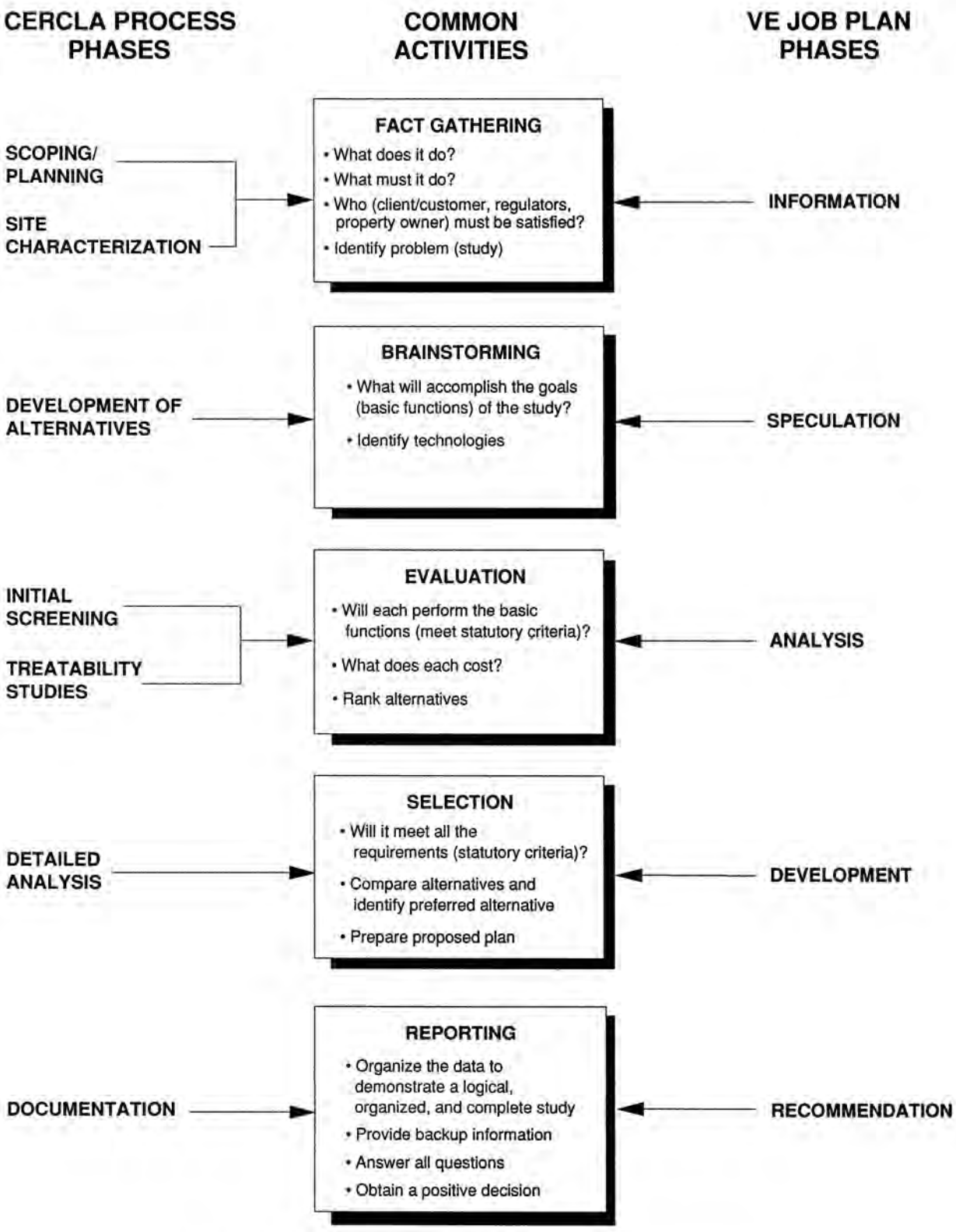

Fig. 3. Comparison of the CERCLA Process and the VE Job Plan.

alternatives are identified that will perform the basic functions, fulfill the statutory criteria, and satisfy the customer, feasible alternatives are ranked, and order of magnitude costs are developed. Treatability studies, which may be required in order to perform detailed analysis, are identified during this phase of the study.

The recommendation phase of a VE job plan and the detailed analysis phase of the RI/FS contain the same selection elements. Alternatives that have the highest probability for success are analyzed in detail to determine that all required functions are provided and that statutory criteria are met; costs are analyzed. The alternatives are compared, the preferred alternative is selected, and a plan to implement the preferred alternative is developed.

The CERCLA process documentation phase and the VE job plan presentation phases are essentially the reporting phase of each method. Both require that the data be documented to demonstrate that a logical, organized, and thorough study was performed. The documents also provide the backup materials used in the selection of the preferred alternative. The documents must contain the data necessary to answer both expected and unanticipated questions and are formulated to obtain a positive decision from the decisionmakers.

MERGING THE METHODS

A VE program must have established goals and objectives against which its effectiveness and accomplishments can be measured. Goals should include, but not be limited to target dollar savings, contractor participation, and number of personnel trained.

DOE Order 4010.1 requires annual reporting of the department's investment in and savings accrued from VE programs. As shown above, while the FUSRAP CERCLA process is quite similar to a VE job plan, significant differences exist, one of which will affect the feasibility of quantifying cost savings. In manufacturing, the VE approach is traditionally applied to an already existing product, the production costs of which are known; VE analysis is the mechanism by which savings in future production costs are identified. Such comparative studies are possible in the context of producing many identical units of a product.

In construction, comparative studies are typically performed at some milestone point in the design phase. Comparative studies may be performed at the completion of the conceptual design (or sketch design), design development, or after development of the design documents (or working-drawings). Construction comparative studies are possible because design alternatives are quantifiable.

In the context of an environmental restoration program in which each "product" is the remedying of a contamination problem, no two "products" are identical because environmental conditions and contamination characteristics differ between sites. Thus, a "standard production cost" against which to compare improvements is not available. Instead, VE effort must be applied at the front end of the "production process," becoming a nonquantifiable "baseline study" through which the most economical, effective remedy is arrive at before it is implemented in the field. As such, the baseline study becomes an exercise in cost avoidance rather than cost saving.

In this front-end investigation, the VE tool of most significance on FUSRAP will be function analysis. Throughout the brainstorming, evaluation, and selection activities, function analysis will maintain the focus of the multidisciplinary project teams on the main purpose of their study. In addition to asking if the alternatives satisfy the selection criteria, the study team must always answer the question "What is the function?" As soon as "...functions have been identified, clarified, understood, and specified..." (Ref. 10), the least-cost approach to achieving that function can be determined.

Although savings attained through the "baseline study" may not be quantifiable, reviews thereof may show that a subsequent, quantifiable VE study is warranted. VE change proposals (VECPs) submitted by subcontractors will also document quantifiable VE cost savings for FUSRAP.

The key to successful implementation of the VE process on FUSRAP is training of the individuals who will be overseeing or using the program. Most managers will require only broad indoctrination in the general principles, the organization, and the objectives of the VE program. However, those who will be on the VE study teams will require more intensive training. Initially training will be accomplished through workshop-seminars presented by VE consultants. Once strong in-house training and indoctrination capabilities are developed, future training needs will be satisfied from within the BNI organization.

A project value engineer will be assigned to work with the multidisciplinary FUSRAP teams. He will be responsible for providing VE program continuity and will work as both a facilitator and trainer. Integration of the VE approach with ongoing FUSRAP activities will also be achieved through the development of procedures assigning responsibilities for performing various VE activities and providing specific methods for implementing VE goals and objectives.

CONCLUSION

The integrated CERCLA/NEPA process and VE are complementary. As demonstrated, the elements of VE exist on projects that use the CERCLA process.

Successful merging of the two processes is dependent on the training of project value engineers and VE study

teams who will develop and implement the formal VE program. That program must be customized to compile the data necessary to record that the CERCLA process has been accomplished. Project instructions must be prepared and issued that will more specifically identify the VE CERCLA process parallels and define how VE will be formally implemented.

Use of the VE job plan and function analysis for "baseline" studies (as well as cost reduction studies) will optimize the value realized from the dollars spent by DOE on FUSRAP.

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