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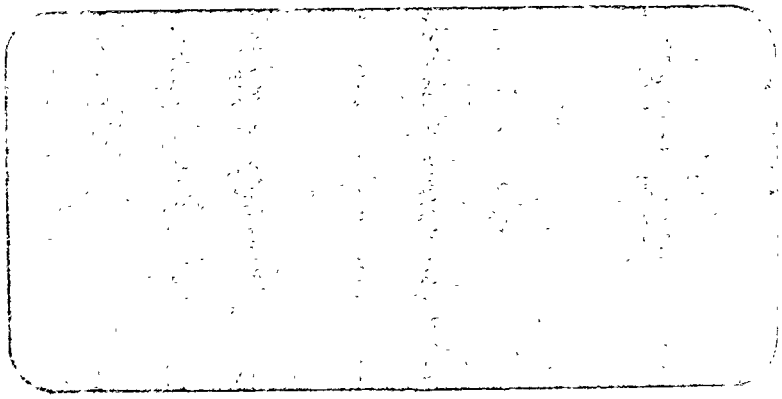

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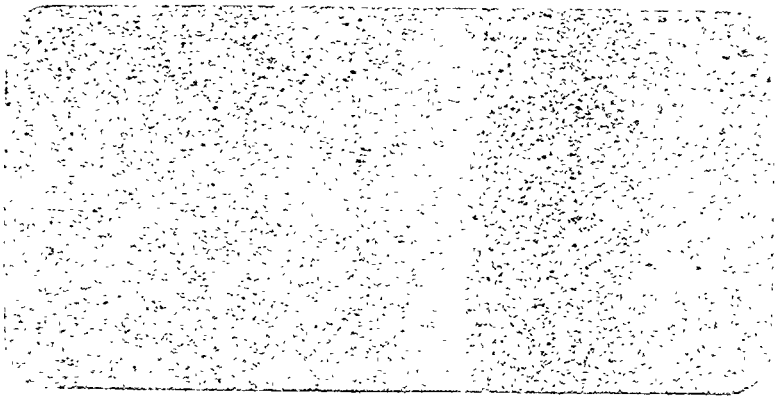

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Risk Reduction and the Privatization Option: First Principles

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Preface And Acknowledgments

This paper, supported by the U.S. Department of Energy (DOE), Office of Environmental Management (EM), Office of Technology Development and Risk Policy, is addressed to the senior manager within EM who must formulate and implement risk management policies within the context of privatization and the 2006 Plan. By design, the paper adopts a perspective a bit more general than the calculations and data base that implement the risk data sheet process and a bit more behavioral than the technical discussions than typically underlie waste clean-up planning. In doing so, it seeks to stimulate a dialog over how best to implement a least-cost, risk-based clean-up that moves away from past practices to take best advantage of economic incentives and competition, but which is realistic about the limitations imposed by technical uncertainties.

One central theme is that the 2006 Plan, if implemented seriously, changes the nature of risk planning within EM because it can be viewed as creating a new class of risks — terminal risks. These are the risks that remain when the "ten year contract" implemented between DOE and Congress expires in 2006. Dollars saved through any means can be applied to terminal risk reduction, and privatization offers great hope for risk reduction by reducing clean-up costs. Other risk management activities include those of stewardship — managing risks from hazardous lands or materials until treated — and clean-up safety — managing risks from the clean-up itself. Cost-effective, risk-based clean-up requires balancing dollars spent on each risk category to best effect.

A second theme is that risk management under privatization implies privatizing risk management. While EM as a program manager may confront grand tradeoffs between terminal risks, stewardship risks, and clean-up risks, it wants its contractors to behave "according to the book," based on financial incentives embedded in their contracts. To do this, EM must convert its own environment, health and safety risks to contractors' financial risks and do so in a manner that removes DOE as a day-to-day consort with contractors, a break from the past.

A final theme is that privatization entails the art of the possible. Not all projects can be privatized, and even candidates for privatization may require special packaging to capture potential cost-reducing opportunities. Once EM begins to use incentives to its own best interest, it will create rivalries among firms for clean-up business that will, in turn, break-up traditional relationships between DOE and its M&O partners and force DOE to forego privileged access to technical information. It will be compelled then to rely further on competition as a substitute for "insider" information about firms' costs and business practices.

The authors are grateful to a range of colleagues far too broad to enumerate separately, though a few stand out too obviously to omit. At EM, Mark Gilbertson provided support and

insights, as well as the admonishment to provide relevant and current advice. Throughout the EM Complex, members of the Private Sector Working Group, and especially Jeanette Berry and Rick Korynta, helped us gain an appreciation of the EM mission that provided a point of departure for this work. A number of students at Georgia State University assisted with the portion of our work conducted at the Environmental Policy Research Center, particulary the experiments. Colleagues at member institutions of the Joint Institute for Energy and Environment (JIEE) provided comments on earlier versions of this paper, and technical assistance in its preparation. Sherry Estep edited the document and offered critical comments, and Kathy Ballew and Glenda Hamlin designed and prepared the document. Naturally, we offer thanks to these individuals while absolving them of any responsibility for the final product.

Under the terms of our agreement with DOE, the authors are accountable for the contents of the document. Neither DOE nor its employees have had control over nor bear responsibility for the views expressed herein.

I. Introduction and Executive Summary

The Department of Energy's Office of Environmental Restoration and Waste Management (EM) faces a challenging mission. It must reduce, and where possible, eliminate ***risks to workers, the public, and the environment*** that arise from the remnants of Cold War nuclear weapons production. It must convert wastes to stable forms that can be disposed of or otherwise stored indefinitely and transform the facilities and lands on which the wastes were produced to acceptable end-states. Mission success requires the reduction of terminal risks through clean-up and site closure, as well as the management of interim risks to human health and safety inherent in the clean-up process.

EM is further challenged to increase its productivity. It has inherited an administrative apparatus from the weapons production process that employs privately-operated facilities, with direct DOE participation in management practices and decisions. This apparatus excelled in managing a nuclear weapons industry at a time when the threats of international conflict placed an unconstrained premium on performance. In peacetime, the clean-up of the nuclear weapons complex must compete with other federal programs and priorities for budget dollars. To maintain the budget needed to reach closure, DOE must be prepared to argue it is effectively achieving greater efficiency.

Additional complexity is added by EM's unique constituency which is composed of distinct local and national interests. Local stakeholders pursue a mixed agenda of ensuring that risks are responsibly managed while seeking for their local economies the continued stimulus of federal dollars. In contrast, national stakeholders charge that EM has spent too many dollars and produced too little clean-up. Thus, while efforts to reduce costs are viewed locally as potential evidence of shirking from risk management and local economic responsibilities, these efforts are required nationally to maintain budgets necessary to complete clean-up.

To increase efficiency, EM is undertaking a number of highly innovative initiatives — two of which are of particular importance to the present study. One is the ***2006 Plan***, a planning and budgeting process that seeks to convert the clean-up program from a temporally and fiscally open-ended endeavor to a strictly bounded one, with firm commitments over a decade-long horizon.[1] The second is a major overhauling of the management and contracting practices that define the relationship between the Department and the private sector, aimed at cost reduction by increasing firms' responsibilities and profit opportunities and reducing DOE's direct participation in management practices and decisions. Collectively, the process of designing and

[1] The 2006 Plan evolved from EM's Ten Year Plan. It basically seeks to convert the largely open-ended planning approach previously undertaken by EM to a plan bounded by time and dollars. The plan emphasizes making tradeoffs and choosing activities that deliver the most clean-up for the dollar. It also recognizes that each major player — stakeholders, DOE, OMB and Congress — has distinct interests that must be resolved if the process is to succeed. See DOE-EM, *Accelerating Cleanup: Focus on 2006*, discussion draft, June 1997.

implementing this new relationship between the Department and the private sector is known as ***privatization***. Throughout DOE privatization is guided by a set of principles, reproduced in Appendix A. EM is also participating in DOE's larger re-engineering effort that seeks to focus internal efforts on DOE's core activities, off-load activities outside its core, and generally achieve efficiencies that lead to reductions in the Department's size.

Privatization, as practiced at EM, has two essential features.[2] First, EM seeks to transfer a portion of the financial risk of project failure to its contractors by writing ***fixed-price*** contracts. Fixed-price contracts provide incentives for firms to cut costs in order to increase their profits. In exchange, the firm bears the risks of incurring financial losses if it fails to deliver at the agreed upon price. Second, EM seeks to ensure its fixed-price contracts are also low-priced contracts by placing firms in competition with one another. In contrast to its traditional contracting approach based on long- term relationships with DOE participating in decision making and bearing virtually all financial risk, this new approach provides a carrot and stick — the promise of profits and the threat of losses — to motivate firms to perform independently and efficiently within the constraint of a fixed budget.

The 2006 Plan provides a similar constraint, promise, and threat. The constraint is the ten year planning environment and a fixed budget over time. The promise is the achievement of greater terminal risk reduction (within ten years) if costs savings can be realized. The threat, however, is more complex. Through its 2006 Plan, EM has essentially entered into a "fixed-price" contract with Congress. If EM fails to deliver, its losses may well be spread throughout the complex as unfinished tasks — which, under the current terms of its agreement, translate into perpetual terminal risks to environment, safety, and health.

Taken together, these initiatives fit well with re-engineering. By transferring responsibilities for selected activities to the private sector, DOE both encourages greater internal focus on core aspects of clean-up and potentially relieves itself of oversight responsibilities which in turn permits staff downsizing. The constraints of the 2006 Plan reinforce the need for continued diligence toward efficiency, effectively setting a clock ticking that can be monitored by its national constituency. Yet there are also pitfalls. The final privatization principle (Appendix A) declares that "privatization requires a new way of doing business." Developing new business practices can be costly if threats to success are not anticipated and avoided.

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[2]The term privatization can be used to refer to other practices that include sale of government facilities to private owners, deregulation, leasing arrangements, and a variety of other transactions, not dealt with here. On its privatization home page (http://www.doe.gov/privatization) DOE divides its privatization activities into contract reform, asset transfer, and divestiture of functions, each of which comes into play for the clean-up. In addition, EM has also used the term privatization to describe several specific initiatives, including the requirement of forward financing of capital facilities by the private sector (to be amortized during waste treatment phases) the pooling of demands for waste treatment across sites into a smaller set of common contracts that multiple sites could access at fixed unit prices, and simply cost control through locking in costs using firm fixed-price contracts.

One threat to EM's success lies in the possibility of its failing to understand how its initiatives may combine to generate unexpected results. Coupled with the constraints imposed by the 2006 Plan, ***privatization will markedly transform the administration of risk reduction and risk management within EM.*** In particular, it will for the first time create a direct linkage between risks to the environment, safety, and health (ES & H) and financial risks to firms and to DOE. This process will force EM to manage two tradeoffs that it has not before explicitly faced.

First, EM must face the tradeoff between allocations of program dollars and terminal risk reduction achieved through clean-up and closure. This includes making judgements as to whether dollars spent on managing risks (i.e., on controlling existing risks and controlling risks imposed by the clean-up process itself) balance dollars spent on reducing terminal risks, i.e., risks remaining at the end of the 2006 Plan. Under the 2006 Plan, EM has self-imposed time and budget constraints within which it must allocate resources to achieve the greatest level of terminal risk reduction consistent with its responsibilities to health and safety. Other things remaining the same, privatization potentially can reduce the burden of this tradeoff by increasing clean-up productivity, thereby stretching fixed budgets. But there is a downside if savings do not materialize. Simply put, if costs exceed planned budgets, some tasks may be left undone, with attendant terminal risks.

Second, EM must manage the tradeoff its private contractors may face between lowering clean-up costs and engaging in responsible risk management practices. Expressed differently, creating opportunities for private firms to earn greater profits could lead them to a reduced commitment to human health and safety, unless contract terms specifically link firms' financial risk to their ES&H risk. In practical terms, privatization and the 2006 Plan have linked dollar and lives inextricably, and now challenge EM to develop means to manage private contractors as effectively through indirect means as it once did through direct ones — or more so.[3]

EM must adopt a benefit-cost mentality that recognizes tradeoffs between risks and dollars as it develops its new administrative apparatus. This, in turn, requires taking into account the motivations behind private sector behavior and making use of financial and market incentives to reduce costs while ensuring responsibility. EM must take these behavioral considerations into account because through privatization it is essentially off-loading its direct oversight function.

This paper, by the Joint Institute for Energy and Environment, takes as its point of departure the tradeoff between financial risks and risks to human health and safety and explores

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[3]Even discounting the possibility that Congress will fail to appropriate funds to complete the clean-up, the promises under EM's self-imposed 2006 Plan are taken seriously. In a mid April (1997) *CSIS Forum*, Alex Flint, a staffer on the Senate Appropriations Committee, stated that Congress, like a bank, needs assurance from DOE that they have minimized the financial risks of investing their projects. As an appropriations staffer, he described himself as being in the same position as a loan officer. He requested that Assistant Secretary Alm assure the committee that the money they appropriate justifies DOE performance. Flint stated that the Appropriations Committee does not want to continue to pay for default costs due to the poor management of DOE programs.

how EM can use financial incentives and technical information to shape its new management and contracting practices. This perspective contrasts sharply with the foundations of DOE's traditional management structure. The old structure viewed DOE and its contractors as a partner relationship in which DOE absorbed financial risks and participated in decisions, and contractors provided managerial and technical staff who were virtually direct extensions of DOE staff. The new perspective views the culture into which the Department is entering as market-driven, rather than administration-driven, with DOE structuring competitions to its best advantage. It focuses on indirect, rather than direct, controls and on motivating desired behavior rather than prescribing it. It recognizes that, in addition to market forces, there remain numerous technical considerations that increase in importance for specific projects, but that under privatization DOE must largely look to its contractors for independent technical solutions. It also embraces the principle that privatization is a management tool, rather than an independent objective.[4]

The goal of this paper is to provide an independent perspective on how EM should create new management practices to deal with private sector partners that are motivated by financial incentives. It seeks to ground this perspective in real world concerns — the background of the clean-up effort, the very difficult technical challenges it faces, the very real threats to environment, health and safety that have now been juxtaposed with financial drivers, and the constraints imposed by government's unique business practices and public responsibilities. The approach is to raise issues through application of first principles. The paper is targeted at the EM policy officer who must implement the joint visions of the 2006 plan and privatization within the context of the tradeoff between terminal risk reduction and interim risk management.

The paper reaches a number of relevant conclusions.

- Not all projects can — or should — be privatized. There are severe legal constraints placed by the courts on the enforcement of fixed-price contracts in the face of significant uncertainty. When these are ignored, the courts may, through constructive change, convert fixed-price contracts to cost-plus contracts, negating advantages gained by privatization and probably add to costs. Cost increases will likely occur because privatization is lodged within a new management culture that budgets

[4]Privatization has leaped quickly from the drawing board to implementation, with several projects having been contracted to private firms using fixed-price management and contracting procedures. The privatization home page describes numerous activities of this kind. Two particularly large, complex and visible projects, the Hanford Tank Waste Remediation System (TWRS) and the Idaho "Pit 9," are now underway, as are a smaller number of efforts that range from outsourcing laundry services to smaller tank waste remediation efforts at Savannah River. An early review of these efforts by the GAO (letter report dated Jan. 31, 1997, from Victor Rezendes to Senator John Glenn) cautioned against declaring early victories for privatization, noting that estimates of savings relative to clean-up by M&O contractors were not clearly established, particularly in light of a history of fixed-price contract cost overruns by EM. DOE responded that the numbers cited were not contract overruns, but cost increases. DOE further argued the need to measure progress over time and to apply lessons learned to its management practices. Such exchanges provide clear evidence of the need to establish conceptual principles to help create realistic expectations for privatization's role in the clean-up effort and develop management tools to achieve them.

projected savings from privatization for future activities. If a project scheduled for privatization overruns its budget, terminal risk reduction targets will not be met. Interim risk management may also be jeopardized, because the management resources required for cost-plus management will have been redeployed. Privatization requires compatibility with fixed-price contracting.

- There is a corollary danger in carelessly or strategically declaring incompatible projects to be successfully "privatized". Even if EM recognizes that privatized projects are likely to overrun and then budgets accordingly, failure to meet its declared goals drives up DOE's own financial risks as perceived by Congress, and will erode Congress's faith in its "fixed-price contract" with DOE. Like a private business, DOE must inspire the confidence of its "banker."

- EM can undertake steps to increase the compatibility of a project with fixed-price contracting by dividing the project into phases or segments that are designed to reduce technical uncertainty. This is called sequencing. It is easy to construct examples that demonstrate that, by dividing a clean-up project into characterization and treatment phases, savings can be achieved. Similar economies can be derived from undertaking demonstration phases prior to production. Such arguments support some of DOE's traditional practices of extensive characterization and demonstration, if they are related directly to achieving greater efficiency. However, EM should not apply this principle in a cookbook manner. It must also explore gains from robust technologies that reduce the value of specifying waste inputs and the implications of larger numbers of smaller projects for losses in economies of scale.

- A corollary is that EM must carefully consider the manner in which projects are defined. DOE's management legacy left a clean-up agenda defined by scientific factors rather than by the pursuit of cost discipline. Because technical risks translate directly to financial risks and in turn to greater terminal risks there is strong justification for reconsidering project definitions to emphasize opportunities for cost reduction.

- Taken together, concerns for compatibility and sequencing will lead EM to devote greater initial attention to planning.

- Once a decision to privatize an activity is made, a procurement strategy composed of two parts must be undertaken. First, an RFP describing a contracting process must be developed that will provide incentives for firms to behave responsibly on matters related to ES&H. This must include a means for EM to ensure ES&H risk management indirectly,

rather than directly. Second, a process for selecting a low priced bidder must be developed.

- Following EM's traditional approach of participating directly in its contractors' decisions about ES&H will undermine its privatization goals. If DOE participates in these decisions it will risk creating opportunities for change orders under which contract costs increase. It also will tend to impose rigid requirements rather than encourage flexible procedures tailored to specific project needs. Instead, EM should consider undertaking ES&H risk management through contract terms that provide private contractors with incentives and penalties for ES&H compliance and which are self-enforcing, perhaps along the lines of an ISO 14000 structure. To the extent possible, EM should adopt an arm's length approach to contract management in general and ES&H risk in particular — a buyer, rather than a partner.

- The Department's commonly used process for soliciting bids — involving either negotiation or what is called a "first price auction" — will *fail* to achieve EM's goals of ensuring that contracts are let to least-cost, qualified contractors at the lowest possible price. Procurement processes that provide bidders with incentives to bid low because of competition with rivals should be considered instead. EM should anticipate that a fixed-price contract, negotiated because technical terms could not be sufficiently fixed to support price competition, will likely not be delivered as originally priced.

- Whereas under cost-plus contracting DOE had complete access to its contractor's information base, under privatization, contractors will have incentives to protect business sensitive information. DOE should take advantage of market incentives to offset this information imbalance.

- Developing self-enforcing, incentivized RFP terms and developing more effective selections processes will require EM to increase the resources it devotes to planning. This should be more than offset by reductions in efforts needed to manage privatized contracts. Overall, privatization fits well with re-engineering.

- EM must recognize that in developing management practices appropriate to privatization it sends signals to firms that will lead them to form expectations about future EM behavior. For example, if EM creates price competitions around incompatible contracts, firms will believe that underbidding actual costs is a desirable strategy because losses due to technical uncertainties will be compensated by the courts. Hence, all firms will underbid, many will experience losses, and the courts will determine DOE's ultimate costs. In general, EM should

treat all procurements as part of a larger business strategy and consider that individual choices will set precedents for activities throughout the Complex.

- EM's greatest challenge may come in evaluating tradeoffs between interim risk management and terminal risk reduction, and having done so, escape the confines of compliance that militate against cost-saving and risk-reducing changes. In the past, without the constraints imposed by the 2006 Plan, EM avoided this by pushing terminal risk reduction forward into the future. If it can no longer do this, it must develop protocols to guide decisions concerning the benefits and costs of risk management relative to terminal risk reduction for privatization management practices.

These conclusions rest upon what we term ***privatization principles for risk management***, to which the remainder of the report is devoted. Section II describes ***incentives*** in terms of firm behavior and market behavior. Regarding firm behavior, it discusses the character of fixed-price contracts relative to other contracting arrangements and explains why shifting financial risk through fixed-price arrangements requires explicit attention to ES&H incentives. Regarding market behavior, it introduces the idea that different bid solicitation mechanisms provide firms with different bidding incentives. This section also discusses ***information*** as an economic concept and how proper conceptualization of information affects EM's development of management and contracting arrangements.

Section III discusses the ***compatibility principle*** — the conditions that make a project compatible with fixed-price contracting. In essence, compatibility means that a project's technical uncertainties must be definable with sufficient clarity so that a fixed-price contract can be managed as written. The point here is that unless contracts are compatible, the legal doctrine of constructive change makes judicial remedies available to the private contractor which will effectively convert fixed-price contracts to cost-plus contracts. Appendix C elaborates on this. In our discussion, it is argued that projects can be arrayed in order of technical uncertainty, with a threshold dividing projects into compatible and incompatible groupings. Many activities that are initially incompatible because of improper project definitions can be transformed into sequential phases to increase their compatibility. Failing to recognize incompatibility will effectively void fixed-price contracts, greatly undermine the credibility of privatization and will contribute to greater terminal ES&H risks.

There may also be opportunities to reduce the costs of compatible projects by further dividing them into segments, which we term the ***sequencing principle***. In formal terms, the sequencing principal seeks to manage technical uncertainty, but in practical terms, it favors redefining projects in accord with management needs rather than technical ones. Clean-up of many DOE sites involves what may be thought of as a "life cycle" with a number of distinct, related activities. An example of a common life cycle is waste characterization, waste treatment, packaging and transportation, and storage. Components of the life cycle must be viewed as a

sequence: characterization must be completed before treatment; treatment must be completed before packaging and transportation, and so on. Sometimes individual elements have their own life-cycles, such as technologies for treatment that go through development, demonstration and deployment. Risk management through sequencing can provide a logical foundation for initial characterization, provided that characterization is linked to cost reductions, but it should be in the context of minimizing costs for the entire life-cycle. Hence, rather than applying the principle mechanistically, managers must also seek opportunities for applying technological fixes, like robust technologies, and for making gains from other technical considerations, like economies of scale.

Section IV discusses the ***incentives principle***, which governs the procurement *process* that is used by the Department for obtaining fixed-price bids. Given comparably qualified bidders, EM is motivated by a desire to provide incentives for firms to undertake responsible ES&H behavior on their own volition and to award contracts to firms offering EM the most favorable price. It is relatively easy to argue that proper use of financial incentives, rewards and penalties will motivate firms to behave responsibly. Practical means for implementing this are discussed in Appendix D. However, EM can never know the true minimum cost of any contractor because contractors have strong incentives to withhold this information. The Department can use published data to estimate what will necessarily be *average* industry cost. By definition, this cost is the worst of the best and the best of the worst, i.e., greater than the costs of the least-cost, most efficient, contractor.

The critically important question then becomes: do the procurement processes commonly used by the Department (negotiated contracts and/or what is referred to as a "first price auction") serve this purpose? If not, does *any* bid solicitation process succeed in ensuring EM that it will achieve its goals? The answer provided by the incentives principle is that current practices do not, and EM should give serious consideration to the use of different procurement processes. The recommended processes that are those in which it is demonstrably true that contractors have incentives to offer bids that reflect their minimum costs — i.e., *the contractor's best interests are served* by the submission of bids that equal their true minimum costs. Two examples of such "incentive-compatible" procurement processes are the English Auction and the Bid Improvement Auction. EM's use of either of these processes will allow them to achieve their goals of ensuring that contracts are let to least-cost, qualified contractors and at the minimum cost DOE can obtain.

Section V concludes the document by returning to the key findings and exploring the alternative management practices they imply. One clear implication is that privatization and the 2006 Plan will force EM to a abandon a purely technical approach to risk in favor of one incorporating features of benefit-cost analysis to evaluate tradeoffs between management of interim risks and reduction of terminal risks. Despite the distasteful prospect of being called to task for "equating risk with money" this is in fact what the public, acting through Congress, requires of DOE.

Throughout the paper, we focus on principles that underlie market behavior, describe their relevance for the DOE Complex, relate them to current experience, and propose methods by which the Department, if it so chooses, could implement them. We develop our principles logically and at some length and believe that the lessons that follow from them are non-controversial, if not largely common sense. What is controversial is the fact that current practices, for specific projects, for a variety of reasons, often conflict with common sense.

II. Information, Incentives, and the Privatization "Marketplace"

To set the stage for discussing the privatization principles, it is necessary to describe the key elements that motivate private firms operating in markets and how and why EM might take advantage of these incentives. Nobel Laureate Milton Friedman has long taken pride in explaining why within the confines of a highly simplified marketplace (that of perfect competition), market prices provide sufficient information and incentives for agents participating in the market to behave in their own best interests and at the same time optimize the well-being of other market participants. This dictum has been repeated since the time of Adam Smith.[5] Such market outcomes are ***economically efficient*** in the sense that, within the confines of initial wealth holdings, production occurs at least cost and no individual could be made better off without making another worse off — the ultimate win-win situation. In the textbook world of perfect competition, large numbers of buyers and sellers share a common information base and apply common technologies. Impersonal exchange takes place through a market institution in which prices signal the relative values of inputs and outputs, and agents trade until a market equilibrium is reached.[6]

The problem with applying such a concept of the "market" and "market forces" to DOE's clean-up task is that the conditions of perfect competition are not available to DOE from existing institutions. First, there is no natural marketplace. Instead, EM must construct a procurement system that emulates a market's desirable features. Second, there are not large numbers of participants (many workers, but few firms). There are the government and a few sellers (vendors), at best. Information is not shared equally, and there is no system of posted prices to guide incentives. Finally, in the world of perfect competition, there is no government, but in the real world EM has explicit responsibilities for risk reduction and management and is accountable to stakeholders for doing so. One might ask whether, given these conditions, a procurement process can be developed that is truly analogous to the textbook market. This is the wrong question. Instead, one should ask if studying the textbook market can provide insights into the real world problems facing EM and improve the design of its procurement process to balance

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[5]Milton and Rose Friedman, *Free to Choose*, (Avon Books: NY, NY) 1979. See esp. Chapter 1. Similar arguments are reproduced in virtually every principles of economics text.

[6]Incentives for individual sellers arise because prices are essentially fixed, and firms earn profits (rents) as the difference between selling price and costs. They thus face significant incentives to reduce costs.

cost reduction and risk management. To this, the answer is clearly affirmative. The following discussion is organized into three sub-sections that take up the issues of the attributes of the procurement "market" — information, incentives, and the unique role of the DOE management and operations contractor — that will bound EM's ability to create a privatized procurement system.

II.1 The Procurement Market

The arena for EM waste clean-up activities that are candidates for privatization is highly specialized and differs markedly from perfect competition. There is only one buyer, the Federal government. There is a number, but a small number, of sellers. Information is not equally shared by all participants, and "facts" may not be known with certainty. Incentives are provided by the contract terms and product specifications which, under current practices, the government may or may not announce before "trading" takes place. "Trading" consists of a procurement process that may entail competitive price bids, but may also entail additional non-price elements, such as firm qualifications, willingness to participate in community affairs, and past performance. In some cases, price is negotiated after a competition on non-price attributes is completed. A "purchase" occurs when the government announces a winner, but even then, the process may continue as the government revises specifications, reviews the firm's business practices, and orders changes in products, practices and other terms of the agreement.

Within this jungle of rules, exceptions, and changes, it is easy to see why EM's 2006 Plan seeks to increase efficiency by drawing from market practices proven outside the clean-up arena. Nevertheless, there are strict constraints on any new practices: they must stand the test of legality, and they must protect the Department's ES&H responsibilities.

Potentially, the Federal government enjoys significant advantage in developing the privatization process, because it both enjoys market power by virtue of its status as sole buyer and has the opportunity to set the trading rules. Yet it must do so in a way that offers firms sufficient opportunities for profit to attract them to the process. It must also struggle under the inertia of its current procurement system, which includes Federal laws governing procurement and a body of case law that has eroded a significant portion of the government's advantage.

II.2 Information and Uncertainty

Information is a common, everyday concept that is defined for present purposes to consist of the entirety of facts potentially available to all market participants — sometimes called the ***information set***. This concept is fundamental to markets because it forms the basis on which decisions are made. Several characteristics of information are critical to the privatization process. First, not all information is shared by all participants, or stated differently, any market participant can have access to only a fraction of the totality of information. This attribute is sometimes known as ***information asymmetry***. A second attribute is the fact that information

may not be absolute, but may be subject to ***uncertainty***. Third, for individual market participants, including the government, information is ***dynamic***, in the sense that participants, though their own actions or through normal market processes, gain access to additional information. Finally, the information set can change through ***R, D, & D*** (research, development, and demonstration) by government or other market participants.

The information set on which market participants base decisions consists of a broad set of facts. Regarding the waste, it is the totality of knowledge concerning the attributes of the waste to be treated, based on past or ongoing waste characterization. For the technologies, it consists of technical literature (the science and engineering on which technologies are based), observations of demonstration and production runs for relevant waste streams, and actual experience in production. It also consists of awareness of the portion of the information set available to each market participant, that is, knowledge of information asymmetries.

Information asymmetries reflect the fact that different market participants play different roles and have different experiences that lead to possession of different types of knowledge. For example, a research institution, like a university or national laboratory, might have a deep understanding of the technical literature but little experience in demonstration and none in production. Firms participating in characterization activities will have experiences other potential vendors do not. Firms working in specific regions better understand local conditions, like labor markets, than those who do not. Sometimes information asymmetries arise because firms behave strategically to gain advantage. For example, a firm engaged in characterization may fulfill its contractual obligation for information disclosure and still retain information that could give it advantage over competitors, a circumstance we refer to as ***insider information***. Or, a government manager might be assigned a narrow task, while firms seeking to win a task competitively might work in a broader range of tasks and enjoy a corresponding advantage. Individual market participants typically strive to protect the information that gives them advantage. For example, a firm with extensive clean-up experience knows precisely how its internal production processes perform, whereas other firms have similar knowledge about their own processes. The government typically would not have access to any firm's proprietary information and must structure the procurement process to account for this information asymmetry.

When facts are known imprecisely or probabilistically, they are said to be uncertain. Uncertainty can take a number of initial forms, such as a range inside which a parameter must fall, or the likely distribution, for example, of contaminants in a waste stream. They may concern the way that a technology will perform when scaled up to a new level or when applied to a new waste stream. Uncertainty can also characterize one participant's belief in the level or character of information held by another market participant. For example, if one firm believes it enjoys a significant cost advantage that belief will affect its bidding. Or, if the government believes a firm can produce at a particular cost, that belief will affect its negotiating posture.

All forms of uncertainty share the attribute that they can be stated in the form of a lottery, though the specific attributes of these lotteries can differ substantially. For example, a gambler

will examine the odds, cost of betting, and payoff to determine the expected value of say buying a raffle ticket for a fishing boat or placing a bet at a craps table. In this case, the attributes of the lottery are well-specified, and the choice by the gambler will depend upon his or her risk preferences, that is, willingness to accept, reject or be indifferent to an even bet. For other cases, the dimensions of the lottery may be known with much less precision. At the extreme, a mathematician developing a certain line of logic may be completely unable to predict where it will lead, an example of purely basic research. An experimentalist may know that one of a series of ten independent experiments may solve a problem, but be unable to arrange them in order of likely success. An engineer may be able to bound the performance of a waste treatment operation in a new application but be unable to describe the mean of the performance distribution. As will be seen below, uncertainty will prove critical to EM as it fashions its privatization process. For example, the courts have held that certain contract types, characterized by excessive uncertainty, cannot be enforced. It is equally important to recognize what one does not know. The recent explosion at the Hanford tanks illustrates the uncertain nature of the wastes stored within, as officials reasoned from the incident the likely contents of the tank.[7]

II.3 Incentives

The term incentives also is given meaning through common usage, but again, a more precise definition is required for analytical purposes. Incentives are the elements in the firm's business environment that guide profit opportunities. EM can influence incentives through the structure of the procurement process, including the nature of the contract and the bidding rules. Incentives, thus, lead firms to behave in a predictable way in order to gain financial advantage. . Of course, not all firm behavior is driven in all circumstances by the pursuit of profits. Firms adopt behavior as corporate citizens, as reflections of owners' preferences and prejudices, and from any number of other systematic or random influences. Nevertheless, pursuit of financial incentives is an excellent first approximation for explaining firm behavior, because in competitive environments firms that fail to earn competitive rates of return on investment go out of business.

The government can structure the incentives of the procurement process in two general ways: (1) by the contractual terms it defines through the request for proposal and ultimately through its contract with the firm; and (2) by the way it structures the procurement process to influence the behavior of the firm in the bidding process. These two steps must be consistent:

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[7]AP 5-2-97. "An explosion at the Hanford nuclear reservation's Plutonium Reclamation Facility apparently was caused by a spontaneous reaction of two chemicals stored in a tank...A preliminary investigation concluded the 408-gallon tank contained less than 40 gallons of a liquid solution of hydroxylamine nitrate and nitric acid....Both chemicals were once used at the building to recover plutonium from waste materials produced at Hanford...officials initially had given conflicting accounts about the likely contents of the tank, with one saying it had contained hydroxylamine nitrate and another saying it instead contained only nitric acid. One factor that apparently led to the explosion was evaporation that had occurred in the tank during storage....The evaporation caused higher concentrations of the two chemicals. The reaction created steam and nitrogen gas, which blew the top off the tank without causing a fire...

carrying out one competently without considering the other will fail to obtain the best possible price.

The fundamental means for the government to provide incentives for firms to behave efficiently is to write fixed-price contracts. In a fixed-price contract, the firm agrees to deliver a specific product in exchange for a fixed sum of money; delivery triggers payment. An auto buyer negotiating to purchase a new car is an apt analogy. The buyer first evaluates his or her needs and enumerates a list of requirements, up to and including warranty periods and coverages. This set of requirements is then presented to a number of dealers who make bids. Given comparable vehicles, the buyer chooses the lowest bid.

The extreme alternative to a fixed-price contract is a cost-plus (or level-of-effort) contract. Under this arrangement, the producing firm agrees to make a best faith effort and to expend a minimum quantity of resources in pursuing an end prescribed by the contract. The agreement is akin to the purchase of a custom-built house wherein the buyer and builder work together to meet the buyer's requirements, including revising plans and rebuilding the structure to ensure that buyer's specific needs are met. Here the buyer assumes financial risk and must monitor the activities of the builder. The builder, in turn, recovers costs as accrued. Detailed discussion of contracting is deferred to Section III below, but several observations are useful at this point.

First, under fixed-price contracts, firms have the opportunity to earn profits, but bear financial risks in exchange. Like firms in competitive markets, their profits are calculated as the difference between the fixed price and costs. By reducing costs they increase profits. Because of uncertainty, firms realize that there will be a set of circumstances in which net revenues will be negative, and this risk will be reflected in the bidding process. However, for any given bid, the firm has the incentive to perform as efficiently as possible.

Second, under a cost-plus contract, profits arise as a "fee" calculated on some base, such as the initial contract value, rather than as a residual between revenues and costs. The government reimburses the firm on the basis of effort expended. Under this form of contracting the firm bears no financial risk (all risk is borne by the government), has no influence on profits, and has no incentive to reduce costs. Thus, the government must manage the contract to provide cost (and other regulatory) oversight. So, one might ask, why ever write cost-plus contracts? The answer lies in the degree of uncertainty present. Clearly, no firm would undertake basic research, as described above for the mathematician, as a fixed-price contract, because the product could not be specified adequately or guaranteed. Likewise, firms would balk at carrying out experiments under a high degree of uncertainty, just as no home builder would agree to meet a customer's undefined requirements at fixed-price. Hence, as is discussed in detail in Section III, one key to successful privatization lies in recognizing and managing uncertainty.

A fixed-price contract will guarantee that firms will seek to reduce costs, but could lead to shirking on E, S, & H responsibilities in pursuit of profits. Thus, contract terms must provide financial incentives for responsible behavior. However, merely transferring financial risk to

contractors by providing incentives for cost reduction is not EM's singular goal. EM also wishes to obtain the best possible prices which, when all else is equal, means selecting the lowest cost, qualified, private firm to carry out the clean-up. The rationale is simple. DOE cannot know the firms' costs and cannot evaluate the quality of a bid, absent bids from other firms. In simple terms, it will not know if it has the best price or not. Hence, it must design the bidding process to provide incentives for the lowest cost firm to win the bid by bidding the lowest price. EM must thus employ incentives to guide firms to pursue cost reductions, responsible ES&H, practices, and bidding strategies, all in the pursuit of profits. This can be done, and the procedure is discussed in Section IV.

We close this discussion by noting that there is no rationale for DOE to knowingly seek any bid that is less than firm costs. First, the firm may renege and not complete its clean-up, in which case DOE must start the procurement process anew. Second, the legal remedies available to firms place DOE at a significant disadvantage. Hence, driving a firm to accept sizable losses may not be a practical option. Third, there is no reason for DOE to do so, given knowledge of auctions. Fourth, DOE has years of clean-up ahead and wishes to attract more, not fewer, firms to compete for its business. And finally, as a representative of the public, the government has no interest in imposing losses on some citizens — the firms undertaking the clean-up — in favors of other citizens — those benefitting from the clean-up.

II.4 Issues of Delegation

Throughout this discussion a clear distinction has been drawn between the government and the private sector, but within the Department of Energy Complex, this distinction is less clear cut. In part, this is because in promulgating its R, D, and D programs, the Department has built up a series of public/private relationships known as Managing and Operating contractors, or simply M&Os. The M&Os have operated as agents of the Department under cost-plus contracts to carry out R, D, and D for weapons and other research, and to manage the national laboratories, uranium enrichment, and nuclear reactor development.

The M&Os have played an important role in the early stages of privatization, partly because their traditional budgets contain logical targets of privatization, and partly because of their significant technical expertise. Yet as cost-plus contractors they have little financial incentive to engage in efficient levels of privatization, because it can erode their fee base. They have also been accused of manipulating make or buy decisions (whether or not to privatize) through accounting practices. In response, the Department has created a new public/private relationship, the Management and Integration contractor (M&I), upon which are placed firm size or other constraints to ensure the M&I does not simply hire staff to perform tasks itself. How this new entity will perform has yet to be determined.[8] For example, will the M&I undertake

[8]The switch from the M&O to M&I is of more than passing interest, because DOE has chosen to lodge much of its technical expertise within its contractor base, rather than within the Department itself. This has led to numerous criticisms of DOE's ability to manage safety programs, especially by the Defense Facilities Safety Board:

incompatible projects, will these be assigned to M&Os, or will the M&I be implicitly incentivized to let incompatible fixed-price contracts? Will the M&I possess the technical expertise to substitute for the M&O in advising DOE?

Moreover, DOE may not be subject to a singular set of incentives. Headquarters staff are far removed from local stakeholders, are close to Congressional and national political pressures. Their goal is to complete the job and move on. For them, tradeoffs between dollars and risks are relatively abstract concepts. In contrast, field office staff are in close and continued contact with local stakeholders and live in the affected communities. They gain intimate familiarity with the technical challenges and the dangers attendant to mistakes. For them success means working their way out of a job.

III. The Compatibility and Sequencing Principles

There are significant restrictions on the kinds of projects that can be privatized successfully, if success is defined as completing an activity at the price bid. These restrictions derive from the considerable body of Federal Acquisition Regulations, contract law, and case law that has developed around transactions between the government and the private sector. In simple terms, the law provides a diverse set of remedies for contractors to recover costs if the terms of the contract fail to characterize the task under contract properly and to anticipate contingencies. Government contract development and management practices can influence significantly whether contracts will stand as written, but regardless of post-contract management, not all projects can be privatized successfully.

This section discusses the conditions under which a project can be successfully privatized. These conditions derive, first, from legal considerations and, second, from the management of uncertainty — conditions that are necessary and sufficient for efficient privatization. The necessary condition is that a contract be written with sufficient clarity to be enforceable, which we call **compatibility**. The sufficient condition concerns opportunities to reduce costs by taking advantage of opportunities to divide projects into phases that reduce uncertainty, which we call **sequencing**. For both conditions, once the contract is written, management of ES&H poses the greatest threat for change orders that drive up costs. An arms-

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In each of its first four annual reports, the Board recognized that the most important and far-reaching problem affecting the safety of DOE [Department of Energy] facilities is the difficulty in attracting and retaining personnel who are technically qualified to provide the management, direction, and guidance essential for the operation of DOE defense nuclear facilities. It remains the most critical problem today.

Defense Facilities Safety Board, *Fifth Annual Report to Congress*, Feb. 1995.

length approach to this management challenge will avoid many of the well-known causes for cost growth.

The discussion is organized into four sections. Section III.1 describes the contract law and relevant Federal Acquisition Regulations that define "sufficient clarity." Section III.2 shows how uncertainties in candidate projects translates into compatibility or incompatibility with privatization. We present simple examples of how projects may be transformed to be made compatible. In Section III.3 we discuss the importance of sequencing projects to reduce embedded uncertainties beyond the requirements of compatibility. Our goal here is to challenge EM managers to look beyond written contracts as a measure of success and concentrate on organizing projects into pieces that lower costs. In Section III.4, we discuss an approach to ES&H management aimed at contingency planning and arms-length oversight. This topic emphasizes the different requirements of privatized contract management relative to cost-plus contract management systems. Developing such systems would also answer critics such as the Defense Nuclear Facilities Safety Board, as the Department transitions away from the technology base lodged in the M&Os to the more restricted base contained in the M&Is.

Several useful conclusions emerge from this discussion. First, legal constraints on EM's ability to write binding contracts limit the use of privatization. It serves no purpose to attempt fixed-price contracting for ineligible projects because change orders will effectively convert them to cost-plus contracts. A corollary is that not all projects can be privatized, as EM uses the term. Second, some projects are naturally compatible. For these projects, replacing cost-plus contract mechanisms with fixed-price contract mechanisms should offer savings with relatively little rearrangement of initial project design. Third, for the remaining projects, a challenge lies in defining projects in ways that permit fixed-price contracting. Setting aside project definitions based on technical or administrative provisos, projects should be defined in segments that reduce uncertainty to a degree compatible with fixed-price contracting practices. Once compatible, opportunities to further reduce uncertainties through proper sequencing should be explored. Finally, contract management practices consistent with fixed-price contracting must be developed.

There are several caveats to these conclusions. First, whereas a fixed- priced contract provides optimal incentives for the firm to perform efficiently, in some "privatization" actions, DOE appears to have approached fixed-price contracting as a way of "locking-in" contracting costs rather than as a means of getting the lowest level of fixed-price. Obtaining favorable fixed-prices using the incentives principle is discussed below in Section IV. Second, whereas sequencing projects can help to manage uncertainty, it also implies the DOE must undertake a series of smaller projects to complete the larger activity. Whether costs savings balance the additional costs of contract development and management and lost opportunities to lower costs through larger facilities must also be considered. Finally, we would not wish to leave the impression that these topics have escaped the attention of Departmental managers, and we discuss several instances in which current efforts address issues we raise.

III.1 Compatibility and Contracting Practices

Despite our characterization of contract types into fixed-price and cost-plus classifications, there are many variations on these polar types, each of which is governed by contract law, Federal Acquisition Regulations, and case law. While we maintain this two-part distinction because it allows us to describe the incentive structures more conveniently, the existence of many diverse contracting options should be noted. Appendix C contains a detailed discussion of these variations and of the relevant regulations and law.

The Code of Federal Regulations (CFR) sets out specific conditions required for DOE to implement a firm, fixed-price contract. It describes fixed-price contracts as appropriate for "acquiring commercial-type products or services on the basis of 'reasonably definite, functional, or detailed specifications,'"[9] but only under conditions where "...the contracting officer can establish fair and reasonable prices at the outset, such as when:

a. There is adequate price competition;

b. There are reasonable price comparisons with prior purchase of the same or similar supplies or services made on a competitive basis or supported by valid cost or pricing data;

c. Available cost or pricing information permits realistic estimates of the probable costs of performance; or

d. Performance uncertainties can be identified and reasonable estimates of their cost impact can be made, and the contractor is willing to accept a firm fixed-price representing assumption of the risks involved."[10]

Present concern is with conditions (c) and (d). Both relate *to the level of uncertainty* associated with a task for which privatization is contemplated and require, as a prerequisite for a fixed-price contract, that one can identify and characterize uncertainties to the point where one can *satisfactorily* characterize the risks involved, and make reasonable, realistic estimates of costs.

The rationale for conditions (a)-(d) as prerequisites for a fixed-price contract is straightforward. If these conditions are not met, the contract may not be enforceable. The contractor, via appeal to the courts, may succeed in ***effectively changing a contract from fixed-price to cost-plus***. In other words, the DOE cannot simply declare that the contract language is sufficiently clear, exact, and unambiguous to write an enforceable contract. Until uncertainty is reduced to the critical point where (at a minimum) a comprehensive set of possible circumstances

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[9] 48 CFR § 16.202-2.

[10] *Ibid.*

has been identified, *changes* in the contract in response to changes in the DOE's understanding of circumstances are inevitable.

Contract changes may result either from direct orders for change by the DOE *or* indirectly from changing circumstances relevant for the contractor's performance under the contract. The validity of these indirect change sources is determined by the courts *via* their reliance on the Doctrine of Constructive Change (discussed in Appendix C). Changes of this type arise through case law and typically fall into one of several categories:

- changes in the scope of work;
- changes in information, required material, or equipment;
- changes in resource demands; or
- defective or deficient specifications.

When validated by the courts constructive change increases DOE contractual liability for costs plus profits.

The existence of legal requirements for an enforceable contract may then be seen as imposing critically important ***prerequisites*** for the feasibility of privatizing a project. One means to guard against constructive change lies in the development of contract language that anticipates contingencies and provides mutually acceptable remedies as part of the contract process. Appendix C examines these considerations in detail, and offers suggestions for contract language that might strengthen the enforceability of fixed-price contracts, given that projects are, in fact, compatible. However, for incompatible contracts, constructive change is inevitable. Contractors may even, in essence, wager that DOE is unaware or unwary concerning the importance of uncertainty in the contracting process and purposefully bid below costs in anticipation of change orders or constructive change. Under such circumstances, initial contractual liabilities are poor estimators of ultimate DOE liabilities under these contracts and can undermine the budget and schedules of the 2006 Plan.

III.2 Subdividing Projects to Increase Compatibility

The fact that a project is initially incompatible need not disqualify it from privatization if DOE has at its disposal a means to reduce project uncertainty. In general, this means dividing a project into smaller components with less uncertainty or into components that systematically reduce uncertainty in subsequent tasks. There are typically two approaches to divide projects. The first approach consists of dividing a project into segments along its life cycle — characterization, treatment, transport, and storage. As we discuss in more detail below, waste characterization considerably reduces uncertainty, given that it is coordinated with contracting needs. The second approach concerns whether or not a technology is sufficiently mature to be subject to contractual requirements. Like waste projects, technologies go through life cycles that

include development, bench testing, field testing (demonstration), and production. For example, for a given body of waste, it might be desirable to set aside several small portions for purposes of demonstrating the feasibility of a technology. Once completed, the remainder of the waste might constitute a project compatible with competitive fixed-price contracting.

This process is illustrated in Figure 1 which presents a hypothetical array of projects ordered from least uncertain to most uncertain, with uncertainty measured on the vertical axis. When uncertainty falls below a level of uncertainty indicated by u, projects are initially compatible with fixed-price contracting, in this case projects 1, 2, and 3. Examples of these might include the privatized laundry facilities mentioned above, libraries, food services, and the like. Just how far to carry the privatization of compatible projects is partly a matter of management philosophy, but in the private sector, virtually all opportunities for out-sourcing outside the business core are exploited. Some projects are by nature sufficiently uncertain that they are incompatible with fixed-price contracting, such as R&D projects and other projects that cannot be subdivided to reduce risk. Project 6 is assumed to be of this nature. In contrast, projects 4 and 5 are considered to be candidates for subdividing to increase compatibility. Figure 2 illustrates one type of result from subdividing projects 4 and 5 into projects 4a, 4b, 5a and 5b. Following subdivision, projects 4a and 4b are both compatible. Project 5a remains incompatible, but, once completed, reduces uncertainty sufficiently that 5b can be privatized.

Without question, project compatibility has subjective elements and should be viewed as a management concern while recognizing that errors in judging compatibility will take place. Nevertheless, as we treat it, compatibility closely parallels the lines that debates over contract conversion are likely to follow. Pit 9 provides an excellent case in point. Pit 9 is a roughly acre-sized parcel in Idaho selected as a "model" privatization project. Two contractors "competed" over technical elements of clean-up, and a fixed-price contract was negotiated with Lockheed-Martin Advanced Environmental Systems Company at a price of $179 million in 1994. Lockheed was to design, build, and operate a special "leaching" system to clean the pit, where several thousand drums of plutonium, laced with a plethora of other toxic materials, were buried. Unfortunately, the approach has proven ineffective, and Lockheed has requested another $158 million, plus the conversion of its contract to cost-plus status. Lockheed has blamed the government for micro-management, and DOE has argued that under a fixed-price contract, it cannot redirect contractor efforts to improve performance. Whether or not a project like Pit 9 is inherently possessed of sufficient technical uncertainty to render it incompatible is of lesser importance than the management lesson provided. Given past contracting practices, DOE should always anticipate that firms will attempt to recover losses, arising for any reason, through the court and should design its management systems to guard against this.[11] DOE should also take care to avoid declaring projects to be "privatized," with the express or implied expectation of significant savings due to competition, unless there is a strong case for compatibility.

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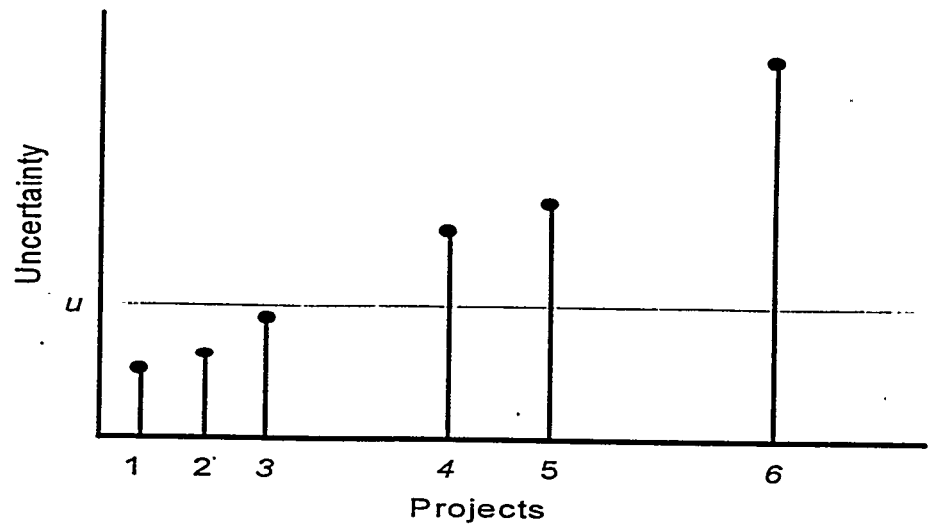
[11] AP, Reported in the *Knoxville News Sentinel*, April 22, 1997.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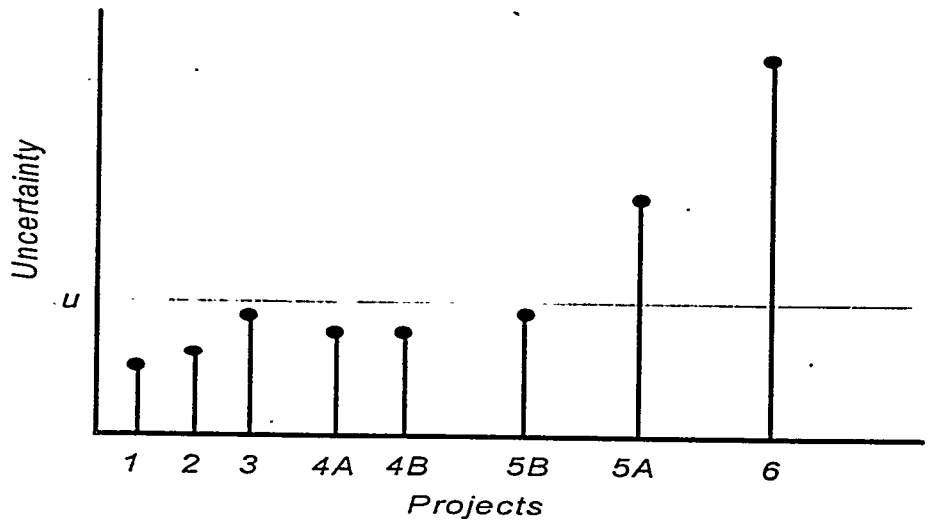
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Projects

Figure 1

III.3 Sequencing to Increase Economic Efficiency

The fact that one can write an enforceable fixed-price contract does not, however, mean that any fixed-price contract is necessarily the best that one can do. In general, cost savings can be achieved, even in fixed-price contracts, by managing the project so that a variety of life cycle concerns, including uncertainty, are optimized. Even when a compatible contract can be written, contractors will demand compensation for assuming risk that might be avoided through proper management. Typically this means dividing larger projects into smaller ones according to logical sequences, a practice we term the ***sequencing principle.***

To illustrate the sequencing principle, we examine a hypothetical waste clean-up project that involves the DOE's need to treat and then dispose of liquid materials stored in barrels at a specific site. The DOE has completed limited efforts to characterize the stored materials. This project is a candidate for privatization *if* a satisfactory contract can be written at this stage of waste characterization. Consider the following situation. Prior to characterization DOE knows that the stored wastes contain some amounts of three toxic materials $\{t_1, t_2, t_3\}$, but that there are no other toxic materials in the liquids. It does not know the proportions of any of the three toxic materials contained in the liquids; this would require complete characterization of the wastes. Its best guess is that each toxic has an equal chance of being in the barrels. To undertake both characterization and treatment as a single project would then require that a contractor (i) complete the waste characterization process (determine the waste proportions), and (ii) treat and dispose of the wastes. Under this circumstance, a contracting officer may determine that sufficient information is available to write an enforceable, fixed-price contract but still has the flexibility to divide the initial project into two projects and undertake characterization and then treatment. If DOE chooses the latter, it must decide whether to characterize the waste itself (or through its M&O) or to let a fixed-price contract to do so. These options are summarized as follows.

Option 1: Privatize total project, including characterization and treatment

Option 2: Privatize characterization and then privatize treatment

Option 3: DOE completes characterization and then privatizes treatment

Issues surrounding these options can be illustrated using hypothetical data from Table 1. Given these data, DOE could deem the project compatible and issue an RFP for a fixed-price contract for both characterization and treatment. Were it to do so the firms would add their cost of characterization to (for example) the expected cost of treatment.[12] The first column shows

[12]Because each toxic has an equal chance of being found in the barrels, a risk-neutral firm would weight the cost of treating each toxic equally. Risk averse firms would require a risk premium, and a totally risk averse firm would assume that the toxic most expensive to treat would be found. In this example, because the probability

each firm's costs of characterization. The next three columns show each firm's costs of treatment for each type of toxic waste. If the firm chooses to bid at the expected value of treatment, the sum of the products of probability and cost, it would calculate an expected cost of treatment shown in column 3. Using this method the firms' respective costs for Option 1 are shown in column 4. If DOE knew these costs, which it does not, it could potentially negotiate with contractor #2 to carry out the project for $407.

Of course, each firm can be expected to require a premium for accepting the risk associated with not knowing the waste proportions, and one would expect to see a price bid that exceeded expected costs. On the one hand, a firm that was risk averse might require a worst case price for treatment, in other words, its highest cost of treatment. On the other hand, a firm might view this as an opportunity to win a contract and later add value to it through change orders, in effect, betting that the courts would overrule the contracting officer's conclusion that the contract was compatible if a mixture of toxics unfavorable to the firm was obtained through characterization. In fact, DOE might be under some pressure to compensate the firm to ensure that it would not attempt cost reduction by shirking on ES&H.

To some extent, the strategy applied by DOE and the firms would depend on the duration of the clean-up activity. If DOE viewed this as a single, unique contract action, it might be indifferent to whether or not a firm earned a satisfactory profit[13]. It might prefer the lowest possible price that it believed it could defend against constructive change. Firms, in contrast, might avoid losses by assuming the worst case and bidding higher. If DOE instead viewed this contract as one of a number of contracts it will ultimately bid, it would prefer the firm to earn a rate of return satisfactory to encourage it to bid on other similar jobs. Satisfactory profits would, in turn, lead others to bid, stimulating competition. In this case, the firm might be willing to assume some additional risk on an individual job if it believed it would have the opportunity to work on a number of projects. In some cases, firms might adopt a "lowballing" strategy, bidding below expected costs in expectation of gaining advantage for future contracting through learning effects or by gaining insider information. In any event, the clean-up as a whole will undeniably span several years, and DOE has an interest in seeing firms earn sufficient profits. Pit 9, for example, has spawned considerable debate among contractors over the desirability of entering into fixed-price agreements with DOE.

We may thus consider two questions. First, are there compelling reasons for the DOE to prefer Option 1 over Option 2 (or 3)? Second, if Option 2 or 3 is shown to be preferred to Option 1, are there compelling reasons for the DOE to prefer Option 2 over Option 3?

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of finding each toxic is one-third, a simple average of treatment costs will estimate costs for the risk neutral firm.

[13]The notion of a satisfactory profit might vary from firm to firm, depending on its business strategy, capacity utilization, and the like. In general it includes full compensation to all productive factors, including "entrepreneurship" and compensation for risk.

Compare Option 1 with Option 2. In Option 1 the best that DOE can expect is a fixed-price contract of $407, and perhaps more for a risk premium. If unfavorable information is obtained through characterization it may face a court battle for a change order. In Option 2, DOE can potentially choose the lowest-priced contractor for characterization (contractor #3) and then with the characterization data added to the information set choose the lowest price contractor to treat the waste. Although, in our example, a different firm has the lowest costs for each toxic waste type, DOE could clearly lower its costs by segmenting the larger project. In doing so DOE would also increase the probability that each winning firm would meet its profit target, a win-win situation. DOE should thus be biased in favor of segmentation that offers significant reductions in uncertainty, despite initial compatibility.

Table 1 Sequencing Examples

	(1)	(2)			(3)	(4)
	Cost of Characterization	Cost for treatment for			Expected Cost of Treatment	Expected Cost of Treatment and Characterization
		t_1	t_2	t_3		
Contractor #1	300	100	200	300	200	500
Contractor #2	240	150	250	100	167	407
Contractor #3	225	300	100	350	250	475

The remaining question is: what about Options 2 and 3. Is there a basis for preferring one over the other? In general, one might maintain that the private sector can accomplish any well defined task at costs lower than those required by the public sector because of its ability to apply flexible practices, financial incentives, and the like. However, because DOE does not have access to the firms' cost data, apart from a bidding process or actual experience with each firm in treating similar waste, it can only estimate the information required for a ***make or buy*** decision, that is, whether it is cheaper to subcontract or do the work internally. Most likely DOE would be able to estimate industry cost averages, but in this example, averages are considerably misleading. In general, DOE might opt for privatization as a philosophical position, realizing that it might not be able to offer the same sort of hard data for waste clean-up that it could if it were deciding whether to use a commercial laundry process or whether to out-source cafeteria services. This is because, in the clean-up market, DOE is the only buyer and DOE cannot observe prices offered to other buyers. Thus, the best DOE can do is to design a competitive procurement process in which rivalry between firms substitutes for direct knowledge of firms' costs. Later, this report will consider the issues of creating incentives to fulfill ES&H responsibilities, obtaining favorable bids, uncertainty, insider information and other issues under market principles. However, we will defer that discussion until we consider management practices companion to compatibility.

It is also important to stress that recognizing the potential gains from financial risk management by sectoring does not excuse EM from exploring other life cycle opportunities for cost reductions. Returning to Table 1, it is notable that characterization costs exceeded preferential treatment costs for each toxic. If a "robust" technology were available that could treat each toxic equally well, there would be no need for characterization. In this construction such a technology would need to treat waste at less than $325, the lowest available cost using sequencing. If such a technology were available, there would be no value to characterization because it would not reduce financial risks.

III.4 Management Challenges for Fixed-Price Contracting

We have stressed that DOE's contract management procedures have been significantly influenced by many years of cost-plus contracting. In simplest terms, DOE is accustomed to participating actively in phases of project management related to ES&H. For example, for M&O contractors DOE sets procedural requirements and participates directly in accident investigations, typically prescribing changes to prevent recurrence. For privatized contracts, such practices invite change orders. One means to overcome this is to develop contract language to guide DOE's interactions with its privatized contractors. However, other solutions should also be explored.

For instance, it should be possible to remove DOE from the contractor arena totally by, in effect, privatizing the monitoring process with third-party monitoring systems. Such systems could be analogous to ISO 14000, the voluntary international environmental management standards program. This program provides a vehicle through which firms can develop internal compliance programs that are verified through third-party audit teams. The program is discussed in more detail in Appendix D.

A desirable third-party monitoring system would have the following characteristics:

a. It would create a DOE-wide standard with criteria to measure compliance with DOE's ES&H responsibilities.

b. It would provide for a third party audit procedure that would report to DOE on degree of compliance along different ES&H dimensions.

c. It would provide a direct link to terms referenced in DOE's RFP and embedded in the privatization contract through which DOE would reward or penalize the firm based on the audit report. Such a system might also provide a mechanism for "whistleblowers" to submit concerns to the audit process. The contract terms could provide for the contract to be voided for gross negligence.

d. It would support DOE's desire for continuous quality improvement without necessitating the expenditure of additional resources.

e. It would answer DOE's critics who charge DOE does not have sufficient in-house staff to monitor competently.

A third-party monitoring system would directly parallel the approach DOE should consider in designing privatization contracts. It would rely on a significant amount of up-front effort to design the proper system. Once in place, DOE would remain at arms length from actual activities unless dire consequences required action.

In closing, it is noteworthy that initiatives are already underway within EM to address several of the issues we have raised. Ongoing Complex-wide meetings are taking place through the Private Sector Working Group to pool experiences and discuss common challenges. A series of privatization training workshops has taken place in which managers from across the complex were trained in privatization initiatives.

Within the Hanford TWRS (tank waste remediation system) project contract, a highly innovative interface system between the DOE managers and the private contractors, designed to avoid, or at least contain the consequences of, change orders was deployed. Section C.2 of this contract sets up a group of Integrated Product/Process Teams (IPTs) that will address issues regarding project management, ES&H, business, contract, finance and development. This approach was developed in light of the fact that DOE faces three distinct and separate roles in this project — a customer purchasing waste treatment services, the owner of the Hanford site and the waste that will be processed, and the regulator of radiological and nuclear safety for the Hanford site. DOE plans to use an *Integrated Process and Product Development* (IPPD) approach to manage interactions with the contractor. The teams consist of technical staff from DOE, a contracting officer's representative, contractor staff, and other Hanford Site contractor staff. A team meeting can be convened by DOE to resolve issues that arise during the operation of the project in a manner satisfactory to the contractually affected parties. Failing this, DOE personnel are adjured from issuing instructions to contractors that are inconsistent with the statements of work in the contracts.

IV. The Incentives Principle

Thus far we have demonstrated that risk management through privatization offers opportunities to take advantage of market forces to DOE's best advantage. In this section we explain how this can be done. In general, DOE must structure contracts and competitive processes so that firms earn the greatest profits when they act in accordance with DOE's requirements. Such structures must accord with the earlier description of the waste clean-up "market" and with the arm's length ES&H monitoring process just discussed.

We begin in section IV.1 by considering the issue of obtaining what we term ***best bids*** by organizing the procurement to promote rivalry among firms in the bidding process. Earlier we

pointed out that DOE could not know individual firms' costs and thus could not know *a priori* what a best bid might be. Here we explain why, contrary to common assumption, it *need* not possess this information. First, we describe the procurement market and discuss what might be a reasonable set of goals for DOE to seek to achieve through the bidding process. Next, we examine four potential selection processes and the incentives they present to sellers. Finally, we discuss data that illustrate these points.

In section IV.2 we discuss contract management incentive clauses. We illustrate this by continuing our earlier discussion of efficient contract management practices. The general approach is to convert non-price contract terms to price terms, such as through penalties or bonuses. In these cases, contracts might better be called fixed-term, rather than fixed-price, contracts. DOE, in fact, in using such terms in some contracts.

In the course of this discussion we reinforce several lessons related to risk management under privatization. First, to obtain best bids DOE must structure the selection process so that it is not penalized by the fact it does not know a firm's true costs. Coupling such a selection process with fixed-price contracts allows DOE to take full advantage of its market power. Second, using penalties and bonuses allows DOE to pursue non-price goals within the structure of a fixed-price contract. DOE should be prepared to answer its critics' charges that privatization increases ES&H risks by replying that properly structured contracts provide the firm with exactly the same incentives that DOE has to reduce hazards. Finally, DOE should avoid replacing inter-firm rivalry with negotiation. When DOE negotiates, it is limited in achieving its goal of a best bid by its lack of knowledge about its potential vendors's costs.

The major caveat arising from this section is that DOE has developed most of its contract management mechanisms to deal with cost-plus contracts in which it directed behavior. Applying these same principles to fixed-price contracts will likely prove unsuccessful.

IV.1 Obtaining Best Bids

The clean-up procurement market is characterized by one buyer and a small number of sellers. There is a shared body of common knowledge available to both DOE and the sellers that includes the attributes of the waste itself, the technology base available for treating waste, the disposal criteria, and industry average costs. Each firm, however, has private knowledge of its own costs and business strategy, and it attempts to use that private knowledge to its best advantage. This includes the firm's capabilities, experience, and access to capital. In the bidding process, each firm will use this information to develop a ***reservation price*** that represents the lowest price it can bid and break even. This price includes a normal level of profits consistent with its business strategy and the risks it perceives. Each firm has unique circumstances and a unique reservation price, which DOE does not know. Both DOE and the firms know industry average costs and can compare them to their own reservation prices. Because there are costs associated with entering the selection process, firms will typically not enter if they know that their costs are greater than industry average costs. DOE also forms a reservation price, the highest price it will pay, based on the information it has available.

In designing its procurement process, DOE seeks to provide firm's with incentives to make ***best bids***. When each firm makes its best bid to occur, the firm with the lowest reservation price, i.e., the most "efficient" firm, will receive the contract, at a price that includes normal profits. In other words, DOE does not seek to cut into the firm's profits, nor does it seek to "spread the work around." It merely seeks a "fair" price, given the cost structure of the bidders.[14] Any procurement process will also reveal information over time about firms' bidding *behavior*, which will remain private between DOE and individual firms, but which, taken as a whole, will increase DOE's knowledge and bargaining ability. DOE would like for the selection process to provide incentives for firms to bid in a consistent manner that will increase the usefulness of the information to DOE. Finally, DOE would like to encourage the largest number of firms to bid.

There are two basic approaches that DOE can employ in selecting a contractor: (i) it can negotiate a price with one or more firms, or (ii) it can structure an auction or bidding system through which firms compete with one another. We discuss both processes to see how well they accomplish DOE's goals. Again, we focus only on the incentives present in each system, leaving technical considerations aside. A summary of the analysis supporting these conclusions is in Appendix B.[15]

First, consider a ***one-on-one negotiation*** process. In this case the government chooses a single firm based on some set of criteria, perhaps technical, and then seeks to negotiate a best bid. If the government's reservation price lies below the firm's, no agreement can be reached. Thus, the only case of interest is when the government's expectation of a best bid is equal to or above the firm's price. From this point, the negotiation begins. There is a variety of ways to structure this process, all of which are keyed to the quality of information each party brings to the table. If the government understands the market very well, such as for the cost of constructing a large metal building, its reservation price may be close to the firm's price. If the government must base its reservation price on industry data, it is likely to estimate a price well above the firm's depending on the cost structure of the firm relative to that of the industry. There is no reason to believe the lowest cost firm will be selected for the negotiation, and no mechanism exists to drive either party to its reservation price. Except for the fortunate case in which the two prices coincide, the firm will earn profits in excess of what it would accept.

As an alternative, consider a ***multi-party, serial negotiation*** in which the following rules are imposed. Each party submits a sealed bid. The bids are opened, and the winner is announced.

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[14]As noted earlier, losses by firms will decrease the probability that the overall program will be successful, despite potential savings to the government on individual projects, because in addition to seeking constructive change, fewer firms are likely to bid. Clearly, the Department does pursue a more complicated agenda than mere cost minimization. But even given its diverse goals, it should still seek best bids.

[15]The research presented in Appendix B considers the properties of an auction with one buyer and a small number (3) of sellers in particular detail, because, to our knowledge, no research has studied auctions relevant to EM's procurement market before.

The government then asks: "Would any firm like to improve its bid?"[16] Each firm must then compare the current price with its reservation price. If the current price is below its reservation price, it drops out of the bidding. If the current price is above its reservation price, it lowers its bid sufficiently to win the standing bid. The government then announces the current low bid and the process is repeated until no firm wishes to lower its bid. When bidding is completed, the lowest price firm has won the bid, but has done so at a price roughly equal to the second lowest cost firm's reservation price. Clearly, this is an improvement over one-on-one negotiation. The more firms in the competition the narrower should be the difference in costs between firms. Experimental evidence presented in Appendix B support these results.

Now compare this with a ***single round, sealed bid auction***. In this case the rules are as follows. Each firm must make a single bid, unaware of the bids of the other firms. Each firm is aware that if it bids below costs, it will always lose money if it wins. It also knows that if it bids above its costs and wins, it will earn excess profits. If it bids its costs and wins it will earn zero excess profits. It thus must evaluate the tradeoff between increasing its profit by bidding high and increasing its probability of winning the bid by bidding low. For a small number of sellers, each firm's best strategy in this case is to bid above its reservation price, though for a large number of bidders, competition theoretically causes bids to converge to each firm's reservation price. However, experimental evidence indicates that even with large numbers, firm's will tend to bid higher than their reservation price.[17] Thus, the winning firm will likely earn excess profits, but unlike the previous case, for small numbers of bidders there is no forcing mechanism to ensure the lowest-cost firm will win the bid.

Finally, consider a ***second-price auction***. In this case, the rules are a bit more complicated. Each firm will submit one bid. The lowest bid will win the competition, but the winning bidder will be paid a price equal to the price bid by the second lowest bidder. In this auction structure each firm has an incentive to bid its reservation price. Like in the multi-party, serial negotiation, the lowest-cost firm should always win the bid and is paid the price bid by the second lowest bidder. Experimental evidence presented in Appendix B reveals this behavior.[18]

The following general guidance emerges from this discussion. First, EM should seek "best bids" which give winning firms earn satisfactory profits, because doing so will stimulate competition and avoid lengthy court battles . It should accomplish this by making competition

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[16]This auction is similar to current procurement processes that, for example, establish a competitive range and request a "best and final" offer.

[17]This result has been reproduced on numerous occasions. The apparent anomaly is discussed in detail in David and Holt, *Experimental Economics*, pp. 284-288.

[18]To our knowledge, we are the first researchers to examine the implications of the single buyer, small-number-of-bidders market. The existence of this evidence allows us to place considerably more confidence in our conclusions regarding procurement mechanisms than we otherwise would, particularly given the anomalous behavior observed for first-price, sealed-bid auctions, commonly used in government procurements.

work to its advantage. First, because the government cannot know the cost structures of the firms qualified to carry out the clean-up, it will always be to the government's disadvantage to negotiate one-on-one because of information asymmetries. However, a properly designed auction mechanism will pool the privately held information in a way that overcomes asymmetries. Second, it is possible to design an auction mechanism such that the lowest-cost firm will always win the procurement, a result consistent with obtaining best bids. We have identified and described two such mechanisms. Third, even though it is possible to design auction mechanisms to identify and award contracts to the lowest-cost firm, the winning firm will usually earn some profits in excess of its reservation price. This is also consistent with best bids. Finally, the procurement market faced by EM (one buyer, small number of sellers) is specialized and has not been examined extensively using experimental analysis. In Appendix B we demonstrate that these results work even with as few as three bidders.

There are two potential caveat concerning these guidelines. First, either of the selection processes will work only with compatible contracts, because if a firm believes it can convert a losing fixed-price contract to a cost-plus contract, as Lockheed-Martin is attempting in Pit 9, its business strategy will be to form a reservation price below its costs. This will not only fail to allow DOE to differentiate between high cost and low cost firms, but will virtually guarantee that the winner will lose money. Second, the guidelines do not square with current practices. DOE currently employs the inferior practices of one-on-one negotiation and first-price, sealed-bid auctions. First-price, sealed-bid auctions do not perform well for small numbers and for large numbers are still inferior to second-price auctions. Negotiation places a heavy demand on the level of information required of DOE, information DOE cannot, in general, obtain.

Finally, within the context of a *series* of procurements, firms often seek to gain information that lowers their costs or reduces their uncertainties for future procurements. They do this by bidding below their reservation price, a behavior often referred to as low-balling, buying-in, or gaming. This behavior is especially prevalent in the defense sector when for weapons systems, about 85 percent of life cycle costs are designed-in during initial phases.[19] It is of significant advantage for firms to position themselves for production phases by winning design contracts. We have not examined this issue carefully for waste clean-up.

IV.2 Adding Incentives for ES&H

Risk management through privatization must guarantee that private contractors will not shirk from ES&H responsibilities in pursuit of profits. The logical response to such criticism is to remove the profitability from such practices through a series of penalties or to increase profitability for good performance through bonuses. This is relatively easy to do. We have explained above how firms take actions to increase profits and avoid losses. Using bonuses and penalties linked to ES&H performance can accomplish this end. It is also possible that EM may wish to engage in risk-sharing, in particular for risks that contractors cannot control, such as

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[19]Jacques S. Gansler, *Affording Defense*, (Cambridge, MA: MIT Press, 1989) p. 222.

changes in the law, in regulations, in budgets, and in program priorities. In a sense, no contract is truly fixed-price, because all include clauses that permit the government to terminate at its convenience. A more complex concern is indemnification through the Price-Anderson Act. In this case, indemnification removes financial incentives for compliance and tends to encourage additional government oversight. This, in turn, runs counter to the fundamental philosophy of privatization. EM should avoid blanket injunctions of Price-Anderson, and use it only on a case-by-case basis.

To implement the systems of penalties and bonuses, we have described an arms-length monitoring system through which the firm, in essence, develops its own regulatory environment. The firm can do this by proposing as part of its formal proposal an audit process to monitor ES&H activities, independently of DOE. Additional detail is provided in Appendix D. Under such an approach firms would propose penalties and/or bonuses for obtaining unfavorable or favorable audit reports. Such conditions would become part of the contract ultimately awarded to the contract winner. While this is not the only means for doing this, as evidenced by the TWRS contract, this approach is advantageous to DOE because it promotes risk management through incentives, rather than administratively through committees. It offers DOE the opportunity to establish a single Department-wide system that would be tailored to specific project needs.

One potential concern over this procedure is that risk-accepting firms might "bet" against the government, in the sense that they would still fail to behave responsibly and hope that accidents or bad outcomes would not occur. However, this danger is minimized by focusing the audit process on the ES&H procedures and protocols followed by the firm, rather than on outcomes, such as occurrences. It is also likely that such a system might spawn growth in private risk management services that, as insurers, would provide independent oversight. The overall point is not to reduce concerns for safety, but rather to locate the financial responsibility for safety outside DOE.

V. Summary and Conclusions

This paper has examined the risk management implications of developing management practices to guide privatization under the constraints imposed by the 2006 Plan. Three major principles for risk management under privatization have emerged from this discussion— the compatibility principle, the sequencing principle, and the incentives principle. From these principles a number of several lessons learned, summarized above, have emerged.

Throughout the paper we have emphasized terminal risk reduction as a goal in competition with interim risk reduction. EM's greatest challenge may come when it must ultimately evaluate tradeoffs between dollars devoted to interim risk management and terminal risk reduction. In fact, however, a number of cost saving opportunities can be implemented before hard tradeoffs are necessary. Privatization is one such opportunity. When all else is the same, privatization allows greater risk reduction with no increase in costs. Thus, in a sense, privatization avoids some hard

tradeoffs, as does implementing management practices that seek out opportunities to reduce costs through sequencing, using R, D, &D to reduce technical uncertainty, and encouraging innovation.

A second opportunity is offered by negotiating what one of the present authors has elsewhere termed a "Grand Agreement" between communities and DOE to separate issues of DOE support to community development and economic transition from those of clean-up priorities.[20] Taking up this opportunity, efficiencies would be gained by using instruments of policy specifically targeted at community needs, rather than lumping them within the flow of dollars supporting clean-up and shackling them to programs with inconsistent or conflicting goals. It would also help allay criticisms that privatization is a means for DOE to shirk on its obligations to communities affected by the end of the Cold War.

Another, potentially more controversial, opportunity is offered by reorganizing the constraints imposed by ES&H compliance, rather than ES&H performance, as a driver for interim risk management. Simply put, cookbook solutions imposed by stakeholders with multiple agendas drive up costs, and may even increase risks, because they divert attention from performance. We have identified one family of solutions to this dilemma in the private, audit-driven, ISO 14000-based, ES&H monitoring plan. While this approach stops short of targeting performance, it provides a useful and likely necessary compromise that allows DOE to indirectly monitor ES&H-related behavior while permitting firms the opportunity to design their own audit plans, thereby allowing maximum flexibility for tailoring activities to the problem at hand.

Eventually, however, hard tradeoffs will be faced. If there is indeed a fixed, or, at minimum, a limited pot of money for clean-up, EM and its stakeholders must make choices between what gets done and what does not get done. An unavoidable public responsibility conferred by this choice will be how to achieve approximately equal "bang for the buck" among competing risk management and reduction activities.

Implementing risk management choices, whether these choices are derived from exploiting opportunities or from explicit tradeoffs will demand new management tools, a practice we described above as the privatization of risk management. By this we mean that EM must find means of converting its own responsibilities for ES&H risks to financial risks for its contractors. One means for doing this is to employ fixed-price contracts for compatible projects, combined with financial incentives embedded in the fixed-price through penalties and/or bonuses, implemented through the private audit procedures just discussed. EM, its stakeholders, and regulatory counterparts must first make the choices — what risk levels are acceptable — and second develop the means for implementing them. This is exactly parallel to the steps EPA must go through: first set standards, and *then* implement them, increasingly through market-based means, such as the use of tradable emissions permits to gain efficiencies in sulphur emissions control. This sequencing of conceptual and practical issues is a very large step for EM to

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[20]Milton Russell, "Toward a Productive Divorce: Separating DOE Cleanups from Transition Assistance," (Knoxville, TN: JIEE, undated) discussion draft.

undertake, and one that breaks sharply from its past, wherein EM managers, or their M&O counterparts, undertook risk management by applying "de minimus" principles using cost-plus contracts and a bottoms-up outlook.

There is also an objective reality that underlies risk management through privatization that will be difficult for EM managers to accept. Not all projects can be privatized, and many projects now on EM's books as "privatizated," like Pit 9, may, in fact, not be compatible with privatization. To preserve the privatization option, EM may do well to create subclasses of privatization, such as "managed competition" to better describe opportunities for cost savings. But, this aside, managing privatization will require rethinking old truisms. For example, in the past, M&O cost estimates served the process of cost-plus contract management with M&Os sharing information freely. Under privatization firms have incentives to withhold information, and internal cost estimates, either to support "make or buy" decisions or to provide a basis for negotiation, will be of limited usefulness. Instead, procurement mechanisms promoting rivalry, either of one of the forms we have discussed or others, must ultimately replace DOE's belief that it possesses true insider information. The usefulness of internal cost estimates will be further limited by the passage of M&Os in favor of M&Is.

Appendix A

Privatization Principles

Principle 1: Privatization should be used strategically. While not an objective itself, privatization should be used as a strategic tool to better structure and focus the Department's resources to meet the challenges of its missions.

Principle 2: Privatization transactions should be structured to benefit taxpayers and to balance risks and rewards. Appropriate cost/benefit analysis should demonstrate the economic value of a privatization proposal to the Government. However, the risks and rewards of a privatization initiative must be balanced for all parties to the transaction to ensure a business climate in which privatization will be successful. Sometimes other considerations such as environment, safety, and health may cut against a decision to proceed with privatization even if the proposal may have economic value.

Principle 3: Competition helps ensure successful privatization ventures. Privatization efforts should harness competition to enhance performance and maximize returns to taxpayers. The competitive forces of the marketplace reward efficiency, challenge new players to participate and often lead to innovative approaches and technologies. However, when other objectives (such as community transition) are also important, the Department should weigh the public interest in achieving those other objectives against the benefits of competition.

Principle 4: Stakeholder involvement in privatization adds value and improves outcomes. Because privatization changes the way the Department conducts business, those affected by the change should participate in shaping the process. Early stakeholder involvement not only helps build support for decisions, it is often a key source of innovative ideas that can enhance the success of a privatization.

Principle 5: Worker and community transition assistance are essential. While privatization initiatives may lead to DOE work-force restructuring and downsizing, they also can translate into new opportunities for workers and communities near DOE sites. The Department will seek to mitigate the negative economic and social impacts that may result from privatization. Where appropriate, workers whose jobs would be affected by privatization should be allowed to compete to retain the work in-house by improving performance and lowering costs.

Principle 6: Environment, safety, and health responsibilities must be addressed. The Department must ensure that the safety and health of workers and the public, as well as the protection and restoration of the environment, are fully addressed when it undertakes privatization efforts. When a potential privatization may involve external regulation, the Department must ensure that appropriate regulatory agencies are notified early in the process and that efforts are coordinated to ensure a smooth transition.

Principle 7: Privatization requires a new way of doing business. The Department must develop new ways of thinking and new skills to successfully develop and manage privatization initiatives. This new thinking must challenge traditional ways of doing business in the Department.

Appendix B

Principles and Applications of Privatization Institutions

I. Introduction

The purpose of this appendix is to provide greater rigor and empirical detail concerning auction mechanisms appropriate for obtaining best bid, as discussed in the body of this report. The remainder of the appendix is divided into two major parts.

Section II defines privatization and discusses a number of issues related to its implementation, in particular, (i) what is the basis for expecting that the DOE's contracting of activities to the private sector should be preferred to the DOE's accomplishing these activities themselves; and (ii) what are the implications of alternative RFP processes relative to the gains that the DOE seeks to achieve through privatization? We argue that cost-reducing gains from privatization derive primarily from incentive mechanisms available to both private contractors and the DOE and that the realization of these gains requires that the DOE make use of contracts with market-determined fixed-prices. However, this conclusion is based on two assumptions. First, projects must be compatible, as discussed in the body of the report. Second, we assume that *there exists* an "efficient" procurement procedure — an RFP process the use of which will assure the DOE that a contract will be awarded to the least-cost contractor.[1] We demonstrate below that there is reason to believe the mechanisms we propose meets this need. In particular, we describe two mechanisms, the English Auction and the Bid Improvement Mechanism the appear to meet the tests we set for obtaining best bids.

Section II presents empirical tests from employing the method of experimental economics to the procurement problems faced by EM?? one buyer and a small number of bidders. This approach consists of placing experimental subjects before a computer terminal and in a strictly controlled environment asking them to make a series of choices based on profits and losses they will receive based on the rules of the experiment. Subjects are paid their profits and losses in cash following the experiment.

Several points should be noted concerning the use of experimental economics. First, the experiments have been structured to abstract from any values the subjects may hold about waste clean-up. We are interested only in the incentives the mechanisms we are studying hold. Second, the choices required of the subjects are not dependent on sophisticated calculation for which one would assume a major corporation would be better equipped. In this sense, the

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[1] The existence of an efficient institution assures the DOE that the contract is awarded to the least cost contractor, but does not guarantee that the DOE will receive the winning contractor's minimum cost. This issue is taken up in section II.B.1.

subjects are "equal" to the decision making processes of the major corporation. Third, we are interested in the ability of the auction mechanism we are testing to provide feedback to the subjects as to the efficacy of alternative "dominant strategies" for bidding. It is not correct that firms can analytically arrive at a dominant strategy, at least, to no greater extent than can we do so analytically prior to running the experiments. Thus, in a sense, the experiments generate data that permit one to evaluate the "theory" on which an analytical strategy would be based. Finally, the purpose of the experiments, as any experiments, is to fail to refute the theory, not to confirm it. Admittedly, our test is in a rarified atmosphere, but if one cannot generate satisfactory results in a simplified setting, they have no hope of doing so in the more complicated arena of the real world. In other words, if it fails to work in this simple setting it will likely also fail in the real world.

We are describing the results we have thus far obtained as "pre-tests" because we have not yet achieved sufficient replication to meet professional standards, but we also have no reason to believe that will not stand up to scrutiny. This is because we have run literally dozens of alternative approaches to arrive at our current state and have forgone reporting them because they are largely negative. This level of effort was necessitated because there has been, to our knowledge, no experimental study of comparable problems contained in the literature. The work is, in this sense, basic research —we have started from scratch. We are currently evaluating the next steps to take.

II. Potential Gains From Privatization: Their Source and the Design of Procurement Processes Required to Achieve Them

"Privatization" refers to the transfer of public sector activities to the private sector in ways that use competition to control or reduce costs. For the present purpose we consider aspects of privatization relevant to initiatives underway at EM as part of the 2006 Plan. In the simplest terms, "privatization" within this context refers to the use of *fixed-price* contracts, as opposed to cost-plus contracts.

If the DOE is to rely on privatization for waste clean-up, it seems reasonable to inquire as to, first, the basis for privatization being viewed as the preferable means for accomplishing tasks for which the DOE has responsibility and, second, the implications of this preference for privatization on the design of the DOE's procurement process. These topics are discussed in turn below.

II.A What are the "gains" attributable to privatization?

The case for privatization is typically based on two lines of argument. First, it is argued that, relative to the public sector, the private sector can achieve all or most tasks at a lesser cost. Second, it is argued that a fixed-price contract is always more cost effective than a cost-plus

contract. Thus, the source of "gains" from privatization is the accomplishment of a task at lower costs.

The strengths of the first argument rely on the premise that two related conditions will exist. First, the private contractor can more efficiently, and at lower cost, organize the factors of production required to accomplish the task. Two possible examples are the following:

a. The private firm has greater flexibility in changing the "mix" of expertise as requirements of the task change or become better understood. It is not obligated to maintain workforces, or to engage in public debates over its choice of business strategies. Thus, it is argued that labor costs for the private firm are more in the nature of "variable costs," as opposed to "fixed costs," than would be the case in the public sector.

b. The private firm can make better use of *incentives* than its public counterpart. An employee can lose his/her job more easily in the private sector than in the public sector. Bonuses/rewards are more prevalent in the private sector than in the public sector. Such incentives may then result in more efficient, less costly, management practices throughout the enterprise, from inventory management through employee supervision and materials acquisition.

The contracting process affords DOE the opportunity to take advantage of these attributes. With privatization DOE can use contractual provisions for performance-related rewards and penalties that are difficult if not impossible to make effective when tasks are provided by DOE employees. Examples of aspects of tasks that may be affected by incentives include timely completion of a task and meeting (or exceeding) standards of product quality and/or safety.

To summarize the above, the argument that privatization offers the DOE a least-cost method for accomplishing tasks relies on the presumption that (i) private contractors can, *via* incentive structures not readily available to the public sector operation, organize factors of production required to accomplish a task in a manner that is more efficient and less costly than can its public sector counterpart, and (ii) DOE, in its contractual relationships with a private contractor, can use incentives as leverage not otherwise available to it for affecting the accomplishment of tasks.

The second argument for privatization —- that fixed-price contracts must be less costly than cost-plus contracts — is immediately obvious, *as is its potential weakness*. Under fixed-price contracts, firms' profits arise as the residual between the contractual price and costs. The firm thus has the incentive to reduce costs in pursuit of profits. However, DOE has an incentive for firms to spend adequate amounts to ensure responsible behavior toward worker safety and the environment. Thus, DOE must write contracts in such a way as to provide incentives for firms

not to shirk in their responsibilities toward the environment, health and safety (ES&H). In contrast, firms operating under cost-plus contracts cannot increase profits by reducing costs. More often, they have incentives to perform at high levels and to minimize possibilities of failure. They thus have the opposite incentive to increase, rather than decrease, costs.

II.B Efficient Bidding Institutions.

Introduction: In what follows, our attention is focused on the question: what kind of a procurement process should DOE use to identify and choose the private contractor with the lowest costs for accomplishing waste treatment, assuming competing contractors have equal technical qualifications?

The general importance of this question arises from the unique circumstances within which this process must take place. The efficacy of most market-based bidding institutions requires, among other things, the existence of "many" buyers and sellers. For the problem at hand, this condition does not exist: there is <u>one</u> buyer (the DOE); and, given the enormous financial burdens and highly specialized expertise required for the waste clean-up projects, there will likely be <u>very few</u> sellers (bidders), maybe only three or four.

II.B.1 Efficiency vs. Incentive Compatibility.

A Digression: At this point it is important that we distinguish between two possible properties of a bidding institution: efficiency and incentive compatibility. An "efficient" institution is one that results in an optimal, least-cost, allocation of resources. For our purposes, it is one wherein the lowest cost contractor wins the bid. An efficient institution is highly desirable from a societal point of view, because with an efficient institution, the social opportunity costs of factors of production used in the waste clean-up project are minimized. An incentive compatible (or "demand revealing") institution is efficient, but it also has other advantages. For the class of incentive compatible institutions that we will consider, the rules of the institution are such that the winning bid is the lowest bid, but the winning bidder receives the *second-lowest* bid price. The potential advantages offered by the incentive compatible institution are that the associated RFP process is efficient, the DOE pays a "minimum-achievable-cost[2]" — a price that lies between the true costs of the lowest and second-lowest cost contractors — and the DOE accumulates cost information — the "true" minimum costs of contractors — which may be useful over time.

For reasons detailed in the following section, we design auction institutions that are incentive compatible under conditions where the number of sellers is small. Thus far, however,

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[2] The term "minimum achievable cost" is used here to refer to the minimum cost that is demonstrably attained in all circumstances with an institution. This is not to say that lower prices might not be obtained with other institutions. For institutions wherein bidders have incentives for strategic bidding, as in a First Price Auction, it could well be the case that for reasons that we can not formally anticipate the lowest cost contractor would see his strategic interests served by a bid that *turned out to be* lower than costs of the second-lowest-cost contractor.

we have been unable to design an incentive compatible institution for conditions in which the number of sellers is small and there exists "insider information." With these latter conditions, the best that we can do is to explore the design of an institution that is efficient.

II.B.2 Discussion of Institutions.

The critical problem that arises is that we have very limited information as to efficient or incentive compatible institutions relevant for the conditions described above: a "market" involving one buyer and (e.g.) three sellers.[3] Thus, available empirical evidence suggests that, while efficient and incentive compatible with large numbers of rivals, a Sealed Bid (first-price) auction — the institution commonly used by the DOE in its RFP processes, as well as second- and third-price auctions may be neither efficient nor incentive compatible when the number of rivals is small.[4]

Among the auction institutions for which there is at least some basis for expecting that them may be incentive compatible under conditions where there are few rivals, it is our view that the English Auction is most appropriate for the DOE's purposes.[5] The English Auction makes use of a "value clock," a clock that begins at zero and moves to increasingly higher values. Bidders stop their "clock" at the value that they wish to submit as a price for which they will accomplish the contract. The winner is the first person to stop their clock. However, the winner receives as his contract price the value on the clock of the *second* person to stop his clock.

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[3] See, for example, Davis, Douglas D. and Charles A. Holt, *Experimental Economics*, Princeton University Press (Princeton: 1993), and Kagel, John H. and Alvin E. Roth, *The Handbook of Experimental Economics*, Princeton University Press, (Princeton: 1995).

[4] Tests of the effects of changing the number of bidders on subject behavior in auctions have, in the main, been limited to experiments based on IPV models ("independent private values wherein bidders know their values and *the distribution* of values from which other bidders' values are drawn) using first, second, and third-price auctions. In general, increasing the numbers of rivals is shown to result in higher bids (more aggressive bidding) in first and second-price auctions, but lower bids in third-price auctions. Average market prices tend to rise when there is uncertainty as to the number of rivals. See Kagel and Roth, *Op. Cit.* 1995, at pp. 514-517. Also, there is limited evidence that suggests that, relative to an English auction, subjects participating in a second-price auction tend to over-bid when the number of rivals is small. This phenomena is argued to arise in second-price auctions because with relatively few subjects the low probability of "punishment" for bidding at a value other than cost (most often, bidding above cost) is small. Thus, subjects do not easily lean a dominant strategy in trial, learning, rounds of the experiment. See Kagel and Roth at pp. 511-512.

[5] An obvious alternative might be the Becker-Degroot-Marshak (BDM) mechanism. With the BDM mechanism contractors submit bids, and a contract "price" is drawn randomly by the DOE — the range of "prices" in the set of possible prices that can be drawn must include all possible bids. The contractor with the lowest bid that is under the "price" that is drawn wins the contract and receives the drawn "price." In terms of the price ultimately paid for the project, the drawn price may exceed costs of the second-lowest cost contractor. Thus, the price paid under the BDM institution may often exceed the price that would be paid with institutions like the English auction.

The incentive compatibility properties of the English Auction are described by the pay-off matrix given below. Let A and B be two contractors. Contractor A's cost is C. Suppose A considers his pay-offs given that he bids one of three different amounts: (1) C, (2) C plus some amount a*, or (C) minus any amount a*. Bids by any other player B that are less than C-a* are irrelevant, because player A cannot win the contract. Player A's pay-offs for any other bids by any other player B are given below.

PLAYER A'S PAY-OFF MATRIX

	$P_A = C-a^*$	$P_A = C$	$P_A = C+a^*$
$C-a < P_B < C$	$-[C - P_B]$	0	0
$P_B = C$	0	0	0
$C < P_B < C + a^*$	$P_B - C$	$P_B - C$	0
$P_B > C + a^*$	$P_B - C$	$P_B - C$	$P_B - C$

Suppose that A bids less than his cost C.

A. If B's bid lies between A's bid and A's cost, A wins the contract but incurs a loss: the price that he receives is B's bid, which is less than his cost.

B. If B's bid equals A's cost, A's earnings are zero. A's return is $P_B = C - C = 0$.

C. If B's bid lies anywhere above A's cost, A's earnings are $P_B - C$.

If A bids his cost C:

A. If B's bid is below C, C does not win the contract and his earnings are zero.

B: If B's bid equals A's cost, A's earnings are zero. A's return is $P_B = C - C = 0$.

C. If B's bid lies anywhere above A's cost, A's earnings are $P_B - C$.

Finally, if A bids above his cost, any amount $C + a^*$:

A. If B's bid is below C, A does not (and should not want to) win the contract; his earnings are zero.

B. If B's bid equals A's cost, A does not win the contract and has earnings that would be the same if he had bid his cost: zero.

C. If B's bid lies between A's cost and A's bid, A's earnings are zero; A foregoes the earnings P_B - C that he would have earned had he bid his cost..

D. If B's bid lies above A's bid, A's earnings are P_B - C.

A moments reflection on the implications of the pay-off matrix given above is sufficient to establish the following: Player A can *never* increase his earnings by bidding at values other than his cost — regardless of the bid made by Player B. If A bids his cost, his returns are always at least as great as they would be with any other bid, and sometimes greater. Bidding cost is A's "dominant strategy." With all players, including the lowest cost player, bidding their cost, the auction must be incentive compatible: the lowest cost contractor must win the contract, and he wins it at a price equal to costs of the second-lowest cost contractor.

Unfortunately, we are unaware of an incentive compatible institution that can accommodate conditions extant in instances where there is the possibility of "insider information." If an institution is to deny all of part of rents to an insider, it must provide some mechanism whereby "outsiders" are given signals that provide useful "clues" as to the nature of the insider's proprietary information. For present purposes, it must also be appropriate for conditions wherein there is a single buyer and few sellers (thus eliminating the possibility of various forms of double auctions). A possibly "best" candidate for an institution that may serve these purposes is the "Bid Improvement" (BI) auction. As we will demonstrate, the BI auction is efficient, and it results in a "minimum achievable cost;" it is not, however, incentive compatible (demand revealing). The BI auction was developed by Brewer and Plott[6] for application to a systems-pricing problem involving the allocation of single-track rail lines in Sweden. The essence of this mechanism is one wherein contractors submit bids for a project. A winning bid is announced, after which contractors are asked the question: does any contractor wish to improve (lower) his bid? If any contractor responds YES, all contractors resubmit a bid (resubmitted bids must be less than or equal to the previously submitted bid, less-than for the contractor that indicates a wish to "improve the bid"). This process of submitting a bid, announcing a winning bid, and offering the opportunity to improve the bid, continues until a winning bid is announced and no contractor indicates a wish to improve his bid. Brewer and Plott demonstrate the efficiency of this basic process, but make no claims for the incentive compatibility of their institution.

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[6] Brewer, Paul and Charles Plott, "A Binary Conflict Ascending Price Mechanism for the Decentralized Allocation to the Right to Use Railroad Tracks," *International Journal of Industrial Organization*, 14, 857-886, Oct. 1996.

Ignoring the possibility of insider information for the moment, the dominant strategy for the BI auction is straightforward. Consider again two players A and B where A's cost is given by C.

A's Cost = C	B's bid, P_B
	C - a*
	C
	C + a*

For any bid $P_B \leq C$ like C - a* or C, A had no feasible improvement bid — A cannot win the auction and receive positive profits. For any bid $P_B > C$, A's incentive is to request a bid improvement, bidding $P_A = P_B - \epsilon$, where ϵ is any small number. It then follows that, if A is the low-cost contractor, A must win the contract at a price $P_B - \epsilon$, where P_B is the second-lowest cost contractor's cost. The BI auction must then be efficient: the DOE awards the contract to the lowest cost contractor. The DOE obtains the contract at minimum achievable cost, a cost that exceeds A's reservation price C but is less than the true costs of all other contractors. It is not demand revealing, however: A will never have incentives to reveal his cost C.

One can argue that the BI auction will be efficient when there exists insider information, but only with the use of a critical assumption. Consider again an auction with two bidders, A and B. For a given project, the waste characterization process (performed by B) results in the project being described as R. Both A and B know their true costs for R, $C_A(R)$ and $C_B(R)$. B is known (by A and B) to be the insider. B knows (but A does not) that, due to peculiarities of the project, the project is in fact best described as R', and $C_B(R') < C_B(R)$. We now introduce the following assumption: priors of both A and B are that for <u>any</u> project R*, $C_A(R^*) \leq C_B(R^*)$. Under these conditions A's incentives are to "improve" any bid offered by B by an increment ϵ. Thus, with bids by B less than $C_A(R)$, A will simply follow B to an ultimate bid $[C_B(R') - \epsilon]$,[7] and the result is that the BI is efficient — the lowest cost contractor, A in this example, must always receive the contract.

Of course, the assumption as to contractor's priors regarding the insider's cost is tantamount to saying that if the lowest cost contractor *knows* that he is the lowest cost contractor, the bidding institution is unaffected by insider information. This assumption obviously limits the potential usefulness of the BI institution for circumstances in which the potential for insider information exist. Notwithstanding this limitation, we will empirically test the *asserted* efficiency of the BI institution with and without insider information as a part of the Phase 1 research activity described below. We plan to continue our search for more robust institutions that might be used in the insider case during Phase 2 research.

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[7] Of course, if A's prior is that B's cost is greater or equal to his, A cannot "follow" B to bids less than $C_A(R)$ — A has no way of knowing if B's lower bids are attributable to his "inside information" or to "true" lower costs.

Our task then becomes that of designing experiments that will test the efficiency of two alternative bidding institutions — procurement processes — under conditions involving one buyer and "few" sellers — "few" here will be taken to be three sellers: the English Auction and the Bid improvement mechanism. As noted above, we will also address, to a limited extent, the effects on the efficiency of prices obtained with the Bid Improvement mechanism when there exists "insider information."

III. Empirical Results

In what follows , we describe our empirical results in these regards. These discussions will hopefully serve two purposes: they will establish the basis for our cautious optimism for our ability to design an efficient institution that is appropriate for the conditions relevant for the DOE; and they will suggest the nature of future work required for us to complete this line of inquiry.

III.A Design and Structure of Experiments.

Three sets of experiments are conducted: an English auction; a Bid Improvement auction; and a Bid Improvement auction with "insider information." The rules applicable for each of these sets of experiments are described below. Experiments are conducted in Georgia State University's Environmental & Experimental Economics Laboratory. The laboratory includes 24 subject stations, each of which is equipped with a 486/DX2 6 MHZ Intel processor computer connected to Ethernet and Token Ring networks. The system is linked to the (TCP/IP) Internet system which provides world-wide access to a wide range of data. A SUN Unix Work Station is used to monitor subject work stations and to act as a distribution center for data made available to users of Internet. The laboratory also has the capability of providing video conferencing — which facilitates the conduct of real-time, multi-locational experiments — and multimedia experiments.

III.A.1 The English Auction.

The following rules apply to the English auction.

a. subjects are advised as to their "cost" for performing a contract — their cost is given on their computer screen. This cost is incurred only if they win the contract.

b. the subject must determine the price — the subject's "bid" — that he wishes to submit for a project.

c. the subject "submits" a bid price in the following way. On the subject's screen is a "value clock." The clock is set at a value x. Once the experiment begins, the value on the value clock will increase by z-lab dollars every 5 seconds (values of x and z will vary from round to round). Thus, after 5 seconds, the clock changes

from x to x + z; five seconds later, from x + z to x + 2z; five seconds later to x + 3z, and so on. This continues until the clock reaches x + 20z at which point the session is over. The subject can stop his clock at any value by simply clicking on a button "submit bid" which appears on his screen. The value that is on his clock when he stops the clock is his submitted bid price.

d. the subject that submits the lowest bid price — the first subject that stops his clock — will win the contract. The price that the subject will receive for the contract is not his bid price, however. The price that the subject will receive for the contract is the value on the clock of the subject that stopped his clock *after* the winning subject stopped his clock. In other words, the winning contractor is the one that is the first to stop his clock, but the winner receives a price equal to the value on the clock of the *second* person who stops their clock.

e. the winning subject's earnings — which is paid to them in cash at the end of the experiment — is the difference between his costs and the second-lowest bid price (the value of the clock of the second person to stop his clock).

III.A.2 English Auction Procedures.

The English Auction is guided by the following protocol.

(i) subjects participate in 5 to 10 practice rounds. After 5 practice rounds, practice rounds are terminated when all subjects are observed to be bidding their costs or at the end of 10 rounds, whichever occurs first.

(ii) there are three subjects in each group — i.e., any one subject is competing with only two other subjects. Each of the three subjects have different costs. A subject's cost is known only to him. A subject knows that he has three (and only three) competitors, but has no information regarding the dollar amount of other subjects' costs. The subject does know the range of costs within which his rival's costs are drawn: between x and x + 10z.

III.A.3 The Bid Improvement Auction.

The following rules apply to the Bid Improvement Auction.

a. subjects are advised as to their "cost" for performing a contract — their cost is given on their computer screen. This cost is incurred only if they win the contract.

b. the subject must determine the price — the subject's "bid" — that he wishes to submit for a project.

c. the contract is to be awarded to the lowest bid price. The winner's earnings — paid in cash at the end of the experiment — is the difference between the winner's cost and the winner's bid price.

d. the subject "submits" a bid price by typing his bid in a box marked "Bid" and then clicking on a button marked "Submit Bid." Once a bid is submitted, it cannot be changed during the current round.

e. after all bids are received, each subject receives a message on his screen: "Winning Bid is $____. The subject knows the winning bid and whether or not there was a tie (more than one person with the winning bid). They are informed that in the event of a tie (and no one wishing to improve a bid) a winner is determined by the flip of a coin.

f. Under the Winning Bid box, the subject sees a box with the question: Do you wish to improve your bid? [ ] YES [ ] NO.

- If no subject clicks on YES, the auction for the relevant three subjects is completed.

- If any of the three subjects in a group clicks on YES, steps (b) through (f) are repeated. A subject that clicks on YES must make a subsequent bid that is lower than the bid that was submitted during the current round. If another subject has clicked on YES, the subject must resubmit a bid that is no higher than his bid in the current round.

III.A.4 Bid Improvement Procedures.

(i) subjects participate in 5 to 10 practice rounds. After 5 practice rounds, practice rounds are terminated when all subjects are observed to be bidding their costs or at the end of 10 rounds, whichever occurs first.

(ii) there are three subjects in each group — i.e., any one subject is competing with only two other subjects. Each of the three subjects have different costs. A subject's cost is known only to him. A subject knows that he has three (and only three) competitors, but has no information regarding the dollar amount of other subjects' costs. The subject does know the range of costs within which his rival's costs are drawn: between x and x + 10z (values used in the English auction are also used in the BI auction).

III.A. 5 The Bid Improvement Auction With Insider Information.

The following rules apply to the Bid Improvement auction with insider information. To facilitate the reader's comparison of the BI instructions given above with those used in the BI-insider institution, any differences are given in **bold print.**

a. subjects are advised as to their "cost" for performing a contract — their cost is given on their computer screen. This cost is incurred only if they win the contract.

b. the subject must determine the price — the subject's "bid" — that he wishes to submit for a project.

c. the contract is to be awarded to the lowest bid price. The winner's earnings — paid in cash at the end of the experiment — is the difference between the winner's **"real cost"** and the winner's bid price.

d. the winner's "real cost" is the cost that the subject sees on his screen, C, plus or minus z-dollars. The subject will not know whether his costs are C, C + z, or C - z until after the round is completed. However, one of the three subjects knows this value (whether costs are what is on each subject's screen, or z-dollars higher or lower than that amount). The subject that has this information — the "insider" — is identified as subject #3 (subject #3 raises his hand so that he is clearly identified to the other two subjects).

e. the subject "submits" a bid price by typing his bid in a box marked "Bid" and then clicking on a button marked "Submit Bid." Once a bid is submitted, it cannot be changed during the current round.

f. after all bids are received, each subject receives a message on his screen: "Winning Bid is $____. The subject knows the winning bid and whether or not there was a tie (more than one person with the winning bid). They are informed that in the event of a tie (and no one wishing to improve a bid) a winner is determined by the flip of a coin.

g. Under the Winning Bid box, the subject sees a box with the question: Do you wish to improve your bid? [ ] YES [ ] NO.

- subject #3, the "insider," is asked if he wishes to improve the bid; his response is made aloud so that the other two subjects are aware of his decision. Subject #3 can not at any later time change the decision made at this point. If Subject #3 says YES, steps (b). through (e) are repeated. If Subject #3 says NO, then continue.

- If no other subject clicks on YES, the auction for the relevant three subjects is completed.

- If subject #3 has indicated NO to the "do you wish to improve the bid" question, if any of the **remaining two** subjects in a group clicks on YES, steps (b) through (e) are repeated. A subject that clicks on YES must make a subsequent bid that is lower than the bid that was submitted during the current round. If another subject has clicked on YES, the subject must resubmit a bid that is no higher than his bid in the current round.

III.A.5 Bid Improvement-Insider Procedures.

(i) subjects participate in 5 practice rounds.

(ii) there are three subjects in each group — i.e., any one subject is competing with only two other subjects. Each of the three subjects have different costs. A subject's cost is known only to him. A subject knows that he has three (and only three) competitors, but has no information regarding the dollar amount of other subjects' costs. The subject does know the range of costs within which his rival's costs are drawn: between x and x + 10z (values used in the English auction are also used in the BI auction). **However, subject #3, the "insider," is identified to all subjects.**

III.B Preliminary, pre-test results from experiments.

Preliminary results from pre-tests of the experimental designs described above follow.

III.B.1 Results from Pre-tests of the English Auction.

Results from our most recent pre-test of the English Auction protocol are given in Table B.1. The reader should note that during this pre-test the experiment was terminated after only 5 rounds — we did not proceed to the 10 rounds set out in the protocol due primarily to our wish to conserve time required to de-brief subjects. Subjects consisted of 15 students in a Public Policy class held on Saturday mornings at GSU. These subjects were part-time students, all being employed in full-time jobs during the week. The demographic composition of subjects was: 11 males, 4 females; 10 white, 4 black, and 1 Asian; average age was 25 years.

Table B.1
Results From Pre-test of English Auction Protocol

Subject No.	Bid as % of Cost: Round 1	Round 5
1	116%	100%
2	105	105
3	105	104
4	117	97
5	105	100
6	103	100
7	117	100
8	115	110
9	115	108
10	110	107
11	200	142
12	122	108
13	113	73
14	140	111
15	107	104

In all cases contracts were "won" by the subject with the lowest cost — i.e., all transactions were "efficient." While bids of only one subject were within 4% of cost during round 1, this number increased to six by the end of round 5 — four of the 15 subjects bid their cost in round 5.[8] However can draw no conclusions as to the incentive compatibility of the English Auction with n = 3 as a result of our pre-tests. As a result of a debriefing session conducted at the end of the experiment, it was apparent that many subjects had not succeeded in understanding their dominant strategy by the end of five rounds — thus we would use greater numbers of rounds in further experiments (10 rounds are called for in our amended protocol).

[8] This result contrasts sharply with experiments with this institution reported in the literature. This may (or may not) be explained by at least two differences between our design and those commonly used in experiments with the English Auction: the number of subjects in our experiments is smaller; and values given to subjects in our experiments change from round-to-round, as opposed to being held constant as is commonly the case.

III.B.2 Results from Pre-tests of the Bid Improvement Auction.

Results from our most recent pre-tests of the Bid Improvement protocol described above are provided in Table B.2. Twenty one subjects participated in the experiment. The twenty one subjects were grouped into seven groups, each group consisting of three rivals. For this particular experiment costs given to all subjects was 3000 lab dollars (convertible into U.S. dollars at the rate of 100 lab dollars = $1.00).

Before discussing the results given in Table B.2, we must briefly comment on an issue that always arises with auctions such as the BI auction wherein the price received by subjects is their bid price. In considerations of the efficiency of such auctions, one must consider the possibility, if not probability, that subjects will have a "reservation price." A subject's reservation price (RP) is his subjectively determined minimum return for participating in the auction. Simply put, a subject may feel that if he cannot earn at least RP-dollars he will effectively discontinue his participation in the auction — he essentially "drops out" of the auction at any price less than his cost plus RP. While one cannot know this necessarily subjective value for any subject, it is common to interpret bid prices at a subject's cost plus $2.00 *or less* as a reasonably robust indication of an efficient price.

With this in mind, consider the values reported in Table B.2. Three groups of subjects — those including subjects 7-9, 10-12, and 19-21 — terminate the bid improvement process after only one round of rebidding. Final bids for these groups are well within ranges of values that might reflect reasonable reservation prices: in the group 7-9, the winning bid by subject #7 is at the price 3001, which is virtually at cost (3000; implying a reservation price of 1 lab dollar — one cent); in group 10-12 the winning bid by subject #10 is 3189, $1.89 over cost; and in group 19-21 the winning bid by subject #21 is 3024, implying (if this bid is interpreted as being efficient) a reservation price of $0.24. Groups 4-6, 13-15, and 16-18 terminate the bid improvement process after two rounds of re-bidding with winning bids of 3001 (subject #4), 3000 (subject #13), and 3000 (subject #17), respectively — all winning bids are virtually at cost. Group 1-3 requires 4 rounds of bid improvement before the process is terminated (no bidder says YES to the question: do you want to improve the bid?). The winning bid by subject #3 is 3025, implying a reservation price of some $0.25.

With six out of seven winning bids that are within 24-cents of cost, and the seventh winning bid but $1.89 from costs, we can conclude that reservation prices held by subjects required to interpret the resulting winning bids as efficient prices are low — extraordinarily low. These results then provide a basis for one's expectation that Phase 2's extensive tests of the BI will provide a strong case for the BI serving as a candidate institution for the DOE's use as a means for implementing privatization for waste clean-up projects.

Table B.2
Results From Pre-tests of the BI Protocol

Subject #	Original Bid	Final Bid After [ ] Bid Revisions
1	4300	3100 [4]
2	4495	3145 [4]
3	5500	3025 [4]
4	3200	3001 [2]
5	3819	3011 [2]
6	3500	3500 [2]
7	3075	3001 [1]
8	3025	3125 [1]
9	3300	3020 [1]
10	3300	3189 [1]
11	3850	2950 [1]
12	3250	3250 [1]
13	3245	3000 [2]
14	3999	3200 [2]
15	3150	3001 [2]
16	4150	3019 [2]
17	3550	3000 [2]
18	3125	3021 [2]
19	3099	3049 [1]
20	3095	3030 [1]
21	3100	3024 [1]

III.B.3 Results from the BI-insider Experiments.

Results from our pre-tests of the BI-insider protocol are given in Table B.3. For this experiment subjects are given costs of 3000, but told that "real costs" may be 3000 plus-or-minus 500 — i.e., real costs may be 2500, 3000, or 3500. They know that one of their group of 3 — an "insider" — knows the value of real costs — subject number 3 in group 1, 6 in group 2, 9 in group 3, and 12 in group 4. In each group, the insider knows that real costs are 2500.

Table B.3
Results From Pre-tests of The BI-Insider Protocol

Subject #	Original Bid	Final Bid After [ ] Bid Revisions
1	3500	3200 [1]
2	4600	2999 [1]
3	**4000**	**3250 [1]**
4	4500	2300 [2]
5	4100	2475 [2]
6	**2700**	**2499 [2]**
7	4000	2100 [4]
8	5200	5000 [4]
9	**5000**	**2250 [4]**
10	6000	2169 [1]
11	7500	2884 [1]
12	**3000**	**2500 [1]**

* **Bold faced** identifies the insider in each group of three subjects.

The debriefing of subjects following this experiment resulted in the identification of a flaw in the protocol used: subjects did not really appreciate the fact that they would actually pay the value of any loss incurred in a round. This is apparent from data given in Table B.3: even with perfect information available to the insider, the insider offers bids that are less than *known* costs in two of the four groups (subjects 6 and 9). We have corrected for this flaw in a revised version of the protocol.

Results from the pre-test are interesting notwithstanding this flaw. Our primary interest during this application of the protocol was the extent to which the institution succeeds in providing non-insiders with incentives to "follow" the insider, thereby denying the insider gains attributable to the insider's exclusive information. In this limited regard the results provide grounds for cautious optimism. In none of the cases observed among these four groups was the insider able to capitalize on his information — non-insiders were successful in winning the bid in all instances. Excluding the obvious effects of the flaw in groups 1-3 in which bidding by non-insiders was carried to values below the insider's known cost, the result of interest here is *suggested*[9] by the outcome in group 1 in which the winning subject, subject #2, "follows" the insider to a winning bid.

[9] The "reservation price" issue discussed above limits any stronger interpretation of this result.

Appendix C

Legal Constraints to Implementing Fixed-price Contracts For Waste Clean-up Projects

I. Introduction and Summary

The purpose of this appendix is to provide a comprehensive discussion of legal issues involved in implementing a fixed-price contract. Particular attention is given to conditions precedent to implementing a firm fixed-price contract. The conditions precedent to implementing a firm fixed-price contract are outlined in 48 CFR §16-202-2. The balance of this section is a general overview and summary of detailed analyses provided in later sections.

I.A Standards governing implementation of firm fixed-price contracts.

Firm fixed-price contracts are not appropriate in every circumstance. Rather, they are appropriate for "acquiring commercial products or commercial-type products or for acquiring other supplies or services on the basis of *reasonably definite, functional, or detailed specifications*."[1] According to the Code of Federal Regulations (CFR) governing this type of contract, firm fixed-price contracts are appropriate:

> "when the contracting officer can establish fair and reasonable prices at the outset, such as when:
>
> a. There is adequate price competition.
> b. There are reasonable price comparisons with prior purchase of the same or similar supplies or services made on a competitive basis or supported by valid cost or pricing data;
> c. Available cost or pricing information permits realistic estimates of the probable costs of performance; or
> d. Performance uncertainties can be identified and reasonable estimates of their cost impact can be made, and the contractor is willing to accept a firm fixed-price representing assumption of the risks involved."[2]

As has been discussed, with appropriate auction mechanisms it is possible to generate adequate price competition. Reasonable price comparisons and estimates of the probable cost of performance are judgmental matters. However, there are performance uncertainties in that the

[1] 48 C.F.R. §16.202-2.

[2] *Id.*

waste must first be characterized before it is treated, transported, treated again and disposed. Nevertheless, since these requirements are disjunctive, this will not be a problem to using firm fixed-price contracts.

After one determines that a firm fixed-price contract is appropriate the next step is to ensure that a firm fixed-price contract is not transformed into a cost-plus contract by a contractor's constructive change claim under the changes clause in Government contracts or the cardinal changes rule.

It is important to remember that a necessary prerequisite to obtaining an equitable adjustment to a contract is a *change* to the contract. Thus, the simplistic response to avoiding firm fixed-price contracts becoming essentially cost-plus contracts is simply to avoid changes to the contract. However, this may not a realistic solution as changes are often necessary to effectuate the contract. If one cannot avoid changes to a contract altogether, the next best approach to avoiding firm fixed-price contracts becoming cost-plus contracts is to at least anticipate any changes to the contract since courts look to *the language in the contract itself* to determine if there has been a constructive change to the contract entitling the contractor to an equitable adjustment. Clear, exact, unambiguous contract language is critical in order for the Government to avoid or at least prevail in these types of claims.

I.B Examples of Types of Contractor's Claims.

Contractors often assert a claim where contract requirements language is open to interpretation or where the facts concerning non-conformance to contract requirements are non-existent, incomplete, or are otherwise defective. Even where the contract and the facts are clear, disputes can arise about the exact nature and size of a contract-impacting event. Impacting events might be changes to the work scope or schedule issued by the Government, or they might be the result of forces totally external to the contract. The most likely types of contract performance-impacting events are:

Work scope changes (content or schedule)
Late or deficient information, material, or equipment
Stop work orders
Other contract resource demands
Inadequate contractor/subcontractor performance
Defective or deficient specifications
Directed, out of scope work
Government-responsible delays
Acceleration of work
Overly stringent or untimely inspection

Furthermore, such constructive changes have been recognized in the courts where the contractor performs work in excess of that called for in the contract requirements and where the

reason for such additional performance was due to Government responsible causes. These constructive changes frequently occur when the contractor fails to limit performance in strict compliance with the contract's specifications and statement of work. This situation occurs when the time constraint of the work to be performed forces the contractor to proceed with work at his own risk rather than to wait for the formal change approval cycle. In many such instances, the contractor might be trying to comply with instructions issued by the Government's on-site representative or is reallocating resources and management priorities in an effort to meet project completion dates. Failure to negotiate resolution of such matters normally results in a dispute under the contract.

I.C Contract Language.

When a contract performance impacting event occurs, courts first look at the contract itself to determine if the impact has been *anticipated and language has been included to deal with all its implications*. If the particular impacting event was anticipated, the contractor must follow the contract's specified procedures. If the particular impacting event was not anticipated, the contractor must proceed with the specified general procedure for changes to the contract often outlined in the changes clause in Government contracts. The changes clause specifies procedures to be followed in the preparation and presentation of change requests. A recent trend with Government contracts of all types is for the inclusion of a timing requirement which limits the time a contractor has to pursue a claim from the time the impact is identified or should have been identified.

I.D Contractor's Justifiable Reliance.

Finally, it is important to note that courts look to evidence to see *if the contractor justifiably relied on the contract estimates, standards, or specifications*. If the contractor relied on the Government's specifications and those specifications were wrong, the Government is responsible for the contractor's damages in relying on those specifications.

I.E Examples: Application to Waste Remediation.

Assume DOE wishes to have contractors bid to provide waste remediation services based on a firm fixed-price contract. These waste remediation firm fixed-price contracts are to include services that provide for:

1. retrieval;
2. characterization;
3. segregation of buried radioactive and mixed wastes, debris, and soil;
4. removal of plutonium and other hazardous substances from contaminated soil, waste and debris;
5. packaging waste for disposal and storage; and
6. storage and loading of containers on approved transport carriers.

The second phase of the contract will include services that provide for the:

1. transportation,
2. treatment, and
3. disposal of soil, tools, containers, and waste.

In light of the above, in order to institute a firm fixed-price contract, one must have:

1. adequate price competition;
2. reasonable price comparisons with prior purchase of the same or similar supplies or services made on a competitive basis or supported by valid cost or pricing data;
3. cost or pricing information available to permit realistic estimates of the probable costs of performance; or
4. identifiable performance uncertainties and reasonable estimates of their cost impact.

One cannot institute a firm fixed-price contract unless one meets the above conditions. In this instance, the only criteria that is problematic to instituting a firm fixed-price contract is number four — identifiable performance uncertainties *and* reasonable estimates of their cost because although the performance uncertainties are identifiable, the composition and amount of the waste is unknown. Thus one cannot give a reasonable estimate of the cost to dispose of the waste. This uncertainty may cause the contractors to refuse to bid, thereby decreasing competition, or it may cause the contractors to inflate their bids to cover every conceivable risk.

After the determination is made that a firm fixed-price contract is appropriate using the above conditions, it is important that *clear, unambiguous contract language* be used. This contract language should include at a minimum the following:

A. Exact descriptions/specifications for the amount of waste to be remediated (avoid general phrases like "contractor will use its best effort to complete the work").

   1. avoid *detailed design specifications* because when the Government uses such specifications, it warrants that if the contractor follows these specifications, an acceptable product will result. Design specifications "describe in precise detail the materials to be employed and the manner in which the work is to be performed." [3] These specifications set the Government up for claims based on breach of warranty or breach of design specifications.

[3] Blake Constr. Co. v. United States, 987 F.2d 743 (1993).

2. utilize *performance specifications* instead which state what the product is supposed to do and that the contractor selects the best method of accomplishing the task. In this way, the Government's warranty is more limited.

B. Clauses requiring the contractor to comply with all applicable Federal, state, and local requirements.

C. Clauses requiring the contractor to obtain all licences and permits required.

D. Timing requirement provisions which limit the time a contractor has to pursue a claim.

E. If the Government uses a Variation in Estimated Quantity Clause, make sure that the Government knows the *actual* quantity (or the actual quantity plus or minus 15%) of the amount of waste being remediated. Otherwise, the Government will be liable for the *cost to remediate* the actual quantity of the waste that is above 15 % of the estimated quantity of waste under Foley v. U.S..

F. Termination for convenience clauses which allow the Government to terminate the contract when it is in the Government's best interest to do so.

G. A provision that limits the Government's on-site representative's authority to issue change orders.

H. Inspection of services clause (FAR 52.246-4).

I. Suspension of work clause (FAR 52.212-12) (only delays for an unreasonable period of time are compensable and the adjustment excludes profit).

J. Government delay-of-work clause (52.212-15).

K Indemnity and hold harmless provisions.

L. Disclaimers - i.e. clauses stating that representations are not guaranteed, clauses stating that the amounts given are "estimates" or "approximations", clauses requiring the contractor to examine the site of the work and make its own assessment of the conditions and nature of the work.

M. No ambiguous terms to avoid *contra proferentem.*

N. No stop work order clause (52.212-13-14). The clause allows the contracting officer to stop work for 90 days and cover all periods of delay, both reasonable

and unreasonable. The clause allows the contractor to obtain an equitable adjustment which includes profit.

II. General Issues Relevant for Considerations of Contracts Used by the Government

Disputes involving Government contracts are generally governed under the Contract Disputes Act, 41 U.S.C. §§601-613. Government contract disputes occur when the Government[4] either intentionally or inadvertently makes demands or changes to a contract without compensation in cost, or time of performance, or both, to the contractor. Realizing that changes to contracts often occur, Government contracts contain standard language governing the implementation of changes (often refereed to as the Changes Clause) that guarantees an *equitable adjustment* to the contract whenever there is a change or deviation from contract terms and specifications. These claims are derived from the doctrine of Constructive Change. The remedy, *equitable adjustment*, often allows a contractor to essentially transform a firm fixed-price contract into a contract more similar to a cost-plus contract. In addition to a claim based on constructive change, contractors also often sue the Government for breach of contract based on delay, disruption, acceleration, differing site conditions, and misleading and defective estimates or specifications.

In order for a contractor to obtain an equitable adjustment to the contract, there must be a change to the contract. There are two distinct types of changes. The first is a "formal change," where both parties recognize, negotiate, and agree to a change in the contract and agree to a change in price or time of performance of the contract. The second is a "constructive change", where the Government has, through action or inaction, caused a change in contract performance and failed to issue a formal change order. Where the Government requires a constructive change in a contract, the Government must fairly compensate the contractor for the costs of the change.[5] Courts look to the language in the contract itself to determine if there has been a constructive change to the contract entitling the contractor to an equitable adjustment to the contract.[6] Thus, appropriate contract language is critical in order for the Government to prevail in these types of claims.

There are several different types of contracts that the Government uses to procure goods or services. These contracts can be divided into two broad groups: cost-reimbursement contracts

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[4] In order to understand the nature of the problems associated with implementing a firm fixed-priced Government contract, it is helpful to characterize the relationship between the private contractor and the Government as one of a buyer (the Government) and seller (the contractor) of services.

[5] J.B. Williams Co. v. United States, 450 F.2d 1379 (Ct. Cl. 1971).

[6] Aydin Corporation v. Secretary of the Air Force, (Ct. Cl. 1995).

and fixed-price contracts. Included within both groups of contracts are incentive contracts.[7] There are also indefinite delivery contracts[8], time and material contracts[9], labor hour contracts,[10] letter contracts,[11] and agreements.[12] In the following sections, we begin with a brief discussion of issues relevant for cost-reimbursement contracts in Section III. Attention is then turned to the class of contracts of primary concern here — fixed-price contracts — in Section IV. The adjudication process relevant for contractors bringing claims against the Government is sketched in Section V, after which attention is focused on the bases most often used for asserting and defending against such claims. These include: appeal to the doctrine of Constructive Change (Section VI); claims based on *Contra Proferentem* (Section VII); the duty of parties to seek clarification (Section VIII); and issues related to contract termination "for convenience" (Section IX)

III. Cost-Reimbursement Contracts: A Contrast

There are four types of cost-reimbursement contracts. These contracts allow for payment of incurred costs as described in the contract, and provide that the contractor receives no fee.[13] These are only suitable when "uncertainties involved in contract performance do not permit costs to be estimated with sufficient accuracy to use a fixed-price contract."[14] They can only be used when the contractor has an adequate accounting system for determining costs applicable to the contract, when there is appropriate Government surveillance to assure efficient methods of cost control, and the Government has executed a finding that the cost-reimbursement contract type is likely to be less costly than other types of contracts or it is impractical to obtain supplies or services of the kind required without the use of the cost-reimbursement types of contracts.[15] Cost

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[7] See 48 C.F.R. §16.401- 404.2 (incentive contracts can encompass technical performance incentives (§16.402-2) and delivery incentives (§16.402-3).

[8] 48 C.F.R. §16.501-506.

[9] 48 C.F.R. §16.601.

[10] 48 C.F.R. §16.602.

[11] 48 C.F. R. §16.603.

[12] 48 C.F.R. §16.701.

[13] 48 C.F.R. §16-302(a).

[14] 48 C.F.R. §16.301-2.

[15] 48 C.F.R. §16.301-3.

contracts include cost sharing contracts,[16] cost-plus-incentive-fee contracts[17], a cost-plus-award-fee contracts[18], and cost-plus-fixed-fee contracts.[19] Fortunately, the Government now prohibits cost-plus-percentage-of-costs contracts.[20]

IV. Fixed-Price Contracts

In its efforts to remediate hazardous waste, the Department of Energy seeks to use a firm fixed-price service contract. Fixed-price contacts can include firm fixed-price contracts or adjustable-price contracts that include a ceiling price or a target price. [21] A firm fixed-price contract:

> . . ..provides for a price that is not subject to any adjustment on the basis of the contractor's cost experience in performing the contract. This contract type places upon the contractor maximum risk and full responsibility for all costs and resulting profit or loss. It provides maximum incentive for the contractor to control costs and perform effectively and imposes a minimum administrative burden upon the contracting parties.[22]

Firm fixed-price contracts are appropriate for "acquiring commercial products or commercial-type products or for acquiring other supplies or services on the basis of reasonably definite functional or detailed specifications."[23] According to the Code of Federal Regulations governing this type of contract, firm fixed-price contracts are appropriate:

> "when the contracting officer can establish fair and reasonable prices at the outset, such as when:
>
> a. There is adequate price competition;

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[16] 48 C.F.R. §16.303 (contractor is reimbursed only for a portion of its allowable costs.)

[17] 48 C.F.R. §16.304 (the contractors initially negotiated fee is adjusted later by a formula based on the relationship of total allowable costs to total target costs. See also 48 C.F.R. 116.404-1)

[18] 48 C.F.R. §305 (incentive type contract that gives the contractor a fee including a base amount (that may be 0) and an award amount in order to motivate the contractor "for excellence in contract performance. See also 48 C.F.R. § 16.404-2)

[19] 48 C.F.R §16.306 (contractor gets costs reimbursed and a fixed fee.)

[20] 10 U.S.C. §2306(a), 41 U.S. C. 254(b), and 48 C.F.R §16.102(c).

[21] 48 C.F.R. 16.201.

[22] 48 C.F.R.§ 16.202-1 (1995).

[23] 48 C.F.R. §16.202-2.

b. There are reasonable price comparisons with prior purchase of the same or similar supplies or services made on a competitive basis or supported by valid cost or pricing data;

c. Available cost or pricing information permits realistic estimates of the probable costs of performance; or

d. Performance uncertainties can be identified and reasonable estimates of their cost impact can be made, and the contractor is willing to accept a firm fixed-price representing assumption of the risks involved."[24]

Fixed-price contracts include pure fixed-price contracts discussed above, fixed-price contracts with economic-price adjustment,[25] fixed-price incentive contracts,[26] fixed-price contracts with prospective price redeterminations[27], a fixed ceiling price contract with retroactive price redetermination,[28] and finally, a firm fixed-price, level-of-effort term contract[29] Firm fixed-price contracts and fixed-price contracts with economic price adjustment must derive from a

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[24] *Id.*

[25] 48 C.F.R. §16.203-1 (Fixed-price contracts with economic price adjustment provides for upward and downward revision of the stated contract price upon the occurrence of specified contingencies. Economic price adjustments are of three general types including adjustments based on established prices, adjustments based on actual costs of labor or material, and adjustments based on cost indexed of labor or material)

[26] 48 C.F.R. §16.204 provides for adjusting profit and establishing the final contract price by a formula based on the relationship of final negotiated total cost to total target cost. There is a ceiling price negotiated at the outset. See also 48 C.F.R. § 16.403. There are two forms of fixed-price incentive contracts: firm target (§16.403-1), and successive targets (§16.403-2). A firm target contract specifies a target cost, a target profit, a price ceiling, and a profit adjustment formula. A successive target contract has an initial target cost, an initial target profit, an initial profit adjustment formula to be used for establishing the firm target profit including a ceiling and a floor for the firm target profit, the production point when the firm target costs and the firm target profit will be negotiated, and a ceiling price that is the maximum that may be paid to the contractor.

[27] 48 C.F.R.§16.205 provides for a firm fixed-price for an initial period of contract deliveries or performance and prospective redetermination at a stated time or times during performance of the price for subsequent periods of performance. This contract may be used when procuring quantity production or services when it is possible to negotiate a fair and reasonable firm fixed-price for an initial period, but not for subsequent periods of contract performance. This contract cannot be used unless a firm fixed-price contract and a firm fixed-price incentive contract are not appropriate.

[28] 48 C.F.R §16.206 provides for a fixed ceiling price and a retroactive price redetermination within the ceiling after completion of the contract. These contracts are only appropriate for R & D contracts of $100,000 or less when a firm fixed-price cannot be negotiated and the time and amount involved make other fixed-price contracts impracticable.

[29] 48 C.F.R. §16.207 requires the contractor to provide a specified level of effort over a stated period of time on work that can be stated only in general terms, and requires the Government to pay the contractor a fixed dollar amount. It can only be used when the work required cannot be clearly defined, the level of effort is agreed upon in advance, the intended result cannot be achieved by expending less than the stipulated effort, and the contract price is $100,000 or less.

sealed bidding process.[30] In sealed bidding procurement, the Government's acceptance is made without negotiation or material variation from the terms of the contractor's offer.[31]

V. Adjudicatory Process, Jurisdiction, and Standard of Review in Contract Claims Against the Government

If a contractor asserts a claim against the Government for an equitable adjustment to the contract, the contractor initially negotiates with the Government's contracting officer by filing a certified claim[32] for equitable adjustment. If the contracting officer does not issue a decision within a reasonable time or if the contractor does not agree with the decision, the contractor may file an appeal before the Government's Board of Contract Appeals for a *de novo* review, or to the United States Claims Court (formerly Court of Claims) directly, but not to both tribunals. A contractor cannot secure judicial or Board relief unless the contractor has first presented a claim for over $50,000 in the proper form to the Government. The contractor can then appeal its case to the United States Court of Claims and then to the United States Court of Appeals for the Federal Circuit. In addition, the contractor may also file a claim in the regular federal courts. However, it is important to remember that in order for the United States Court of Claims to have jurisdiction over the claim, the claim must first be certified and submitted in writing to the contracting officer.[33] Further, and importantly, although a contractor may change the amount of his claim, he may not raise any new claims not subject to a decision by the contracting officer because the Court does not have jurisdiction to hear these new claims that were not raised to the contracting officer.[34] A court has jurisdiction over a claim if it is "based on the same set of operative facts underlying the claim submitted to the contracting officer".[35] The test is "whether the contracting officer's right to adjudicate the claim is undermined by circumventing his statutory role to receive and pass judgment on the contractor's entire claim". [36]

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[30] 48 C.F.R. §16-102(a).

[31] 10 U.S.C. §2305(b)(3) See also CRF v. United States, 624 F.2d 1054 (Ct. Cl. 1980).

[32] The date the contractor submits a claim is important because if the claim is deemed valid, that is the date from which the Government must pay interest (FAR 33.208). If the claim is more than $50,000, the contractor must certify that it was made in good faith, by supporting data that is accurate and complete to the best of the contractor's knowledge and belief and by an amount that accurately reflects the contract adjustment for which the contractor believes the Government is liable (FAR 33.201 and 33.207).

[33] 41 U.S.C. §§605(a), 605(c).

[34] Santa Fe Eng'rs, Inc. v. United States, 818 F.2d 856, 858 (Fed. Cir. 1987).

[35] Cerberonics, Inc. v. United States, 13 Cl. Ct. 415, 417 (1987).

[36] *Id.* at 418.

The standard of review from Board decisions employed by the Federal Circuit Courts regarding questions of fact is set forth in 41 U.S. C. §609(b) (1994):

> the decision on any *question of fact* shall be final and conclusive and shall not be set aside unless the decision is fraudulent, or arbitrary, or capricious, or so grossly erroneous as to necessarily imply bad faith, or if such decision is not supported by substantial evidence.[37]

Decisions of law are reviewed *de novo*.[38] However, the standard of review that the U.S. Court of Appeals for the Federal Circuit uses when reviewing Claims Court decisions is a clearly erroneous standard, a more subjective standard, i.e., "when although there is evidence to support it, the reviewing court on the entire evidence is left with the definite and firm conviction that a mistake has been committed."[39]

In addition to litigating their claims, contractors and the Government sometimes agree to arbitrate their disputes. Some contracts contain arbitration clauses which detail the procedures for settling contract disputes. When no arbitration clause is included in the contract, the parties may still agree to arbitration. This is particularly true when the contractor has suffered disruption and loss of efficiency, since there is no totally objective method in existence for quantifying such impacts. It is often difficult to show the kind of clear cause-and-effect relationship between a proposed change and its calculated scope of impact, which is the usual demand of the Government before it will agree to a contract change.

Finally, a contractor's claim is barred unless the contractor appeals to an agency board within ninety days from the date of a receipt of a contracting officer's decision.[40] However, the contractor has one year to bring his claim before the Claims Court.[41] A contractor has 120 days to appeal to the United States Court of Appeals for the Federal Circuit from a Board or Claims Court decision. An appellant must file its notice of appeal with the trial court within thirty days of entry of final judgment (or 60 days when the U.S. is a party.)

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[37] United States v. Wunderlich, 342 U.S. 98 (1951) (substantial evidence test).

[38] Triax-Pacific v. Stone, 958 F.2d 351, 353 (Fed. Cir. 1992).

[39] United States v. United States Gypsum Co., 333 U.S. 364 (1948).

[40] FAR 33.21(a) and 52.33-1.

[41] 41 U.S.C. §604(3) and FAR 33.211(a)

VI. The Doctrine of Constructive Change

VI.A Constructive Change.

The Legal Principle: A constructive change "is a change that a contractor argues that he [the contractor] has to make even though he has not been issued a written order under a changes article."[42] A constructive change results from action or invitations by Government personnel which are construed by the contractor to be a change to the contract. A constructive change occurs when:

1) extra work is done beyond the minimum requirements of the contract;
2) an action by a Government representative required the contractor to perform work not covered in the contract; and
3) the contractor gave the Government notice of the change.[43]

One of the legal bases for a constructive change derives from the Changes Clause in Government contracts or the cardinal change rule. A changes clause permits the Government to unilaterally make changes in work within the general scope of the contract.[44] The clause also authorizes an equitable adjustment if the change increases or decreases the cost or time of performance. [45] The changes clause does not authorize cardinal changes, which affords another means for the contractor to make an equitable adjustment claim. [46] A cardinal change is a substantial deviation from the original scope of work that changes the nature of the bargain between the parties.[47] "A determination of the scope and nature of alleged changes requires a fact-intensive inquiry into the events that led to the excess work and their effect on the parties. The court must investigate the contract as a whole to determine whether the Government is responsible for the contractor's difficulties."[48] A contractor's claim for equitable adjustment therefore can be based under the Cardinal Changes Rule or the Changes clause in the contract. In addition, a claim may also be based on the Variations in Estimates Quantity (VEQ) clause. A VEQ clause provides that:

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[42] W. Noel Keyes, *Government Contract in a Nutshell* p.443.

[43] Consultants, Inc. ICA 79-2, B.A. 13,527

[44] See Thermocor, Inc. v. United States, 35 Fed. Cl. 480 (1996).

[45] *Id*

[46] *Id.*

[47] *Id.* at 490.

[48] *Id.* citing Universal Contracting & Brick Pointing Co. v. United States, 19 Cl. Ct. 785, 792-93 (1990).

> if the quantity of a unit-priced item in this contract is an estimated quantity and the actual quantity of the unit-priced item varies more than 15 percent, above or below the estimated quantity, an equitable adjustment in the contract price shall be made upon demand of *either party*. The equitable adjustment shall be based upon any increase or decrease in costs due solely to variations above 115% or below 85 % of the estimated quantity.[49]

This clause has been the source of litigation in several cases, however the federal courts seem to have found the clause to not be ambiguous, therefore the doctrine of *contra proferentum*, discussed below, does not seem to apply to this clause. [50]

The amount that a contractor is awarded in a constructive change claim via an equitable adjustment depends on the level of responsibility that the contractor assumes or is made to accept for the change to the contract. An equitable adjustment permits recovery of the reasonable value for the work where an agreement was not reached on price. This is *quantum meruit* at common law and therefore should not include anticipatory profit; however, contractor's often do ask for anticipatory profit in asserting their claims.[51]

To understand how contract dispute situations can be avoided, a thorough understanding of their causes is essential. Disputes usually arise where contract requirements language is open to interpretation or where the facts concerning non-conformance to contract requirements are non-existent, incomplete, or are otherwise defective. Even where the contract and the facts are clear, disputes can arise about the exact nature and size of a contract impacting event. Impacting events might be changes to the work scope or schedule issued by the Government, or they might be the result of forces totally external to the contract. The most likely types of contract performance impacting events are:

Work scope changes (content or schedule)
Late or deficient information, material, or equipment
Stop work orders
Other contract resource demands
Inadequate contractor/subcontractor performance
Defective or deficient specifications
Directed, out of scope work
Government-responsible delays
Acceleration of work
Overly stringent or untimely inspection

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[49] 48 C.F. R. §52.212-11

[50] See Foley Co. v. United States, 11 F.3d 1032 (Fed. Cir. 1993); Thermocor Inc. v. United States, 3 Fed. Cl. 480 (1996).

[51] See Thermocor Inc. v. United States, 35 Fed. Cl. 480 (1996).

Furthermore, such constructive changes have been recognized in the courts where the contractor performs work in excess of that called for in the contract requirements and where the reason for such additional performance was due to Government responsible causes. These constructive changes frequently occur when the contractor fails to limit performance in strict compliance with the contract's specifications and statement of work. This situation occurs when the time constraint of the work to be performed forces the contractor to proceed with work at his own risk rather than to wait for the formal change approval cycle. In many such instances, the contractor might be trying to comply with instructions issued by the Government's on-site representative or is reallocating resources and management priorities in an effort to meet project completion dates. Failure to negotiate resolution of such matters normally results in a dispute under the contract.

When a contract performance-impacting event occurs, the contract must be analyzed to determine if the impact has been *anticipated and language has been included to deal with all its implications*. If the particular impacting event was anticipated, the contractor must follow the contract specified procedures. If the particular impacting event was not anticipated, the contractor must proceed with the specified general procedure for changes to the contract often outlined in the changes clause in Government contracts which specifies procedures to be followed in the preparation and presentation of change requests. A recent trend with Government contracts of all types is for the inclusion of a timing requirement which limits the time a contractor has to pursue a claim from the time the impact is identified or should have been identified.

Government change clauses generally require the contractor to estimate the performance scope (direct impact) of the proposed change in terms of man hours, dollars, and time, whereas commercial change clauses are frequently limited to estimates in dollars only. In addition, it is sometimes necessary to estimate the indirect impact of delay, disruption, and inefficiency. This indirect impact must also be stated in man hours, dollars, and time for Government contracts.

During the last ten years, the basic methodology for determining the delay of impacting events has standardized around the use of Critical Path Method (CPM) network scheduling techniques. CPM, in many of its configurations, is widely accepted by Government negotiators, industry arbitrators, civil courts, and Government contract appeals boards and courts. The application of CPM in determining schedule impacts, however, varies widely from user to user, since the exact technique of application is dictated by the availability of data and different contractors collect different types and levels of data in support of their varied management information and accounting systems. Determining disruption and loss of efficiency from contract impacting events requires the use of less exacting techniques than CPM. There are many methods in use for quantifying disruption and inefficiency, but all methods require reliance on subjective evaluations.

VI.B Examples of Relevant Case Law.

Despite the fact that the Contract Disputes Act prohibits fraudulent and misrepresented claims,[52] contractors often assert questionable claims for equitable adjustments to a Government contract. While the majority of the cases reviewed suggested that the contractor was often unsuccessful in his/her claim, the following are examples of cases where the contractor prevailed or at least overcame the Government's Motion for Summary Judgment in its constructive change claims.

Example #1: Thermocor, Inc. v. United States (35 Fed. Ct. 480 (1966)). One of the recent cases concerning a contractor' claim for an equitable adjustment in a waste remediation project is seen in Thermocor. In Thermocor, Thermocor was awarded a contract to provide excavation, treatment, transportation and disposal of soil contaminated with polychlorinated biphenyls (PCBs). Thermocor sued the Government requesting damages for 1) differing site conditions; 2) changes, delays, and additional requirements by the contracting officer; and 3) misleading and defective contract specifications, as well as claims for bad faith and defective specifications. Thermocor essentially claimed that it processed more soil than contemplated in the contract under the estimated quantities. Both parties instituted cross-motions for summary judgment which is essentially an argument that the facts are so clearly in favor of one side or the other that no trial is necessary, which the court denied in part and granted in part. The Court found that additional facts were necessary to decide the case. In so doing, the Court provided guidance as to how the case would be decided on its merits: First, "if plaintiff justifiably relied on the contract estimates, the Government may be responsible for plaintiff's difficulties. Reliance, however, is a question of fact which may not be appropriately handled on a summary judgment." Second, "whether the Government's decision to ignore the quantity estimates provided in the ROD was reasonable. Additionally, "[whether processing and transporting the soils was governed primarily by design or performance specifications. Design specifications 'describe in precise detail the material to be employed and the manner in which the work is to be performed.'[53] In performing the contract, the contractor is not allowed to use its own discretion. Performance specifications, however, "set forth an objective or standard to be achieved, and the successful bidder is expected to exercise his ingenuity in achieving that objective or standard of performance selecting the means and assuming a corresponding responsibility for that selection."[54] Furthermore, the Court stated that "whichever party was responsible for choosing the process may provide insight into which party is responsible for overruns and the contractor's difficulties. Finally, with respect to the contractor's concern over the amount of material that was treated, the Court stated "whether the quantity increases in the case at bar reached a point beyond reasonable limits [to constitute a cardinal change rendering an equitable adjustment

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[52] 41 U.S.C. §604.

[53] *Id.* citing Blake Constr. Co. v. United States,987 F.2d 743 (Fed. Cir. 1993).

[54] *Id.* at 491.

appropriate], however, cannot be determined on the facts before the Court."[55] This criteria and these specifications are important in DOE's efforts to institute a firm fixed-price contract.

Example #2: J.R. Pope, Inc. In this case, requiring a contractor to continue performance under unusually severe weather conditions constituted a constructive change and entitled the contractor to additional compensation for extra costs incurred in performing under those conditions. The Government awarded a paving contract to J.R. Pope Inc. After unusually severe weather conditions, the Government refused to issue a stop work order. The Court held that under Suspension of Work Clauses, the contractor may obtain relief if the contractor established that an act or failure to act by a contracting officer or his authorized representative 1) caused delay to appellant, 2) that such delay was unreasonable, and 3) that the unreasonable delay was that necessary cause of the increase in the contractor's costs. This may be important if the Government storage sites are not available after the characterization, excavation, treatment, and transportation aspects of the contract are completed.

Example #3: Lockheed Martin IR Imaging Systems, Inc. v. Secretary of the Army (96-1087 (1997). In this case, requiring a contractor to provide less than the 100% option at the same unit price as for the 100% option constituted a constructive change entitling the contractor to recover its increased costs in supplying items under the condition as they were ordered along with profit. The Court concluded that the Army constructively changed a fixed-price contract when the Army departed from its option terms. In this case, the Army issued a fixed-price sealed bid to deliver "Detector Cooler Assemblies" with a 100% option to increase the quantity provisions. The contractor bid at the 100% option and did not offer lesser quantities for an increase in price. The contractor bid for 779 assemblies at a unit price of $389.00. The Army then sought less than 100% option quantities or only 131 assemblies. The contractor protested the Army only purchasing 131 assemblies saying this constituted a constructive change. The Court agreed reversing the Armed Service Board of Contract Appeals. This might be important if the actual quantity of the waste is in dispute.

VII. Interpreting Contract Language: The *Contra Proferentem* Doctrine

In addition to concerns associated with writing a contract that insulates the Government from losing a claim brought by a contractor for constructive change, the Government must also be concerned with the doctrine of *Contra Proferentem*. *Contra Proferentem* means that "if a written contract contains a word or phrase capable of two reasonable meanings, the preferred interpretation will be that which is less favorable to the party who drafted the contract and had control over choice of words."[56]

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[55] *Id.*

[56] WPC Enterprises, Inc. v. United States, 323 F.2d 874 877-78 (Ct. Cl. 1963).

> If some substantive provision of a Government-drawn agreement is fairly susceptible of a certain construction and the contractor actually and reasonably so construes it, in the course of bidding or performance, that is the interpretation which will be adopted. If the Government changes under the continued application of this check, it can obtain a looser rein by more meticulous writing of its contracts....[57]

This means that in drafting the contract, the Government must be careful to avoid ambiguous terminology. A contract provision is deemed to be patently ambiguous if it is susceptible to two different yet reasonable interpretations, each of which is consistent with the contract language and with the other provisions of the contract, and if the ambiguity would be apparent to a reasonable person in the claimant's position.[58] However, the existence of an ambiguity raises the duty of the contractor to seek clarification.[59]

VIII. Duty to Seek Clarification

In Secretary of the Navy v. Cessna Aircraft Company, 95-1409 (1996): The Navy issued a request for quotations for a firm fixed-price services contract for services and equipment to assist in radar and navigation training to undergraduate naval flight officers. After being awarded the contract, Cessna filed a certified claim for equitable adjustment claiming the Navy had made constructive changes to the contract by requiring Cessna to *perform outside the contract's training parameters* and to increase the flight training time. The Court held that the contract created a patent ambiguity, which created an obligation on Cessna to seek clarification before submitting its proposal, so the court denied the contractor' claim for equitable adjustment.

IX. Termination for Convenience

Finally, still another clause that the Government may use to avoid a contractor's claim for equitable adjustment is the Termination for Convenience clause. A Termination for Convenience clause provides that "the Government may terminate performance of work under this contract in whole or, from time to time in part if the contracting officer determines that a termination is in the Government's interest." In Krygoski Construction Company, Inc. v. United States, the Court held that to accommodate the Competition in Contracting Act (CICA)[60] and fairness requirements, the contracting officer may need to terminate a contract for the Government's convenience to further full and open competition; thus, to further its full

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[57] *Id*

[58] See Community Heating & Plumbing Co. v. Kelso, 987 F.2d 1575, 1579 (Fed. Cir. 1985.)

[59] Fortec Constructors v. United States, 760 F.2d 1288, 1291 (Fed. Cir. 1985).

[60] 41 U.S. §402, §405(a), and §416.

competition objective, CICA permits a lenient convenience termination standard. However, when tainted by bad faith or an abuse of contracting discretion a termination for convenience causes a contract breach.[61]

Most constructive changes result from an immediate dispute between the contracting parties which forces the change outside of the normal contract change procedure, but disputes can also grow out of a breakdown in negotiations between the parties during the formal change process. While no contract can ever preclude the possibility of a suit by a contractor, the key to prevailing in a contract dispute is clear, unambiguous contract language. Further, no matter how the dispute arises, negotiation is always the preferred mode of settlement by all parties.

[61] Allied Material & Equip. Co. v. United States, 215 Ct. Cl. 902, 905006 (1977).

Appendix D

Creating a Third-Party Monitoring Process for Enforcing ES&H Compliance

I. Introduction

Stemming from its tradition of managing M&O contractors through cost-plus contracts, and coupled with the strict demands for security and precaution associated with developing and constructing nuclear weapons, the Department of Energy has evolved a contract management process that has led DOE to be closely involved with decisions made by its contractors on ES&H matters. Such a process will not well serve the management of fixed-price contracts, because it opens the door to numerous change orders. In general, whenever the Department instructs a contractor to carry out activities beyond its contractual obligations, DOE is liable for the costs of those changes. While there will always be exceptional circumstances where reason and responsibility require DOE to intervene in the affairs of its agents, business-as-usual management practices should put in place mechanisms through which initial recourse is to automatic enforcement mechanisms, triggered without DOE intervention, and motivated by financial incentives, rather than to administrative procedures.

The purpose of this appendix is to demonstrate the feasibility of creating contract practices and language that implement the type of incentive mechanisms analyzed in Appendix A and discussed in Section II.3 of the body of the study. It stops well short of creating a precise blueprint through which these practices could be immediately implemented. It takes as a "template" the conventions evolved to implement ISO 14000. The essential nature of these conventions is that firms subscribe voluntarily to management practices leading to continuous quality improvement in specific areas, such as environmental practices. They simultaneously propose measurable criteria to judge progress toward their voluntary goals that are in turn reported to the public and audited by independent auditors who report their findings to management. Through these practices firms act outside the regulatory arena, but nonetheless benefit from economies gained from improvement and from recognition by potential customers of their efforts.

We propose herein a variation to these practices. Under this proposal, DOE would announce its ES&H goals through the RFP process. Firms would include in their proposals criteria and auditing procedures to ensure practices in support of DOE goals. These criteria would be audited by a third party, who would report the results to management and to DOE contract managers. DOE would, in turn, assess penalties for non-compliance and provide rewards for exceptional performance, based on the terms of the RFP and the proposal. Under extraordinary circumstances, DOE intervention could be specified in the contract terms. Thus,

the goal of the effort would be to permit DOE an "arm-length" ES&H monitoring system. Auditors could include teams of governmental regulators and/or private sector regulators.

We discuss this topic in four sections. The Section II discusses the typical regulatory requirements that projects of this nature must meet. Included in these requirements are various environmental, safety and worker health regulations, along with DOE orders or regulations. The Section III discusses the ISO 14000 system. The standards of the system are set forth and discussed along with the procedural issues regarding audits and certification under the system. The Section IV discusses the potential for the integration of the current state of regulation along with the proposed ISO system of "arms-length" regulation. This section also discusses the Department's changing role as a result of the changed regulatory system. Finally, Section V discusses the contractual issues that accompany a change in the manner of regulation. This section also discusses the potential effect such issues may have on the number of bidders for clean-up projects.

II. Typical Regulatory Requirements for a Privatization Project

A typical privatization project must comply, and meet the requirements set forth in, a number of lengthy and complicated environmental, safety, and health regulations. For example, a project will likely be subject to the Occupational Safety and Health Act (OSHA), the Clean Air Act (CAA), the Resource Conservation and Recovery Act (RCRA), the Toxic Substances Control Act (TSCA), and the Clean Water Act (CWA). Additionally, the procurement process itself must adhere to the directives set forth in the Federal Acquisition Regulations (FARs) and the Department of Energy Acquisition Regulations (DEARs). Occasionally, work performed at a particular facility will be governed by a Consent Order, as with the Hanford Tri-Party Agreement, which further directs how the procurement process and actual work is to be done. This means that the private contractors performing work for DOE will face voluminous reporting and permit requirements to be in compliance with the various regulations governing the work.

The regulations listed above each cover different aspects of the environment, safety, or public health. For example, the Clean Air Act establishes the basic framework for federal regulation of air pollution. This Act establishes national ambient air quality standards which must be implemented by the states and sets forth national emission standards for hazardous air pollutants.

The Clean Water Act bans the unpermitted discharge of pollutants into surface waters, establishes a national permit system, and requires application of technology-based controls on dischargers. The Act additionally requires any owners or operators of point sources to maintain records pertaining to the effluents. Any facilities with point source discharges must obtain certification from the state indicating that the facility will comply with the CWA before construction or operation can begin.

The Toxic Substances Control Act provides the Environmental Protection Agency (EPA) with comprehensive authority to regulate or prohibit the manufacture, distribution, or use of chemical substances that pose unreasonable risks to human health or the environment.

The Resource Conservation and Recovery Act is perhaps the most commonly involved regulation in waste clean-up projects. Most of the privatization projects that DOE is initiating involve the treatment of some form of hazardous waste. This Act required EPA to establish regulations ensuring the safe management of hazardous waste from "cradle to grave". This Act also imposes extensive record keeping requirements on those who handle hazardous waste. Reports must be submitted to the Administrator of EPA at least every two years providing information on the amount and disposition of hazardous waste, any efforts taken to reduce the volume or toxicity of hazardous waste and any resultant changes in volume or toxicity. This Act also sets forth strict record keeping requirements in the form of a manifest system that tracks all the hazardous waste that enters or leaves the possession of the generator, transporter, storer, etc. Permits are required to treat any hazardous waste. These permits are issued by the EPA unless a particular state in which the treatment is to take place has been certified by the EPA to be allowed to implement its own permit program. This is allowed only if the state's program requirements are at least as stringent as the EPA's requirements.

Most of the regulations mentioned above are overseen by the EPA. However, the Department of Labor (DOL) oversees the Occupational Safety and Health Administration which is in charge of ensuring safety in the workplace under OSHA. In the past, the DOE and the Nuclear Regulatory Commission (NRC) were jointly responsible for protecting the public from risks associated with nuclear materials as set forth in the Atomic Energy Act. Last March, NRC agreed to assume full responsibility for overseeing DOE's nuclear facilities. This transfer of oversight is expected to be phased in over the next ten years.[1] In addition, the Department of Transportation (DOT) also plays a role in the regulation of these projects through its regulation of the transportation of hazardous materials under the Hazardous Materials Transportation Act.

Each regulation discussed above includes its own requirements for permitting and reporting to monitor compliance. As mentioned above, most of the regulations that a privatization project will be subject to are overseen by the EPA, but there is no mechanism for the consolidation of the information required for reporting and permitting activities, thus the firm performing the privatization project must comply with each such regulation separately which likely involves some duplication of effort and waste of resources.

II.A DOE's Dual Role in Privatization Projects.

DOE plays a dual role in these privatization projects. Not only is DOE the purchaser, or customer of these firms that bid for privatized contracts, it also is often a regulator. This can

[1] "U.S. NRC Agrees to Oversee Energy Dept. Nuke Sites", March 31, 1997, Washington.

potentially lead to problems from several fronts. DOE, as customer, wishes to maintain a fixed-price contract where the risks of cost overruns and loss of profits shifts to the firm performing the work. DOE as customer wishes to avoid making or requiring changes in the mode, manner, or time re quired for performance as this often leads to change orders which fundamentally change what began as a fixed-price contract into a cost plus contract which shifts increases in costs to DOE as customer. However, as regulator, DOE has an obligation to ensure that the contractor is performing according to the letter of the law and any orders issued by DOE as regulator. Once again, if DOE as regulator mandates a change in performance due to regulatory noncompliance, this can lead to a change order.

Typically, change orders stem not from changes due to regulatory noncompliance, but from changes in the requirements for the work that is being performed. Case law concerning the doctrine of constructive change seems to indicate that if any changes in the work performed are specifically the subject of contract modifications and priced out change orders, no claim for constructive change and equitable adjustment will survive.[2] This suggests that in order to avoid altering a fixed-price contract to a cost plus contract, changes must be compensated for and agreed to by both parties as soon as the change has occurred. In addition, any contract modification needs to specifically state that the modification accounts for all of the costs associated with the change, leaving nothing open for further negotiation.

The doctrine of constructive change is one of concern to those who want to write firm fixed-price contracts for cleanup activities. On the surface it seems as if it would be relatively simple to get a fixed-price contract converted to a cost-plus contract simply by arguing constructive change. However, the development of the concept has led to a fairly well defined list of required elements to make out a successful constructive change argument. The elements of constructive change are: 1) work done in excess of the contract's minimum requirements whether the result of government action or inaction, 2) the contractor did not perform voluntarily, in other words the government required performance, and 3) adequate notice of the change was given by the contractor to the government.[3] There are two notice requirements applicable to constructive changes. The first requires the contractor to assert all claims before "final payment" and to submit a written statement describing the nature and extent of the claims within 30 days of receipt of a formal change order or the notification to the Contracting Officer of a constructive change.[4] The second requires the contractor to give written notice of a constructive change claim setting forth the date, circumstances, and source of the order. This notice requirement limits the recovery of any costs based on a constructive change claim to costs incurred within 20 days prior

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[2] *Pittman Construction Co.*, 81-1 BCA, 73, 287 and *Dawson Construction Co.*, GSBCA 3998, 75-2 BCA.

[3] Feidelman, Joel R. and Jacob B. Pankowski, "The Doctrine of Constructive Change", *Legal Times of Washington*, April 27, 1981, p. 30. *See Also J.R. Pope, Inc.*, 80-2 BCA, 71,769 at 71,777.

[4] Feidelman at 5.

to the notice.[5] It appears that if the Contracting Officer keeps abreast of the progress being made on the project and deals quickly and definitively with any problems that arise and prices out any resulting changes explicitly and immediately, no claim for constructive change will be successful.

There will likely be instances during the performance of these cleanup projects where changes in the manner of performance will be necessary in order to meet particular specifications that are not in the control of DOE or the firm providing the services. For example, if the Waste Acceptance Criteria for the Waste Isolation Pilot Project changes, the firm performing the work will necessarily need to change the resultant product to meet these criteria. These changes are not mandated by DOE but could potentially lead to change orders.

While DOE has turned over regulatory oversight of its nuclear facilities to NRC, the plan is to be phased in over a ten year period. Therefore, DOE will still be assuming a dual role in these projects until the phase in is complete. It would be wise for DOE to adopt an "arms-length" regulatory approach during this time period to minimize the likelihood of constructive change claims. In other words, it would be beneficial for DOE to isolate itself from directly mandating the way the firm comply with regulations and concentrate more firmly on its role as customer. This way, if a change in the way the firm is required to meet regulatory requirements occurs, DOE will be isolated and will not have mandated this change. This will lessen the likelihood that DOE will be held responsible for the resulting change. The key to implementing this isolation lies in developing or locating an independent party or group who will be able to perform the regulatory monitoring functions that DOE now faces. DOE must concentrate on its role as customer without getting involved in the role of regulator as well.

III. ISO 14000

ISO 14000 is a series of voluntary consensus standards which provide a model for an Environmental Management System (EMS).[6] It is designed as a tool for an organization to keep aware of the interactions that its products and activities have on the environment and to continuously improve the level of environmental performance. The series consists of several guidelines standards and one compliance standard.

The standards are developed from consensus agreements reached between all players in a particular industrial sector. There are three main phases to the development of a standard. In the first phase, the need for a standard is usually expressed to a national member body of ISO by a

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[5] *Id* at 6.

[6] Http://www.scc.ca/iso14000/thestnds.html, page 1.

particular industry sector.[7] Once this need has been recognized and formally agreed to, the first phase includes the definition of the scope of the standard to be developed. The second phase consists of negotiations involving the detailed specifications within the standard. This phase is considered the consensus building phase as countries all try to come to an agreement as to what the standard will entail. The final phase comprises the formal approval of the draft standard. The draft must be approved by two-thirds of the ISO members that have participated actively in the development process and approval by 75 percent of all members that vote. When the approval has been granted the standard is published as an ISO International Standard. ISO has established a basic rule that all standards are to be reviewed at least every five years to ensure that changes in technology, new methods, and changes in safety requirements or procedures are accounted for.[8]

The guidelines are as follows: 1) A commitment by management to define an environmental policy that integrates pollution prevention techniques, commits to regulatory compliance, and is available to the public, 2) procedures to identify the environmental aspects of a company's activities, products, or services that it can control and over which it can be expected to have an influence, 3) definitions of roles and responsibilities to facilitate environmental management within a company, 4) establishment of emergency-response procedures, 5) checking and corrective action measures such as procedures for monitoring and measuring environmental impacts of operations, and periodic audits of the EMS to determine that it conforms to the requirements of the standard, and 6) periodic management review of the EMS. ISO 14000 consists of several elements. These are environmental policy, environmental planning, implementation and operation, checking and corrective action, and management review.

ISO 14000 basically ties mandatory requirements such as regulatory measures into a management system which is made up of objectives and targets focusing on meeting and exceeding the mandatory requirements with a focus on prevention and continuous improvement. It is modeled after the BS 7750 (Environmental Management Systems) originally published in 1992 in the European Union by the British Standards Institute.[9]

III.A Certification Processes for ISO 14000.

The ISO 14000 standards are generally not compulsory. A company typically chooses to comply with the standard or not. However, there are some circumstances where governments or regulations explicitly call for a particular ISO standard in which case, compliance is not

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[7] Http://www.iso.ch/infoe/intro.html, page 6.

[8] Http://www.iso.ch/infoe/intro.html, page 7.

[9] Http://www.mgmt14k.com/ems.htm, page 1.

voluntary. The European Union has incorporated these standards into its regulatory requirements.[10] In addition, compliance with a standard could be called for contractually.

A company can either apply for registration and be "certified" as complying with the ISO 14000 standards or the company can simply announce that it is complying with the standards without going through the formal certification process. However, the demand is increasing for companies with actual ISO registration so it is likely that more companies will go through with the formal registration process. *Fortune* magazine reported recently that only 5 percent of businesses used international standards versus corporate or national standards in 1970, but anticipated that number to increase to at least 50 percent by 1995.[11] This increase in the acceptance of international standards is due to the trend toward international standards and the emphasis the international community is placing on environmental matters.

III.B Requirements to Remain Certified.

Since the goal of ISO 14000 is to continually improve the management system and production, the system requires periodic audits. These audits are performed both by external and internal auditors.[12] Typically these audits do not replace, but rather complement any audits that may be performed by regulators. The audits are necessary to ensure that the EMS in place at that particular company conforms to the requirements of ISO 14000. The results of these audits can be used to identify areas that are in need of improvement and corrective action. The purpose of these audits is not to ensure regulatory compliance but rather to ensure that the entire EMS is functioning as it should. However, since one of the primary goals of the ISO standards is regulatory compliance, favorable audit results would suggest that compliance is being achieved.

III.C Description of Standards in ISO 14000.

ISO 14000 is not a single standard. Rather, it is a systematic way of approaching a company's operating mechanisms to determine whether the company is in compliance and for developing action plans to bring a company into compliance and to continue to progress. The standards that make up ISO 14000 do not contain defined performance criteria, rather the ISO 14000 standards consist of a series of guidance standards designed to aid companies in designing an effective and comprehensive EMS. The 14000 series is a basic introduction to the concepts of Environmental Management Systems. The 14001 series define the specific core elements of an EMS and delineate the standards for registration. The 14010-12 series gives information regarding the systems auditing and auditor criteria and defines the principles and procedures for the auditing process. The ISO 14014 series establishes guidelines for developing baseline

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[10] Http://www.dep.state.pa.us/dep/deputate/pollprev/ISO14000/pinero.htm, page 2.

[11] Http://www.dep.state.pa.us/dep/deputate/pollprev/ISO14000/pinero.htm, page 2.

[12] Http://www.mgmt14k.com/ems.htm, page 4.

operating positions and for determining priorities for improving environmental performance. The 14015 series delineates the guidelines for site assessments while the 14020-24 series describes the environmental labeling process and discusses the principles of the potential environmental benefits of products. The 14031 series sets the standard for measuring environmental performance. This series is intended to measure performance over time and to show trends in a company's environmental performance. Finally, the 14041-44 series describes the development of a methodology for establishing a product's life cycle. This includes an assessment of environmental impacts and an evaluation of areas for improvement.[13]

IV. Potential for Integration of ISO System and Current Regulatory System

The current regulatory system that a privatization project faces is voluminous and complicated. There are numerous regulations that a project may be subject to and noncompliance with any one of these regulations could lead to delays in completion of the project which could potentially lead to change orders. The ISO system is a relatively new one which focuses on the entire management system, not solely on what is required to conform with the regulations. In theory, a firm that utilizes a comprehensive environmental management system that meets the criteria set forth for ISO certification will be complying with any corresponding environmental regulations as well as attempting to improve beyond mere compliance. The question is how to integrate these two systems to effectuate a complete and thorough management system that will ensure compliance with a minimum of regulatory compliance monitoring.

IV.A Integration of the Two Systems.

Preliminary planning for the development of an ISO certified EMS requires that a firm thoroughly examine every aspect of its present operations and management, including legal and regulatory requirements.[14] After this review is complete, an environmental policy is designed to meet all the objectives and targets, including regulatory compliance. The environmental policy is then implemented through the EMS. Once the EMS is functioning, management continually measures environmental aspects and develops an environmental effects register to document these aspects. At this point, an environmental regulations register is developed to track regulatory compliance. Each of these activities is well documented to ensure that both internal

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[13] The information describing the specific series contents was obtained from a presentation given by Dr. Raymond Martin entitled "Strategic Environmental Management: ISO 14000 Decision Criteria and Implementation Issues", given at the University of Tennessee through the National Center for Environmental Decision Making Research, February 26, 1997. Dr. Raymond heads the ENSR Environmental Management System Development Team at ENSR Consulting and Engineering.

[14] Http://www.ait.ac.th/AIT/som/as/ISO14000/chapter1/chapte1.htm, page 2.

and external auditors are able to access all the required information.[15] When a thorough investigation of these types of issues has been completed, the firm will know its status in regard to applicable environmental regulations and the information used to reach that decision can be used to indicate compliance. In essence, the firm itself will be performing the regulatory compliance monitoring function.

While ISO 14000 does not require an "Environmental Report", often external stakeholders such as legislators, regulators and local communities, will request one. It has been suggested that a firm should compile an Environmental Report at least annually. In this way, stakeholders can be kept abreast of the situation a firm is in and how well it is meeting its goals. An Environmental Report should cover the following: 1) environmental policy, 2) environmental strategy, 3) a description of the EMS components, 4) the policy regarding environmental aspects related to products and services, 5) a list of all inputs and outputs, including a list of emissions, etc., 6) an assessment of compliance with environmental regulations, 7) an evaluation of environmental performance, 8) a description of the environmental management programs, 9) a description of relationships with external stakeholders, and 10) audit report findings.[16] While ISO 14000 does not require this type of reporting, this type of report could aid in easing regulatory compliance monitoring. It provides a thorough description of the types of regulations a firm faces along with a report that can provide regulators with the information they need.

IV.B Changes in Regulatory Compliance Monitoring Due to Integration.

Since the ISO 14000 EMS system is still evolving, there are few independent third party groups in existence that are able to monitor a firm's EMS to ensure that it is meeting the criteria set forth in ISO 14000. As was mentioned above, DOE's goal should be to have a "arms-length" regulatory approach with regard to the regulatory function it is responsible for in these privatization projects. As such, an independent third party monitoring or auditing group would need to be identified to assume these functions for DOE. This auditing group would necessarily need to be recognized by DOE and other regulatory agencies as providing an accurate and reliable audit. In this way, if audit results were favorable, this would indicate that regulatory compliance was being achieved and compliance monitoring would be kept to a minimum.

The criteria set forth in the ISO 14000 standards requires that the firm take regulatory issues into consideration, focusing not only on meeting compliance but also on furthering environmental performance beyond mere compliance. If the ISO concept of environmental management were to be accepted by the regulatory groups in the Unites States, monitoring for compliance could be a less complicated matter. In theory, a firm could develop an EMS that would be acceptable not only in relation to ISO standards but also for purposes of regulatory compliance. The audits described above could provide the necessary information for the

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[15] *Id.* at 4.

[16] Http://www.alt.ac.th/AIT/som/as/ISO14000/chapter2/Capt.htm, page 2.

regulatory agencies to indicate either compliance or non-compliance. In this manner, if only one such report were necessary describing and detailing all the issues necessary for compliance and continual improvement, time and money would be saved which could then be devoted to further improvement or other matters.

As was indicated above, compliance with ISO standards can be called for contractually. If DOE were to require ISO compliance in contracts for privatization projects it would be mandating that the companies bidding for these contracts would be committed to meeting and exceeding compliance with regulatory requirements since that is one of the criteria to meet the ISO standards. This would be an explicit requirement of the contract award. The acceptance of ISO is evolving in the U.S. and as such it will take some time for the regulatory agencies mentioned above to become familiar with and begin to accept ISO as a means of ensuring regulatory compliance. However, once this process becomes accepted, the regulatory process for these types of projects will likely become less involved. This is because the process of conforming with ISO 14000 through the development of a comprehensive EMS coupled with third party auditing makes the firm essentially self regulating.

IV.C DOE's Changing Role with Successful Integration.

If DOE were to require this type of commitment on the part of firms bidding for privatization projects then it could in turn accept the decisions of the third party auditors who assess the success of the EMS for that particular firm. While the third party auditors do not examine the firm to determine compliance, they do audit to determine if the EMS is living up to the standards set forth in ISO 14000. If the firm is following the directives set forth in the ISO standards then it is complying with any environmental regulations and is necessarily attempting to improve beyond mere compliance. If the firm is not complying with the criteria set forth in the ISO standards, the firm must take immediate action to correct any problems. These problems could include environmental regulation noncompliance. However, a firm commitment to ISO standards would lead to ensuring that the firm would correct these problems on its own without intervention by the regulatory agencies. DOE, as well as other regulatory agencies, would no longer be primary regulators since the firm and to a degree, the independent auditors, will have accepted this responsibility.

IV.D Successful Integration's Potential Effect on Change Orders.

As was discussed above, DOE should attempt to isolate itself from regulating and concentrate on its role as customer. By requiring firms bidding for privatization projects to become ISO certified and accepting the decisions of third party auditors, DOE can minimize its involvement with the regulatory process and thereby minimize the threat of change orders occurring and altering the fixed-price contract into a cost plus contract. This is because DOE would not be mandating changes in the way the firm does business. This is one of the essential elements required to sustain a claim for constructive change. If a particular firm makes a commitment to live up to ISO standards then any changes the firm makes in the way it proceeds

with a particular project or process to meet these standards would be voluntary thus taking away the threat of a successful constructive change claim.

V. Contractual Issues

The above discussion suggests that DOE can effectively manage a contract in such a way that change orders are avoided and a fixed-price contract can be maintained. DOE contracts are governed by Federal Acquisition Regulations (FARs) and further by DOE Acquisition Regulations (DEARs). These regulations dictate the precise methods and language allowable for formulating RFPs and any resultant contracts. Nothing in the FARs or DEARs indicates that DOE would be unable to require a potential privatization project bidder to be ISO certified. FAR Part 15 indicates that special requirements or certification requirements can be set forth explicitly in the RFP and resultant contract.[17] This section suggests that DOE could simply include a requirement that any potential bidders be ISO certified in order to be eligible to be awarded the contract.

The discussion set forth above regarding Environmental Reports indicates that ISO 14000 does not require this type of reporting in order to maintain certification. However, this type of reporting is essential to ensure that all the regulatory compliance information is available in a central document in order to ease compliance monitoring. It is also essential to ensure that DOE's role as regulator is minimized. DOE needs to minimize its regulatory function to ensure a firm fixed-price contract. With an ISO certified firm DOE would not be mandating any changes due to regulatory noncompliance. The firm itself, along with the auditors, would essentially be performing the compliance monitoring function and would discover any noncompliance and mandate the changes itself in order to keep within the requirements set forth for an ISO certified EMS. An Environmental Report would provide all the regulatory agencies with sufficient detailed information to gauge levels of compliance.

V.A Contractual Language Requiring ISO Certification and Environmental Reports.

To minimize the threat of a claim for constructive change and to increase the efficiency of the regulatory compliance process, DOE should contractually require that any potential provider of privatized services is ISO certified and will be prepared to provide the above mentioned Environmental Report. Since the constraints set forth in the FARs and DEARs indicate that these types of special requirements are allowable, DOE simply needs to include appropriate language in the RFPs and resultant contracts requiring such. In addition, DOE could also structure the contract to include language requiring certification and environmental reporting from any subcontractor that the privatization firm would hire to perform part of the work.

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[17] FAR Part 15.406-5(a), Http://www.gsa.gov/far/90-46/html/15PART.HTM, page 9.

Nothing in basic contract law indicates that this can not be done. An example of this type of language is set forth below.

> The Contractor agrees that it is currently or will be ISO 14000 certified at the time of contract award. The Contractor further agrees that it will provide documentation of such certification or efforts toward becoming certified at any time throughout the contracting process upon request of DOE and/or the Contracting Officer in charge of the project. The Contractor further agrees that it will maintain ISO certification for the duration of the contract period. The Contractor agrees that it will take any and all steps necessary to correct unfavorable results indicated through the third party auditing process within a reasonable amount of time after identification of the problem in order to maintain constant certification. Any actions taken to correct unfavorable audit results or to maintain certification will be at the sole expense of the Contractor and will not be the basis for a claim for constructive change or a change order.
>
> The Contractor agrees that it will require any subcontractors hired to perform or assist with work set forth in the Statement of Work to be ISO certified. The Contractor will require any such subcontractors to provide proof of such certification at any time upon request of DOE or the Contracting Officer.
>
> The Contractor agrees that it will provide an Environmental Report to any regulatory agencies upon request. The Contractor further agrees to provide an Environmental Report to each involved regulatory agency at least once per fiscal year. The Contractor further agrees that it will compile the Environmental Report to meet the specific requirements set forth in the RFP.

The above examples of contract language are very brief but provide a starting point for the development of appropriate contract language. This new form of privatization contract should also include appropriate language delineating specific rewards or penalties for meeting or failing to meet the requirements set forth in the contract. This type of language can stimulate appropriate behaviors that will lead to more efficient performance under the contract. This reward/penalty language can also lead to a shifting of risks from DOE to the Contractor. For example, DOE could include language indicating that if the firm were to lose ISO certification or suffer an unfavorable external audit, the firm would be subject to a penalty such as a decrease in payments or a "fine". DOE could also include language indicating that each subcontractor of the privatization firm would be subject to the same reward/penalty structure. If the subcontractor failed to adhere to the requirements the privatization firm could also be subject to a penalty. This would likely ensure that the privatization firm hires competent subcontractors and monitors their behavior to ensure compliance with the contract requirements.

V.B Effect on Potential Bidders.

The concept of a complete and comprehensive Environmental Management System is a relatively new concept in the United States but has been functioning in Europe for some time. As such, it is unclear how many firms that would be bidding for privatization projects in the states have even begun to develop this type of management system. There is a real potential for DOE to lose bidders by requiring certification. However, if these firms knew that DOE was going to begin to require certification for contract award they would likely begin development of an EMS capable of attaining certification or risk losing out on a potential contract.

Eventually, this type of certification requirement will become more commonplace in the U.S. as it has in Europe. In all likelihood, firms that wish to maintain their competitiveness for contracts will begin to develop management systems capable of certification on their own. However, it may take some time for the ISO concept to take root in business decisions in the U.S. DOE could effectively increase the pace of this process by requiring a comprehensive management system from its privatization contractors while at the same time ensuring firm fixed-price contracts and minimizing its role as regulator.

The ***Joint Institute for Energy and Environment*** (JIEE) is an organization established by the Oak Ridge National Laboratory (ORNL), the Tennessee Valley Authority (TVA) and the University of Tennessee (UT), to conduct collaborative research and other joint activities involving people and facilities at all three institutions in areas related to energy, the environment and economics.

The JIEE provides a convenient access point for collaborative ventures involving the facilities and people of ORNL, TVA and UT. It eliminates many of the institutional barriers that otherwise make collaborative activities difficult or impossible. The JIEE increases efficiency by matching tasks to the most appropriate professional resources with minimum administrative cost.

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