The Design-Build Approach for DOE Nuclear Facilities:
Can Compliance with 10CFR835 ALARA Requirements be Achieved?

Ron Morgan

ABSTRACT

The "Design-Build" approach for the acquisition of new facilities has recently achieved popularity within the DOE complex, due to the potential for significant cost reductions over the traditional approach. However, the Design-Build process seems to exclude interaction between the contractor and the project management team during the design of the facility. Can adequate dose optimization procedures be carried out in the absence of interaction between the architect and the radiological engineering organization during the design process? This paper explores that question, using a facility to be built at Los Alamos National Laboratory (LANL) as an example.

INTRODUCTION:

The acquisition of a facility within the DOE complex requires an act of congress[1]. The congressional action provides funding for the design and construction of the new facility, however several acquisition and funding strategies are available depending on project-specific needs.

This paper addresses the acquisition (design and construction) of an office/light laboratory building at Los Alamos National Laboratory (a DOE-owned Laboratory). Radioactive sources will be stored within the building in shielded vaults, and the sources will be used in various locations within the building for the purposes of testing, calibration, and training. The acquisition strategy chosen for this facility has prompted radiological engineering personnel to develop new tools in order to comply with the ALARA requirements in Federal Law 10CFR835.

ACQUISITION STRATEGIES:

There are numerous acquisition strategies for federal property. When programmatic needs require the acquisition of a new facility, a Project Manager is assigned and chooses an acquisition strategy based on the cost, complexity, funding sources, and urgency of his/her project. In the past, the acquisition strategy for complex facilities (such as those requiring significant radiological shielding) was almost invariably Design-Bid-Build. This strategy requires an Architect/Engineering (A/E) firm to be contracted (via bid) to design the facility based on a "performance requirements" document developed by the

[1] There are numerous funding and management strategies, but for facilities costing more than $5 Million, congressional approval is required. A comprehensive review of all of the permutations of acquisition and funding strategies will not be attempted here.

future user of the facility. During the design process the user provides comments and direction to the A/E, in order to obtain a design that the user finds acceptable. The construction of the facility is then bid, and the A/E and the constructor collaborate to construct the facility.

This system works well when the Project Manager and his/her project management team have clearly defined the goals of the acquisition, when the project management team ruthlessly protects the goals of the acquisition from each of a host of critics, and when the DOE managers of the project (who provide "oversight" to the project management team) will let the project management team do its job. Unfortunately, this combination of circumstances is fairly rare, and large cost overruns are common.

Another acquisition strategy, called "Design-Build/Fixed Price," is commonly used for relatively small, simple projects. This strategy requires an Architect/Engineering (A/E) firm and a construction firm to be contracted (via bid) to design and build the facility for a fixed price, again based on a "performance requirements" document developed by the future user of the facility. In this case, the performance requirements document has to be well-thought-out and complete, because the design will be developed solely in reference to this document. Project managers like this strategy because, in principle, you get exactly what you want for a fixed price, and for this reason the Design-Build/Fixed Price strategy has been chosen by project managers for increasingly complex facilities. However, the work required to develop the performance requirements document increases dramatically as the complexity of the facility increases.

ALARA COMPLIANCE:

Federal Law requires that new radiological facilities be designed and operated with ALARA in mind (10CFR835 1002/1003). With the Design-Bid-Build acquisition strategy, radiological engineering personnel (as agents of the Project Manager) work with the A/E firm to perform ALARA and cost-benefit analyses for various systems as the design progresses. This approach is not possible with a Design-Build/Fixed Price acquisition strategy. In order to comply with federal law (specifically, the 10CFR835 ALARA requirements), radiological engineering personnel developed two major criteria for this project that must be met in order for the Design-Build/Fixed Price acquisition strategy to proceed:

1) Project and Operational management must be committed to developing appropriate administrative controls to compliment the physical design features of the facility, and
2) Conservative source terms have to be developed and used to establish shielding requirements for various areas within the facility.

There is an assumption inherent in the use of the Design-Build/Fixed Price acquisition strategy coupled with the criteria described above: A radiological facility **can** be designed and built in accordance with the ALARA objectives in 10CFR835, without performing cost-benefit analyses for various systems within the facility. This assumption necessarily places a lot of emphasis on the source terms which are developed to establish shielding

requirements. An appropriately chosen source term should drive appropriately conservative shielding designs, thus providing a large benefit relative to the cost of the shield.

Another assumption inherent in the use of this strategy is that the money saved through a fixed-price contract will offset any design features that are more robust than required. Thus a shield that is more expensive than necessary (due to an overly conservative source term) ideally is paid for by the cost savings realized by the implementation of the acquisition strategy.

EFFORTS TO DATE:

A lot of effort has gone into the project to date, from a great many diverse people. The Pre-Conceptual and Conceptual Design phases are complete, and the Project Manager is currently accepting proposals from A/E and construction firms.

From a radiological engineering perspective, the following has been accomplished:

1) Commitment from Project and Operations management has been obtained to integrate operational requirements with physical design aspects of the facility.
2) Conservative source terms have been developed and used to establish shielding requirements for storage vaults, special-use rooms, and laboratory rooms.
3) Preliminary shielding calculations have been performed, using source terms developed for the purpose, to establish shielding materials and thicknesses for various scenarios.
4) A radiological engineering staff member has been assigned to the project to assist the Project Manager with radiological concerns.

FUTURE EFFORTS:

1) A radiological engineering/ALARA design review will be performed on the final design, and comments submitted to the Project Manager prior to the start of construction. Any changes to the design at this point will be a "design change" (given that the performance specifications have been met), and thus the cost of the change will be over-and-above the cost of the original contract.
2) Radiological engineers will inspect the facility during the construction.
3) A radiological evaluation of major systems will be performed after construction to verify the integrity of the systems.
4) A review of the integration of operational requirements with physical design aspects of the facility will be performed, to insure that a comprehensive ALARA program is in place.

AGREEMENT PARTIES:

This approach (i.e. Design-Build/Fixed Price with up-front ALARA design criteria) has been agreed to by the Radiological Engineering Team Leader, the Radiation Protection Services Group Leader, the LANL Radiation Protection Manager (RPM), and the Project Manager for this project.

CONCLUSION:
We believe that compliance with 10CFR835 ALARA requirements can and will be achieved in this project, given the development work that has been performed to date and the follow-on work to be performed throughout the duration of the project.

All of the parties involved in this project are keenly aware that design and construction cost savings are being traded for potentially expensive shielding designs. The greatest difficulty in this approach from a radiological point of view is that the source terms which are developed are absolutely critical to the cost-effectiveness of the project. Overly conservative source terms will drive expensive shielding, hamstringing efforts to control costs. Source terms which are not conservative enough will necessitate backfitting the facility with even more expensive shielding.

Even though the economic viability of the chosen acquisition strategy is unproven for such a complex facility, in the current environment of skyrocketing costs and huge cost overruns the Project Manager is to be commended for attempting to control costs in every way possible. It will probably take several projects of this complexity, together with appropriate as-built analyses, to effectively evaluate the economic viability of this acquisition strategy.

Acknowledgements:
I gratefully acknowledge the assistance and guidance of Jim Bland, LANL (ESH-12) Radiological Engineering Team Leader, throughout my involvement in this project. Jim performed much of the engineering that went into the pre-conceptual and conceptual design phases of the project, he developed the radiological design criteria for the project, and he continues to be a valuable resource as the project progresses.