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LAND MANAGEMENT SYSTEMS

Major Software Development Does Not Meet BLM's Business Needs

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Mr. Chairman and Members of the Subcommittee:

Thank you for inviting us to participate in today's hearing on the Bureau of Land Management's (BLM) Automated Land and Mineral Record System project, also known as the ALMRS/Modernization. The ALMRS/Modernization was intended to provide modern computer and telecommunications equipment and office automation for over 200 offices nationwide as well as software to more efficiently record, maintain, and retrieve land description, ownership, and use information to support BLM, other federal programs, and interested parties. As you requested, I will discuss (1) the history of the project, (2) the results of our reviews, including the key reasons for problems, and (3) where we believe BLM should go from here.

Mr. Chairman, BLM spent over 15 years and estimates that it invested about \$411 million planning and developing the ALMRS/Modernization, only to have the major software component—known as the ALMRS Initial Operating Capability (IOC)—fail. As a result of that failure, the bureau decided not to deploy ALMRS IOC at this time.

We have previously reported on the significant problems and risks that BLM has encountered. We have made many recommendations to reduce those risks; however, BLM has been slow to implement some recommendations and has not yet fully implemented others. The bureau now needs to determine whether it can salvage any of the more than \$67-million reported investment in ALMRS IOC software, by analyzing the software to determine if it can be cost-beneficially modified to meet BLM's needs. In addition, to reduce the risk that future efforts will result in similar failures, BLM should assess its information technology investment practices and systems acquisition capabilities.

We performed our work from July 1998 through February 1999, in accordance with generally accepted government auditing standards.

The ALMRS/ Modernization: A Brief History

During the energy boom of the early 1980s, BLM found that it could not handle the case processing workload associated with a growing number of applications for oil and gas leases. The bureau recognized that to keep up with increased demand, it needed to automate its manual records and case processing activities. Therefore, in the mid-1980s, it began planning to acquire an automated land and mineral case processing system. At that

time, BLM estimated that the life-cycle cost of such a system would be about \$240 million.

In 1988 BLM expanded the scope of the system to include a land information system (LIS). The expanded system was to provide automated information systems and geographic information systems technology¹ capabilities to support other land management functions, such as land use and resource planning. BLM combined the LIS with a project to modernize the bureau's computer and telecommunications equipment, and estimated the total life-cycle cost of this combined project to be \$880 million.

The project was reduced in scope in 1989 to respond to concern about the high cost and named the ALMRS/Modernization. The project consisted of three major components—the ALMRS IOC, a geographic coordinate database,² and the modernization of BLM's computer and telecommunications infrastructure and rehost of selected management and administrative systems. Estimated life-cycle costs were \$575 million (later reduced to \$403 million), and BLM planned to complete the entire project by the end of fiscal year 1996.

The ALMRS IOC was to be the flagship of the ALMRS/Modernization, and was to replace various manual and ad hoc automated systems. The bureau designated the ALMRS IOC a critical system for (1) automating land and mineral records, (2) supporting case processing activities, including leasing oil and gas reserves and recording valid mining claims, and (3) providing information for land and resource management activities, including timber sales and grazing leases. The system was expected to more efficiently record, maintain, and retrieve land description, ownership, and use information to support BLM, other federal programs, and interested parties. It was to do this by using the new computer and telecommunications equipment that was deployed throughout the bureau, integrating multiple databases into a single geographically referenced database, shortening the time to complete case processing activities, and automating costly manual records.

¹A geographic information system is computer technology designed to assemble, store, manipulate, and display geographically referenced data, such as the location of a lake or oil well.

²We previously reported significant cost overruns and milestone slippages on an earlier project to develop the database. See Land Management Systems: Extensive Cost Increases and Delays in BLM's Major Data Base Project (GAO/IMTEC-91-55, August 5, 1991).

Despite the promise of ALMRS IOC to significantly improve business operations, repeated problems with its development have prevented deployment. For example, during a user evaluation test in May 1996, problems were reported involving unacceptably slow system performance. Subsequent testing in 1996 uncovered 204 high-priority software problems, which delayed project completion by about a year. In testing conducted in November 1997, BLM encountered workstation failures and slowdowns caused by insufficient workstation memory and by problems discovered in two BLM-developed software applications. Some of these problems had been identified in earlier tests but had not been corrected. Additional testing uncovered software errors that resulted in missing, incorrect, and incomplete data, and error files that contained accurate data. As a result of these problems, BLM postponed the Operational Assessment Test and Evaluation (OAT&E) that had been scheduled for December 1997. The OAT&E was to determine whether ALMRS IOC was ready to be deployed to the first state office.

In October 1998, the OAT&E was conducted and showed that ALMRS IOC was not ready to be deployed because it did not meet requirements. During the test, users reported several problems, including that ALMRS IOC (1) did not support BLM's business activities, (2) was too complex, and (3) significantly impeded worker productivity. For example, one tester reported that entering data for a \$10 sale of a commodity, such as gravel, required an hour of data entry using ALMRS IOC, whereas with the existing system, the same transaction would have taken about 10 minutes. Users also reported that system response time problems were severe or catastrophic at all test sites. One user said "It is ridiculous to spend 2 or 3 hours to enter information in this system, when it takes 30 minutes to an hour to process the information into the legacy system." Finally, users reported data converted from legacy databases were not accurate, and that validation of the converted legacy data required inordinate effort and time.

Because these problems are significant, senior BLM officials have decided that ALMRS IOC is not currently deployable. According to BLM, it obligated about \$411 million on the ALMRS/Modernization project between fiscal years 1983 and 1998, of which more than \$67 million was spent to develop ALMRS IOC software. The \$67 million does not include ALMRS IOC costs that are part of other cost categories, such as costs for work performed from fiscal years 1983 through 1988, project management, computer and telecommunications hardware and software, data management, and systems operation and maintenance. The reported

obligations associated with the major cost categories of the ALMRS/Modernization are summarized in table 1.

Table 1: Reported ALMRS/Modernization Obligations, Fiscal Years 1983 Through 1998

Cost category	Explanation	Obligations
FY 1983-1988 obligations	<ul style="list-style-type: none"> • Data collection • Concept development • Requirements definition • Contract preparation 	\$32,925,000
Project management	<ul style="list-style-type: none"> • BLM and contractors' costs for project management, oversight, and administration • BLM salaries, benefits, and travel 	74,690,940
ALMRS IOC software development	<ul style="list-style-type: none"> • ALMRS Release 1 and 2 	67,547,220
Administrative systems modernization	<ul style="list-style-type: none"> • Rehost of selected management and administrative systems from outdated mainframe computers to BLM's modern, networked environment 	8,198,466
Computer and telecommunications hardware and software	<ul style="list-style-type: none"> • Acquiring and installing new hardware and software to support office automation and administrative functions 	121,348,325
Data management	<ul style="list-style-type: none"> • BLM and contractor costs to collect, edit, and convert BLM land and mineral program related data • Ongoing work to establish the geographic coordinate database • Conversion of BLM data from legacy systems into the ALMRS database 	85,476,518
Operations and maintenance	<ul style="list-style-type: none"> • Configure, operate, and maintain administrative, database, and e-mail software, telecommunications and computer hardware, and operating systems software • Contract maintenance fees • BLM and contractor labor costs 	20,957,296
Total ALMRS modernization		\$411,143,765

Source: BLM; amounts include funding from all sources. We did not independently verify these data.

Senior BLM officials told us that although ALMRS IOC is not currently deployable, BLM has benefited from the ALMRS/Modernization work. BLM has deployed about 6,000 workstations throughout the bureau, provided office automation capabilities, and implemented a national telecommunications network with electronic mail and internet access, which has enhanced communications and enabled BLM to communicate with other federal agencies. BLM's view of the benefits received, however, does not reflect the fact that it has not realized the significant business-related benefits and improvements ALMRS IOC was to provide.

Our Reviews Have Shown Long-Standing Project Weaknesses

Mr. Chairman, since May 1995 we have reported many problems and risks that threatened the successful development and deployment of the ALMRS/Modernization. Our reports have discussed these issues, their causes, and our recommended corrective actions.³ BLM has been slow to implement some of our recommendations and has not yet fully implemented others. Following is a summary of the problems, causes, and associated recommendations we have reported.

- BLM did not develop a system architecture or formulate a concept of operations before designing and developing the ALMRS/Modernization. A system architecture describes the components of a system, their interrelationships, and principles and guidelines governing their design and evolution. A concept of operations describes how an organization would use planned information technology to perform its business operations and accomplish its missions. Designing and developing the project without a system architecture and concept of operations unnecessarily increased the risk that the ALMRS/Modernization would not meet the business and information needs of the bureau.
- BLM has never had a credible project schedule, reliable milestones, or a critical path to manage the development and deployment of the ALMRS/Modernization. As a result, BLM has not known with any certainty how long it would take and, therefore, how much it would cost to complete the ALMRS/Modernization. Because BLM has not implemented our recommendation to establish a credible project schedule, the ALMRS/Modernization has been driven by self-imposed deadlines. In trying to meet those deadlines, BLM has deferred some tasks until after completion of the project, and has not corrected all problems when it found them because doing so would cause it to miss the self-imposed project deadlines.
- BLM faced serious risks because it had not established a robust configuration management program for the ALMRS/Modernization. Configuration management is essential to controlling the composition of and changes to computer and network systems components and documentation. The lack of configuration management increased the risks that system modifications could lead to undesirable consequences,

³Land Management Systems: Progress and Risks in Developing BLM's Land and Mineral Record System (GAO/AIMD-95-180, August 31, 1995), Land Management Systems: BLM Faces Risks in Completing the Automated Land and Mineral Record System (GAO/AIMD-97-42, March 19, 1997), Land Management Systems: Information on BLM's Automated Land and Mineral Record System Release 2 Project (GAO/AIMD-97-109R, June 6, 1997), and Land Management Systems: Actions Needed in Completing the Automated Land and Mineral Record System Development (GAO/AIMD-98-107, May 15, 1998).

such as causing system failures, endangering system integrity, increasing security risks, and degrading system performance. In response to our recommendation, BLM later developed a configuration management plan and related policies and procedures for the ALMRS/Modernization. We planned to review field office implementation of the configuration management program after completion of the ALMRS IOC; however, we have not done so because the system was not deployed.

- BLM incurred serious risks because it had not established a security plan or security architecture for the ALMRS/Modernization. The lack of such security controls increased risks to the confidentiality, integrity, and availability of stored and processed data. BLM recently completed work in response to our recommendation. It performed a risk analysis, developed a system security plan and architecture, identified management and operational controls, and developed disaster and recovery plan procedures. As with configuration management, we planned to review field office implementation of the security program after completion of the ALMRS IOC, but have not done so because the system was not deployed.
- BLM invited serious risks because it had not established transition plans to guide the incorporation of ALMRS IOC into its daily operations. Deploying a major information system that people will use to do their jobs requires careful planning to avoid business and operational problems. Without transition plans, BLM increased the risk that using ALMRS IOC would disrupt, rather than facilitate, its work processes and ability to conduct land and mineral management business. In response to our recommendation, BLM developed transition plans; however, the plans were not adequate. They did not outline needed changes in organizational roles, responsibilities, and interrelationships, or address issues such as how state and subordinate offices would deal with oil and gas, mining, and solid mineral business process changes that would result from implementing ALMRS IOC.
- BLM faced serious risks because it had not established operations and maintenance plans. The lack of plans increased the risk that the bureau would not meet its automation objectives or the daily needs of its offices. BLM developed operations and maintenance plans in response to our recommendation. We expected to review field office implementation of the operations and maintenance plans after completion of the ALMRS IOC; however, we have not done so because the system was not deployed.
- BLM invited serious risks because it planned to stress test only the ALMRS IOC component—state and district offices, ALMRS IOC servers,

terminals, and workstations. This increased the risk that BLM would deploy the ALMRS IOC nationwide without knowing whether the ALMRS/Modernization—ALMRS IOC, office automation, e-mail, administrative systems, and various departmental, state, and district software applications in a networked environment—would perform as intended during peak workloads. BLM agreed to fully stress test the entire ALMRS/Modernization before deploying the ALMRS IOC component throughout the bureau.

- BLM did not develop a Year 2000 contingency plan to ensure that critical legacy systems could operate after January 1, 2000, if the ALMRS IOC could not be delivered in 1999. We recommended that BLM develop a Year 2000 contingency plan to ensure continued use of those critical legacy systems ALMRS IOC was to replace. BLM implemented this recommendation and began executing the plan in 1998, when it became clear that ALMRS IOC would not be fully implemented by the end of 1999.

Where BLM Should Go From Here

At this point, BLM has made an enormous investment in software that does not meet its business needs. At the same time, it has not adopted information technology management practices required by recent legislation or suggested by industry best practices. Because of its large investment, BLM should analyze ALMRS IOC to determine whether the software can be cost-beneficially modified to meet the bureau's needs. In addition, to reduce the risk that future information technology efforts will result in a similar outcome, BLM should assess its investment management practices and its systems acquisition capabilities. Until these assessments and subsequent improvement actions are taken, BLM will not be adequately prepared to undertake any sizable system acquisition.

Analysis of ALMRS IOC Software Is Needed

We believe that since BLM has invested over \$67 million to develop the ALMRS IOC software, the bureau should thoroughly analyze the software to determine whether it can be modified to meet users' needs and at what cost. This analysis should be part of an overall effort to identify and assess all viable alternatives, including (1) using or modifying ALMRS IOC software, (2) modifying or evolving existing land and recordation systems, (3) acquiring commercial, off-the-shelf software, or (4) developing new systems. The alternative analysis should clearly identify the risks, costs, and benefits of each alternative, and should be performed only after BLM is assured that it has fully verified its current business requirements. In this regard, senior BLM officials said they are performing an analysis to

determine where ALMRS IOC failed to meet users' expectations and critical business requirements.

Assessment of BLM's Information Technology Investment Management Practices Is Needed

According to the acting land and resources information systems program manager, BLM is beginning to develop plans for future information technology modernization. These plans are to identify alternatives to deploying ALMRS IOC, and evaluate those alternatives based on cost, functionality, and return on investment. BLM also plans to document its current and planned business processes and systems architectures as part of this effort.

While such planning is necessary, BLM also needs to assess its investment management practices to help avoid future problems. The Clinger-Cohen Act of 1996 seeks to maximize the return on investments in information systems by requiring agencies to institute sound capital investment decision-making. Under the act, agencies must design and implement a process for maximizing the value and assessing and managing the risks of information technology acquisitions.

An information technology investment process is an integrated approach that provides for data-driven selection, control, and evaluation of information technology investments.⁴ The investment process is comprised of three phases. The first phase involves selecting investments using quantitative and qualitative criteria for comparing and setting priorities for information technology projects. The second phase includes monitoring and controlling selected projects through progress reviews at key milestones to compare the expected costs, risks encountered, and performance benefits realized to date. These progress reviews are essential for senior managers to decide whether to continue, accelerate, modify, or terminate a selected project. The third phase involves a postimplementation review or evaluation of fully implemented projects to compare actuals against estimates, assess performance, and identify areas where future decision-making can be improved.

According to senior BLM officials, the bureau has established an Information Technology Investment Board to provide support for its capital

⁴This process is documented in our [Assessing Risks and Returns: A Guide for Evaluating Federal Agencies' IT Investment Decision-Making](#), Version 1 (GAO/AIMD-10.1.13, February 1997) and OMB's [Evaluating Information Technology Investments: A Practical Guide](#), Office of Management and Budget, Version 1.0, November 1995.

planning processes. It intends to apply more rigorous, structured processes to analyze its information technology investments and select, control, and evaluate information technology investment alternatives. Until such processes are fully in place, the bureau cannot be assured that future investments will be properly selected, managed, and evaluated using sound investment criteria to provide effective support for the bureau's mission and goals.

Further, to ensure that information technology investment processes are carried out adequately, the Clinger-Cohen Act also requires agencies to assess the knowledge and skills of its executive and management staff to meet agencies' information resources management requirements, and to take steps to rectify any deficiencies. The Software Engineering Institute⁵ (SEI) has identified the need for organizations to focus on information resources management capabilities.⁶ Organizations should improve their capabilities using a process to characterize the maturity of their workforce practices, guide a program of workforce development, set priorities for immediate actions, and establish a culture of software engineering excellence.

According to senior BLM officials, the bureau examined the kind of skills that its field office computer specialists had, and identified the skills they would need. However, the officials recognize that this was not the same as the more comprehensive assessment suggested by SEI. Such assessments are needed to better identify and manage information technology investments. Consequently, the bureau should evaluate and, where needed, enhance the knowledge and skills of its staff to help ensure that the investment management processes it puts in place can be effectively carried out by its information resources management organization.

⁵SEI, located at Pittsburgh's Carnegie Mellon University, is a nationally recognized, federally funded research and development center established to address software development issues.

⁶Software Engineering Institute, People Capability Maturity Model, CMU/SEI-95-MM-02, September 1995.

Finally, the Clinger-Cohen Act requires agencies to develop, maintain, and facilitate the implementation of a sound and integrated information technology architecture.⁷ An information technology architecture provides a comprehensive blueprint that systematically details the breadth and depth of an organization's mission-based mode of operation. An architecture provides details first in logical terms, such as defining business functions, providing high-level descriptions of information systems and their interrelationships, and specifying information flows; and second in technical terms, such as specifying hardware, software, data, communications, security, and performance characteristics. By enforcing an information technology architecture to guide and constrain a modernization program, an agency can preclude inconsistent systems design and development decisions, and the resulting suboptimal performance and excess cost.

As I discussed earlier, BLM did not develop a system architecture before designing and developing the ALMRS/Modernization. This is a key reason why ALMRS IOC did not meet the bureau's business needs. BLM still has not developed an architecture that documents its business processes and the technology and systems that support them. BLM needs to develop an information technology architecture to guide its future investment plans.

BLM Needs to Assess Its Systems Acquisition Capabilities

Research by SEI has shown that defined and repeatable processes for managing software acquisition are critical to an organization's ability to consistently deliver high-quality information systems on time and within budget. These critical management processes include project planning, requirements management, software project tracking and oversight, software quality assurance, software configuration management, and change control management.⁸ To assist organizations in evaluating and enhancing systems acquisition capabilities and processes, SEI has developed models for conducting software process assessments and

⁷The Clinger-Cohen Act of 1996 gives the Chief Information Officer of an executive agency the responsibility for developing, maintaining, and facilitating the implementation of a sound and integrated information technology architecture. An information technology architecture is sometimes referred to as a system architecture.

⁸Definitions of these processes were obtained from [the Software Engineering Institute's Capability Maturity Model for Software, Version 1.1](#), © 1993 Carnegie Mellon University.

software capability evaluations to determine the state of their capabilities and identify areas requiring improvement.⁹

BLM also needs an independent assessment of its systems acquisition capabilities, and must ensure that it uses sound systems acquisition processes. As I discussed earlier, BLM did not develop several key management controls for the ALMRS/Modernization. BLM did not develop a credible project schedule or develop adequate transition plans. In addition, the lack of a configuration management program, security plan and architecture, and operations and maintenance plans further increased BLM's risks. These problems indicate the need for BLM to ensure that the deficiencies in its systems acquisition capabilities and processes are acknowledged and corrected. Until such assessments are completed and corrective action taken, BLM should not undertake any sizable systems acquisition or development efforts.

Mr. Chairman, that concludes my statement. I would be happy to respond to any questions that you or other members of the Subcommittee may have at this time.

⁹SEI has developed two models to assist organizations in assessing the maturity of their software development processes. These models are the Capability Maturity Model for Software and the Software Acquisition Capability Maturity Model. Capability Maturity ModelSM is the service trademark of Carnegie Mellon University, and CMM® is registered in the U.S. Patent and Trademark Office.

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