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The Interactive On-Site Inspection System: An Information Management System to Support Arms Control Inspections

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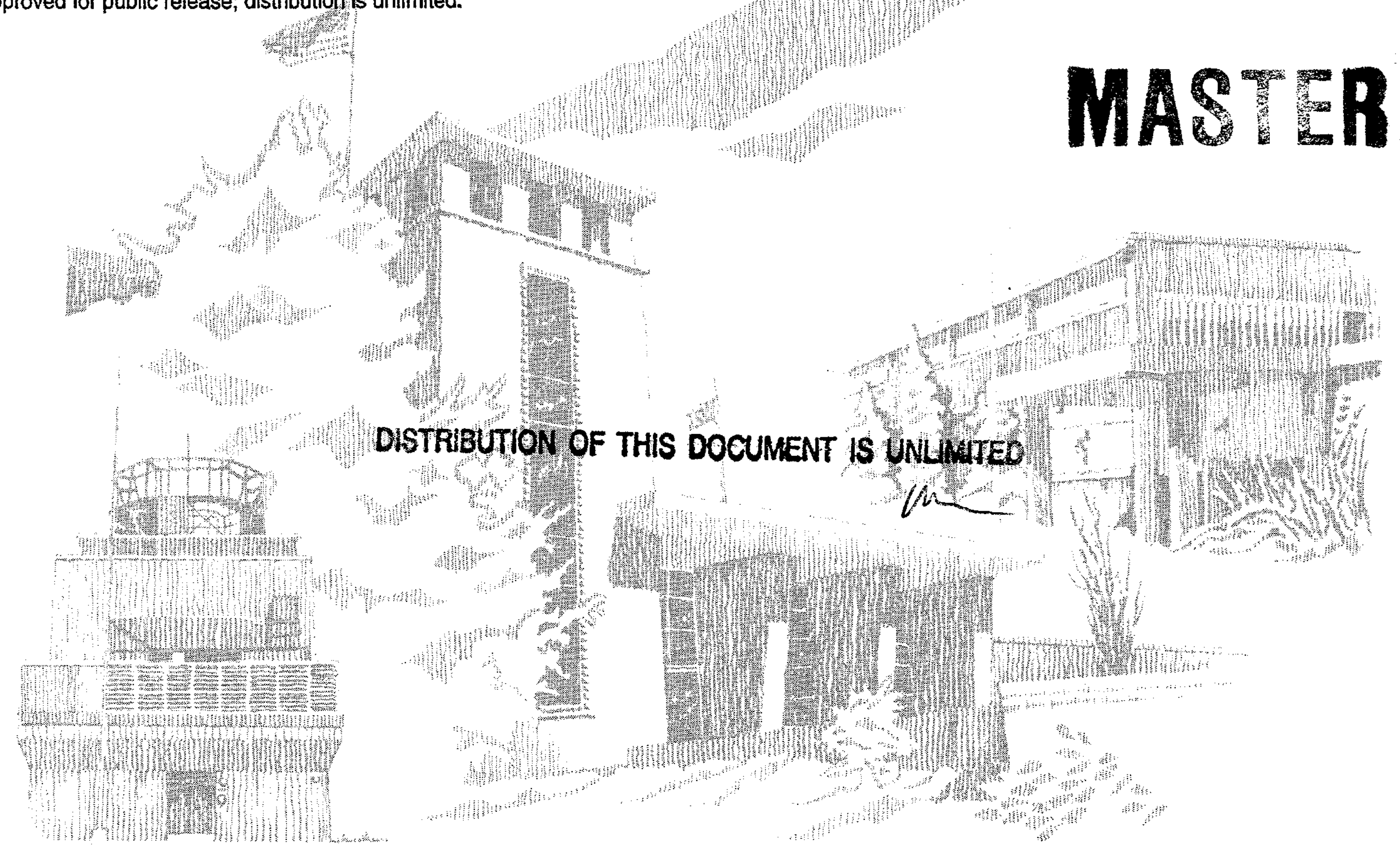

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ABSTRACT

The increasing use of on-site inspection (OSI) to meet the nation's obligations with recently signed treaties requires the nation to manage a variety of inspection requirements. This document describes a prototype automated system to assist in the preparation and management of these inspections.

Notice

Acknowledgments

The authors would like to thank Michael Vannoni and Edwin Kjelgaard for their help and advice throughout this project, particularly concerning the applicability of GIS systems to the on-site inspection problem. We also thank Keith Johnstone, John Taylor, and Pauline Dobranich for their thoughtful input on the information management needs in support of on-site inspection. Finally, we would like to thank Bess Campbell-Domme who provided several useful tours of Building 805, as well as much useful information.

Acronyms

CRADA	Cooperative Research and Development Agreement
CWC	Chemical Weapons Convention
DG	Director General
DOS	Disk Operating System
ES&H	Environment, Safety and Health
GIS	Geographic Information System
OSI	On-site inspection
OSIA	On-Site Inspection Agency
OSIRP	On-Site Inspection Readiness Plan
OSIS	On-Site Inspection System
PC	personal computer
QIC	???
SNL	Sandia National Laboratories
US	United States

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Executive Summary

Preparing for an inspection requires the host nation and facility to address a variety of questions including:

- What activities may be pertinent to the inspection?
- What buildings or areas are likely targets of the inspection?
- What information needs to be protected? Where is it physically located? How can it be protected within the confines of the treaty?
- What arrangements need to be made to ensure the physical safety of the inspectors? Do they need specialized safety training? Specialized clothing? For which facilities?
- Who are the designated escorts? Have they received any training? How recently?
- Are briefing materials (including site maps and other background information) readily available?

In addition, inspection procedures generally use short time lines between the announcement of and the beginning of an inspection in order to discourage cheating. This means potential inspection targets will need a readiness plan in place before an inspection is announced and will need to be able to quickly access information once the inspection is announced and/or taking place. The problem of quick access to pertinent information can readily be addressed by an information management system.

This report described the development of the On-Site Inspection System (OSIS), an information management system to support on-site inspections. The software was based on a Geographic Information System and provides the user a powerful tool for accessing the wide variety of information necessary for hosting an inspection at a complex facility. OSIS provides several important functions including:

- The display of site diagrams and building layouts
- The ability to highlight buildings and rooms on the maps based on certain predetermined features such as access restrictions, presence of classified information, presence of chemical equipment, etc.
- The ability to receive further information about a particular building or room using the "point-and-click" method.
- The ability to access relevant documents on-line
- The ability to display relevant photographs
- The ability to record an inspection log for later review and analysis

There could be many benefits if an on-site inspection support system could be standardized across many facilities. From an economic standpoint, facilities could save the time and money they would have spent on individual systems. Moreover, by making information exchangeable, long-term analysis of inspections could be done both within a treaty and across treaties.

In addition to the inspection-hosting function for which it was developed, OSIS has a variety of other potential uses including:

- carrying out inspections at foreign facilities

- supporting inspector training
- familiarizing inspectors with a new site

1.0 Introduction

1.1 Background Information

The increasing use of on-site inspection (OSI) as part of verification regimes is spreading the burden of preparing for such inspections to a broad range of facilities. In the past, OSI was typically used to monitor activities in a limited number of specific facilities (e.g., nuclear facilities in nations that are party to the Non-Proliferation Treaty and certain US and former Soviet missile production facilities under the Intermediate Range Nuclear Forces Treaty). However, the recently-signed Chemical Weapons Convention (CWC) permits challenge inspections of *any* suspect facility; such inspections could potentially be requested for commercial chemical plants or DOE facilities. In addition, the Open Skies Treaty provides for aerial overflight of *any portion* of each signatory's territory. The basic problem for the host site is meeting the nation's obligations in terms of facilitating the inspection and demonstrating compliance with the treaty, while at the same time protecting information that is not pertinent to the treaty.

1.2 Statement of Problem

Preparing for an inspection requires the host nation and facility to address a variety of questions including:

- What activities may be pertinent to the inspection?
- What buildings or areas are likely targets of the inspection?
- What information needs to be protected? Where is it physically located? How can it be protected within the confines of the treaty?
- What arrangements need to be made to ensure the physical safety of the inspectors? Do they need specialized safety training? Specialized clothing? For which facilities?
- Who are the designated escorts? Have they received any training? How recently?
- Are briefing materials (including site maps and other background information) readily available?

In addition, inspection procedures generally use short time lines between the announcement of and the beginning of an inspection in order to discourage cheating. This means potential inspection targets will need a readiness plan in place before an inspection is announced and will need to be able to quickly access information once the inspection is announced and/or taking place. The problem of quick access to pertinent information can readily be addressed by an information management system; such a system is the subject of this paper.

1.3 Purpose of Document

This paper describes the development of a computer system to support on-site inspection. Two major subsystems are envisioned:

1. A base computer system at some central location that contains information for many sites and can be used for planning and analysis.

2. A field system that can be taken on the inspection for real-time recording, accessing, and analysis of data.

Data would be readily exchangeable among the subsystems to allow planners and analysts easy access to each other's results. The system development described in this report focused primarily on the field portion of this system; however, a limited base station capability was also implemented in order to examine data exchange issues.

There could be many benefits if an on-site support system could be standardized across many facilities. From an economic standpoint, facilities could save the time and money they would have spent on individual systems. Moreover, by making information exchangeable, long-term analysis of inspections could be done both within a treaty and across treaties. Such analyses could be used to:

- Look for indications that inspectors have hidden agendas (perhaps industrial espionage),
- Consider how information loss (if any) in a series of inspections could be integrated,
- Look for ways to better protect information in the future, and
- Incorporate past lessons learned into future inspection planning.

The purpose of this paper is to explore how a computer system could help resolve many of the information access and management problems associated with planning and carrying out an inspection and to elicit feedback on these ideas from potential users. Although the focus of this paper is a system that supports hosting inspections, clearly a similar system could be valuable to those who carry out inspections in foreign facilities.

1.4 Scope of Document

The paper begins with a description of typical on-site inspection procedures and roles, based primarily on the CWC. These procedures and roles help define the environment in which the system must operate and help define system requirements. Chapter Three then describes the development approach while Chapter Four contains a technical description of the field unit. Details of the implementation are given in Appendix A.

2.0 On-Site Inspection and Information Management

2.1 Key Players

The key players in an inspection are the inspectors and the escorts. The specific rules governing the interaction of the inspectors and escorts depend on the treaty governing the inspection and perhaps the inspection type. Treaties that call for declarations of the number of treaty limited items a country has may allow baseline inspections to verify the declarations. If items are to be destroyed or facilities shut down, inspections may be held to verify items were actually destroyed or a facility rendered inoperable. If a limited number of items are permitted, periodic inspection may be held to verify the limit is not exceeded. Finally, some treaties permit inspections of an activity; these inspections may be permitted at declared facilities or at "suspect" facilities.

During the inspection, the inspectors' job is to determine whether or not the materials and/or activities that are the subject of the inspection match the declarations made by the host country. Inspectors are charged with monitoring the provisions of the treaty and thus are on the lookout for discrepancies that indicate possible noncompliance. Inspectors do not make decisions regarding compliance or noncompliance because of the political ramifications of such a decision. Although authorized to seek whatever information is necessary to allow a compliance determination, inspectors are also instructed not to collect non-treaty related information.

The escorts accompany the inspectors throughout the inspection in order to prevent unauthorized access to sensitive or non-treaty-related information, to ensure the physical safety of the inspectors, and to answer the inspectors' questions about the facility. Thus the escorts are usually balancing their treaty obligations to respond to the inspectors concerns with their national security obligations to protect information. The escorts are typically of two types: On-Site Inspection Agency (OSIA) escort and technical escorts. The OSIA escort is typically the chief escort and is responsible for resolving disputes pertaining to treaty interpretation. Technical escorts are knowledgeable about the site and are responsible for ensuring inspector safety and answering technical questions pertaining to the site.

There are a number of satellite roles which, though not considered primary members of the inspection team or escort team, are nevertheless essential players in an inspection. The facility point of contact receives the initial notification of an inspection from the national authority and coordinates the site's response to the inspection request. He or his representative will provide site-specific information to the inspection team upon arrival, make arrangements for entering the facility, make arrangements for billeting and meals, and other logistical arrangements that need to be made on site. The site may need to call on specialists with detailed, knowledge of facilities or activities to answer inspectors' questions. The site will also need key logistical personnel such as locksmiths or operators of heavy equipment on hand to open locked doors or to move large objects if so requested.

2.2 Rules of Engagement: the Inspection Protocol

The interaction of the inspectors and the escorts is governed by the inspection protocol, which discusses the inspection process. In general, the inspection protocol describes what kinds of facilities may be inspected, the circumstances under which the inspection may occur, the time scale by which certain activities must take place, what inspectors may and may not do during the course of the inspection, and what the escorts may or may not do during the course of an inspection.

As an example, the protocol governing the time scale for events in a challenge inspection under the Chemical Weapons Convention (CWC) is summarized in Table 1; the full text is available in the CWC.[1] Notice that the time scales are rather short: the Inspected State may have as little as 12 hours notice of an inspection team's arrival in its territory, and may be admitting that team to the site within 12 hours after the inspection team's arrival. This leaves the Inspected Party little time to prepare its site and to prepare briefing materials for the inspectors. Note that Inspected Parties are allowed to protect sensitive information and therefore may shutdown sensitive operations or shroud sensitive items. The perimeter monitoring is designed to prevent treaty-limited objects from being removed from the site.

In addition to the time lines outlined above, the inspection protocol identifies what inspectors and escorts may or may not do. In the CWC, one of the key concepts under the heading of rights and responsibilities, is that of managed access. Under managed access, the host site may limit full access to areas it deems too sensitive by offering alternative means of access. The site may for example, allow inspectors visual access to a room without letting them walk around in it freely, or it may allow the inspection team access to some percentage of the rooms in a building rather than allowing access to every room. Of course, the Inspected State is still obliged to demonstrate that areas not subject to full access are not being used for prohibited purposes.

2.3 The Information Management Problem

One of the major challenges presented to facilities hosting an inspection is "facilitating" the inspection. In most complex industrial facilities this could be an enormous task. For example, the inspection route must be planned, building managers must be notified, and locksmiths must be on hand to navigate the myriad of doors that might be encountered. Building managers, ES&H experts, and project experts must be notified in the event their expertise is needed. Even plumbing, duct work, electrical diagrams for the facilities should be available in case they are needed. The fact is, that while the general reason for the inspection is known, no one knows what questions will be asked by the inspectors. In addition, the host facility must protect themselves from compromising sensitive information during the inspection. For instance, classified information not related to the inspection must be protected, and this means that one must first know where it is. Should it be moved prior to the inspection, or should it be shrouded? In addition, it is possible that the inspectors themselves may have motives that are unrelated to the treaty; this also should be protected against.

With so much information to manage, in a rapid real-time environment, facility managers need tools capable of displaying any kind of information immediately. They might want to plan the logistics for the inspection team and be able to change them at the inspector's request. They may want to access various databases in order to answer inspector's questions. Facility managers may also want to know where sensitive information is kept and what provisions are in place to protect it. Managing this information is made more difficult by the fact that the data may be in a variety of different formats such as vector drawings, raster images, relational databases, and free text.

Developing such an information management system was the primary motivation for designing and developing the Interactive On-Site Inspection System (OSIS)

Table 1: Timeline for a Challenge Inspection under the CWC

Time Required	Description of Task
Beginning of process:	Requesting party submits request to Director-General (DG).
As soon as possible once request received:	Inspection team should be dispatched.
At least 12 hours before inspection team arrives at point of entry:	DG must notify inspected State of the inspection site.
At least 12 hours before inspection team arrives at point of entry:	DG must transmit inspection request to inspected State.
Within 108 hours after the inspection team arrives at the point of entry	Inspection perimeter negotiations must take place. Key times include: • within 24 hours, the inspected State must accept the requested perimeter or suggest an alternative perimeter • if a final perimeter is readily agreed to, the inspection team must be transported to the final perimeter within 12-36 hours after arrival at the point of entry • if the final perimeter is under negotiation, the inspection team must be transported to the alternative perimeter within 36 hours of arrival at the point of entry • if negotiations are still continuing 72 hours after arrival at the alternative perimeter, the alternative perimeter becomes the final perimeter
12 hours after inspection team arrives at point of entry:	The inspected State will begin collecting factual information on all vehicular exit activity.
When inspection team arrives at alternative or final perimeter, whichever is first:	• Inspected State must provide information on all vehicular exit activity. • Exit monitoring will begin. • Commence perimeter activities; the team has the right to commence perimeter activities until the completion of the challenge inspection.
For non-declared sites: Upon arrival at the inspection site and before the commencement of the inspection (with preparation of inspection plan, not to exceed three hours):	Pre-inspection briefing: The inspection team will be briefed by facility reps on the facility, the activities carried out there, safety measures, and administrative and logistic arrangements necessary for the inspection.
After the pre-inspection briefing:	Preparation of initial inspection plan.
Within 108 hours of the arrival of the inspection team at the point of entry:	The inspected State must provide access within the requested perimeter.
The period of inspection itself shall not exceed 84 hours.	May be extended by mutual agreement of the parties.
Upon completion of post-inspection procedures at the inspection site:	The inspection team and any observer of the requesting State shall proceed to the point of entry and leave the territory of the inspected State n the minimum time possible.
Not later than 72 hours after its return to the primary work location:	The inspection team must submit a preliminary inspection report to the Director-General.
After the DG receives the preliminary inspection report:	DG must transmit the preliminary report to the requesting State, the inspected State party and to the Executive Council.
Not later than 20 days after the completion of the challenge inspection:	A draft final inspection report must be made available to the inspected State.

2.4 Primary Use Scenario

In reviewing the problem of managing information for on-site inspections, it was determined that the OSIS system (base station plus field unit) would have four distinct uses corresponding to the phases of an inspection. The four phases and corresponding uses of OSIS are described below.

1. **Long-Range Planning.** In the first phase, long range planning, a site develops an On-Site Inspection Readiness Plan (OSIRP)[2] and gathers information essential for conducting an inspection. This information would be entered into the site's OSIS base station and periodically updated. In any complex facility, and particularly those with high security concerns, there is a tremendous amount of information that might be necessary during an inspection. This information might include:

- various plans, such as a **logistical support plan** or a **public affairs plan,** which specify how the site will handle various aspects of the inspection
- a **treaty** or other document that authorizes the inspection
- **site information** - a graphical, on-screen **site map** and a detailed description of any feature
- **process or activity flows** which might include plumbing lines, electrical lines, or chemical processes
- **high profile buildings** which might attract the attention of inspectors. This might include those having smokestacks or high security fences, for example
- **sampling points** to enable chemical samples to be collected safely and efficiently
- **site specific activities** - any program, project, or technical process that occupies physical space and might require explanation
- **security sensitive information** - what kind, its location, and what measures have been, or should be taken to protect it
- **security checkpoints** - access procedures, escort personnel needed, and how long it takes to clear a checkpoint
- **safety requirements** - certain areas may require special training, special clothing or procedures
- **key facility personnel** - on-site experts, training personnel, escorts, building managers, ES&H experts, locksmiths all need to be available to assist the inspection
- **personnel training** - access to how current the training of escort support personnel is.

2. **Pre-Inspection.** In the second phase, pre-inspection, the inspection has been announced and the facility has a short amount of time (typically 48 to 72 hours) to make vital preparatory steps. OSIS is used actively during this period to review information and plan for the inspection. Examples of OSIS-related activity include:

- OSIS is used to negotiate an **inspection perimeter**
- suggested **inspection routes** may be determined based on security points, building profiles, security hazards, ES&H hazards, door locks, sensitive information etc.
- **security sensitive information** is moved, shrouded, etc.
- **key support personnel** are notified and briefed. This includes escorts, locksmiths, site-specific experts, building managers, etc.
- **pre-inspection briefing materials** are prepared for the inspectors and printed.

3. **During Inspection.** This phase is characterized by rapid, on-line information retrieval to provide a decision support capability. This is also the greatest challenge for OSIS. Information gathered during

long-range planning would be downloaded to the field unit to support the escort team. Information either available to the escorts or recorded real-time includes:

- the **site diagram** - an on-line map of the facility showing all buildings, the inspection perimeter, etc. The site diagram may also be viewed at different scales so that the user may "zoom in" to a small portion of the map and "zoom out" again for the big view.
- **site activities and processes**
- **safety training required** to enter certain locations
- **location of inspection teams** could be tracked
- **inspection itinerary** - routes available
- **bottlenecks** caused by security checkpoints, monitoring stations, special training areas, etc.
- **questions asked by inspectors** and answers

4. **Post-Inspection.** After the inspection, the OSIS is capable of playing back all the tracking functions and comments displayed on the screen. Thus facility managers can piece together the events of the inspection to determine its impact. For example, they may determine what information was compromised, if any. Debriefings may also be input into OSIS.

Developing a system to support these task is an ambitious undertaking. In order to focus the program more closely in the initial development stages, it was decided to (1) demonstrate a portable system which could interact with a base system and (2) support escorting a challenge inspection at Sandia under the CWC. Some planning features were addressed because of the need to collect information, but various logistical plans were not developed. Post-inspection analysis features were not incorporated, except for analysis being supported by the data collection during the inspection.

In order to concentrate on system development, data collection was restricted to Tech Area 1 and specifically Buildings 805 and 890. It was assumed that inspectors were coming in response to a request from country X that asserts the US may be producing and storing chemical agent at SNL. The project used SNL to provide realistic data to populate OSIS. Actual data was used when possible, but fictitious data was added to the system to replace sensitive data or to highlight features of the system.

3.0 Approach

One of the first decisions regarding the development of OSIS was to split the functionality outlined in Section 2.4 between two hardware systems:

1. A portable computer that accompanies the inspection parties
2. A workstation system that constitutes the more powerful, "base system."

In the long run, the portable system would be used for collecting data during the inspection and performing real-time analyses to support the inspection, while the base system would be used for long-range planning, pre-inspection planning and post-inspection analysis. For FY93, the portable system supports collecting information during the inspection and the base station supports minimal planning and post-inspection analysis.

3.1 Functional System Requirements

In the initial stages of development, functional requirements were drawn up, based primarily on the functionality require for the portable system. The desired functionality was divided into three categories, *Required Global, Required Tech Area 1*, and *Desirable*. Detailed requirements are given below:

Required Global
1. The ability to highlight buildings, structures based on characteristics of interest
2. The ability to get detailed information about highlighted map features
3. Graphical display of site diagrams and building layouts
4. Linking of maps or layouts to related information
5. Text searching (including phrases, sections, and Boolean searches) of the CWC treaty text.
6. A pull-down menu to provide zoom and pan capability for maps and building layouts

Required Tech Area 1
1. Site diagram for Tech Area 1 showing buildings, fences, roads, and chemical tanks
2. Building layouts for Buildings 805 and 890 (show at least two floors in one building)
3. Key personnel list/phone numbers for areas/building/room(s) to be inspected
4. ES&H concerns/check lists
5. Security concerns
6. Building/room usage
7. Location and identification of treaty-related items

Desirable
Inspection Log/Graphical Map: showing the location of the inspection team within the facility and the ability to record the progress of the inspection so that it can be played back later. Information tracked should include the location, date, time, and the action (entering, leaving, anomalies, sampling, and comments)

3.2 Development Environment

3.2.1 Geographic Information Systems

One of the key factors in the functional requirements outlined above is the need to relate information to a site diagram. For example, a user trying to route inspectors through a facility would like to have a map that displays not only the facility layout, but also show where safety hazards or sensitive information are. He might then want to be able to "click" on a room or building and be provided additional information (e.g., a building's owner and his phone number) in tabular format. A class of software applications called Geographical Information Systems (GIS) are designed to provide exactly this kind of functionality. GIS support this functionality by "knowing" what type of graphical objects the map is composed of, those objects' spatial relationships with each other in real coordinates, and by being able to link the graphical objects to tabular databases.

GIS systems also develop a topography of the underlying drawings. This means the system understands what lines are connected, what items are inside or outside of others, and what polygons are next to each other. This kind of knowledge base means GIS systems are well adapted to the complex routing problems that may arise during an inspection.

GIS software utilizes a vector format (lines, points, and polygons) for graphics as opposed to a raster format (matrix form of weighted pixels). The vectors are used to define edges and direction. GIS also have the ability to use raster files, aerial photography, satellite images, etc., as background imagery for the vector display. In addition, software exists for converting the objects in a raster file into a vector format in order to enable that image to be tied into the GIS.

Based on this information, the development team chose to use GIS as the basic software for OSIS development.

3.2.2 Software Selection

Commercial, off-the-shelf software was utilized whenever possible in order to reduce costs for both development and long-term software maintenance throughout the life of the project. The aim was to achieve as much functionality as possible with the commercial products, while limiting the writing of custom software to that required to achieve the integration and functionality required for the OSIS applications

Field Unit:

The development environment for the field unit came down to a choice between a portable UNIX workstation or a notebook PC. While the former kept the development environment homogeneous with the workstation environment expected for the base station and thus would have simplified development, the latter was considered easier for the escorts to use since the escorts are not likely to be very computer literate. If some problem were to develop in the field, the escorts were considered more likely to be able to deal with the problem if it developed in a PC environment rather than a UNIX environment. The decision was thus made to develop the portable system on a notebook PC.

The primary software chosen for the fieldable unit was ArcCAD which is designed to work with AutoCAD. ArcCAD was developed by the makers of ARC/INFO, one of the leading GIS applications, and can exchange data with it easily. AutoCAD is a leader in PC-based drafting software and there are many third-party applications designed to work with it. These third-party applications could be integrated into the ArcCAD/AutoCAD environment and provide opportunities for even greater functionality. ArcCAD also uses a relational database management system based on dBase. By choosing the ArcCAD/AutoCAD software suite, OSIS would be based on popular software tools with which potential users may already be familiar.

ArcCAD is a command-line driven software package and is not, by itself, very user-friendly. However, ArcCAD makes use of the AutoLISP programming language common to AutoCAD to allow the designer to implement his own menu structure. As described later, the development team was able to use this approach very effectively.

The complete list of software for the field unit is given below:

- AutoCAD (graphics engine)
- ArcCAD (GIS)
- TRACER (raster-to-vector conversion)
- Folio Views (text retrieval)
- Animator Pro (raster file display)

Microsoft Windows was not used for the FY93 demonstration because the then-current version of ArcCAD did not support it.

Base Station

Arc/INFO was chosen as the primary software for the base station. It is one of the leading GIS packages and is compatible with the ArcCAD package chosen for the field unit.

ARC/INFO is also command-line driven software. It is designed to have graphical user interfaces written for specific applications, using its own advanced command language macros. On the surface, this system is rather awkward, but if the resources are expended in development of the interface, the results can be quite intuitive.

The complete list of software for the base station is given below:

ORACLE
ARC/INFO
CADCORE
ArcVIEW
(No selection of a text-retrieval package has been made at this time)

3.2.3 Hardware Platforms

Field Unit:

Hardware specifications for the field unit were divided into required and desirable based on estimates of data handling requirements and past experience with portable systems. The specifications were

Required Specifications

- Color active matrix display
- Minimum hard drive - 200 MB

- Weight of notebook less than 10 lbs. including battery
- Battery life minimum of two hours
- RAM minimum 20 MB
- Video - resolution 640 x 480
- Minimum colors 16
- Minimum processor type/speed 486/25 MHz
- I/O ports - serial, parallel, and mouse compatible

Desirable Specifications
- Hard drive 200 MB or greater
- Weight of notebook only 4-6 lbs.
- Battery life four to six hours
- Greater than 20 MB RAM
- Colors up to 256
- Active-matrix display
- Processor type/speed 486/25-50 MHz
- Modem, internal (14 kbps)

Based on these specifications, the portable system was developed on a Toshiba T4400C.

<u>Base System</u>
Two Sun SPARC 2 Workstations, with the specifications listed below, were available and considered appropriate for development of the Base System

SUN SPARC 2 Workstation #1
- 64 MB RAM
- 424 MB System disk
- 424 MB disk for software tools
- 1.2 GB users data disk
- QIC tape drive
- CD ROM drive
- 2 MB floppy
- 35 GB optical juke box

SUN SPARC 2 Workstation #2
- 64 MB RAM
- 424 MB System disk
- 8 mm tape drive.

Additional available hardware for the Suns follows:
- HP pen plotter
- Scanner (300 dpi - 400 dpi)
- Printers - Mainly POSTSCRIPT

These SPARCs ran SUN OS version 4.3.2 in the Open Windows environment

3.3 Natural Language Information Modeling

After selecting software and hardware, the next step in developing OSIS was to develop an information model for the on-site inspection process. This work was done in conjunction with Olin Bray, Larry Claussen and Paul Flores of Organization 2865 and was used primarily to guide what information was included in the system. A full description of the model and its development is given in *Information Model for On-Site Inspection, Vol. 2*.[3]

The information model developed for this project was an entity-relationship model based on the Nijssen Information Analysis Methodology. An entity-relationship model lists the key objects that are to be tracked, the key attributes of those objects, and the relationship among the objects. For example, in the case of OSIS, the key objects included an inspection itinerary, equipment, and processes. The inspection itinerary tracked where the inspectors had been and included in its key attributes the time spent at any point on the itinerary, comments made, what discrepancies with the treaty requirements were noted, where samples were taken, etc. Relationships included things like each itinerary was made up of many stops, but each stop had only one beginning time and ending time.

Although the original intention was to use the information model to design the underlying relational database in the GIS system, this turned out not to be practical for the field system. The GIS software used for the field system, ArcCAD, cannot handle many-to-one relationships (i.e., a list of many chemicals stored in one room); this limitation had to be worked around every time it appeared in the model. In addition, ArcCAD only allows for two databases to be related; a normalized version of the database schema resulting from the model required the linking of several databases. The schema resulting from the information model thus would have had to be greatly denormalized in order to work on the field system. This situation does not occur on the base station which can use an Oracle database as the underlying relational database. However, work would need to be done in order for the two systems to exchange data, therefore the base system database design is currently being driven by the field system design.

4.0 Technical System Description

This chapter describes the field-portable OSIS system developed during this project including an explanation of the menu structure and the interaction of the various components.

OSIS meets the functional requirements laid out in Section 3.1. It allows the user to display a site diagram of Sandia's Tech Area 1 and building layouts for Buildings 805 and 890. As will be described below, items such as buildings or room can be highlighted based on certain pre-defined characteristics. In addition, a user can point and click on a room or building to get further information about that object. If a photo of an object exists, the user can display it by pointing at a label such as a building number. The CWC treaty text is also available on-line and can be searched with the Folio Views software. Finally, the user can record an inspection log using the tracking function developed for this project.

The user can carry the OSIS laptop computer with a backpack equipped with a nylon tray similar to the cigarette trays seen in the nightclub scenes of older Hollywood movies. The computer is fastened to the tray in front of the user with Velcro fasteners. This configuration allows the computer to be carried on the inspection so that the operator can access or input data. Experience gained with the backpack on this project indicated it was simplest to operate the computer while standing still.

The operation of the OSIS system will be described by explaining its menu structure. This chapter will focus on the functions performed by the menu options; details of the implementation may be found in Appendix A.

4.1 The Menu Structure

Figure 1 shows the basic OSIS screen with a map of Sandia's Tech Area I and the custom OSIS menus at the top of the display. When prompted, the user enters any required information at the command line shown at the bottom of the display. Each menu option will be discussed in more detail below.

The menu structure illustrated in Figure 1 utilizes the standard AutoCAD menu structure with the following modifications:

1. The AutoCAD/ArcCAD pull-down menus have been replaced with the custom OSIS menus
2. A sidebar menu usually found at the right hand side of the display has been turned off to increase the map display area.
3. A new pop-up menu, called OSIS tools and accessed with the Shift+RightMouseButton combination, has been added. This menu can be seen in Figure 7.

It should be noted that the user has the full capabilities of both AutoCAD and ArcCAD available through the command line, if he desires to use them.

The menus have been divided into six categories:

- Display
- Building
- Room
- Query
- Documents
- OSIS tools

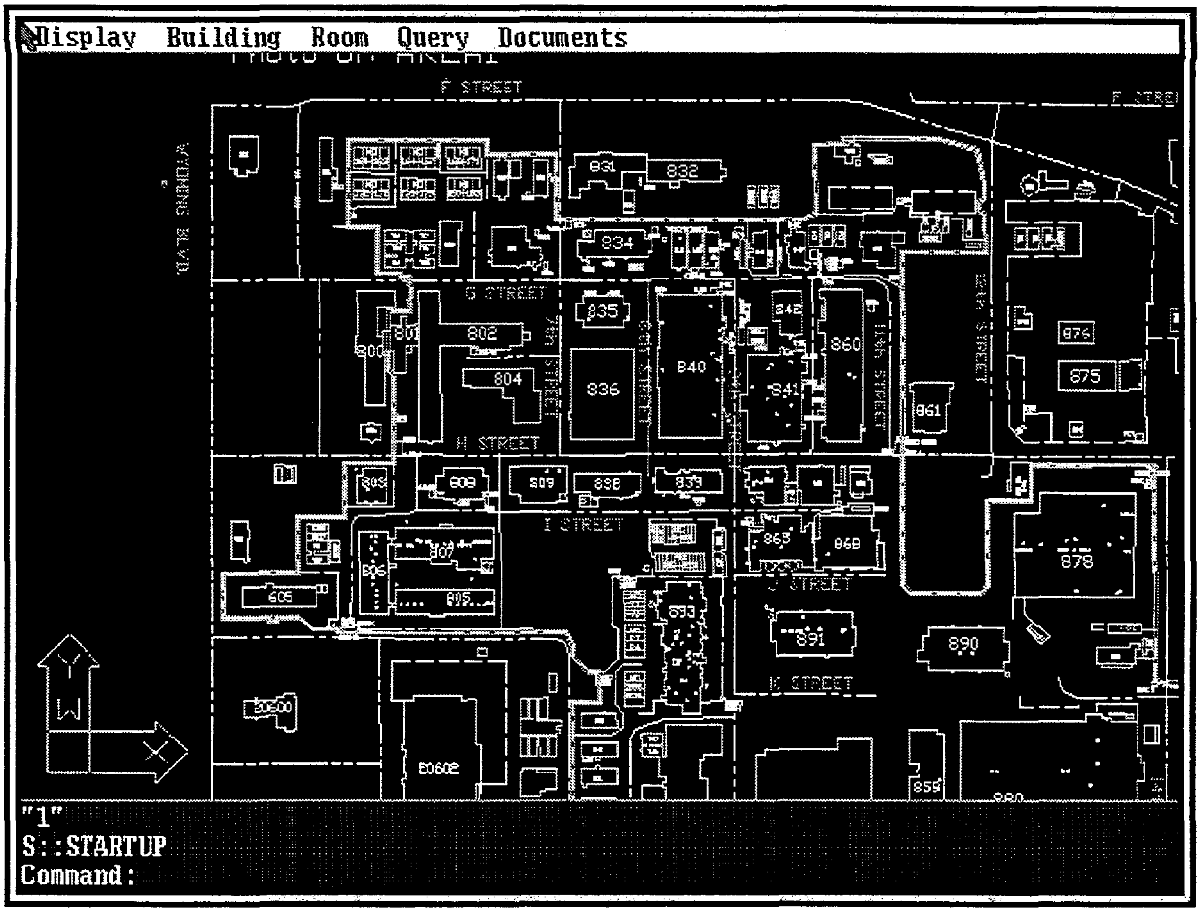

Figure 1: OSIS's general menu structure.

Each menu is controlled by a "POP N" (N=0-5) section of the \OSIS\ARCAD12.MNU file. See Appendix A for details. As will be shown below, the menu structure and prompting was maintained as consistent as possible throughout the menus in order to make the system more user-friendly.

4.1.1 The Display Menu

The display menu, shown in Figure 2, contains options that allow the user to control the display, extract the inspection route information to a text file, and exit OSIS. These functions are implemented primarily through map manipulation calls to AutoCAD; the extract route function requires a call to AutoCAD's block attribute extraction routine to build a file containing date/time stamp information. The function of each option is explained below:

Open maps - allows the user to change the current map. Current options are:

- Tech Area 1
- Building 805
- Building 890

Center map - places the current map at the center of the display at a low enough resolution that the entire map fits within the display area.

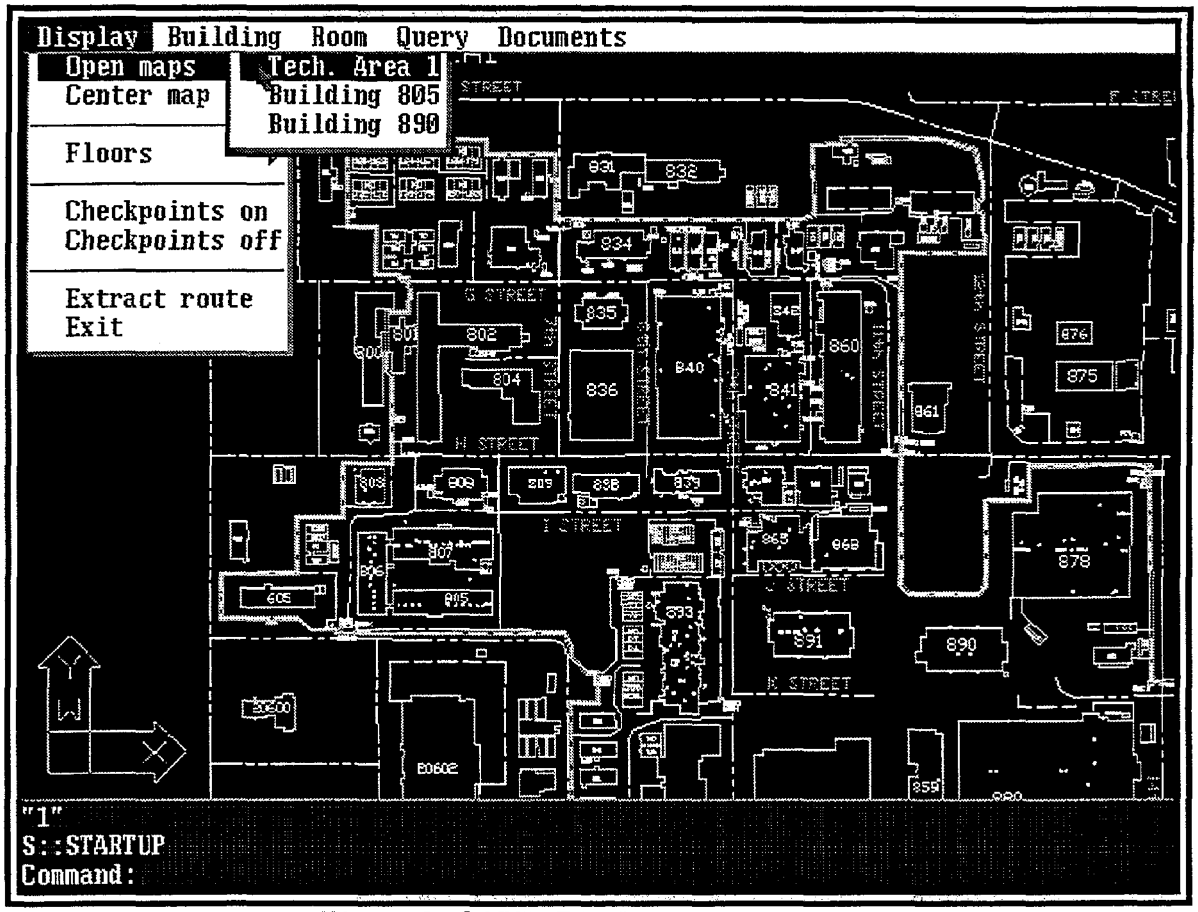

Figure 2: OSIS's Display menu

Floors - when the current map is a building layout, this option allows the user to display layouts for different floors within the building. Options are:

- Basement
- First
- Second
- Third
- Fourth
- Roof

Checkpoints on - displays the location of guard gates

Checkpoints off - turns off the display of guard gate locations

Extract route - takes the inspection log recorded using the inspection logging functions of the OSIS tools menu and extracts it to a text file. An inspection log recorded on the Tech Area 1 map is saved to TA1.txt while logs recorded in buildings are saved to LMN.txt, where LMN is the building number.

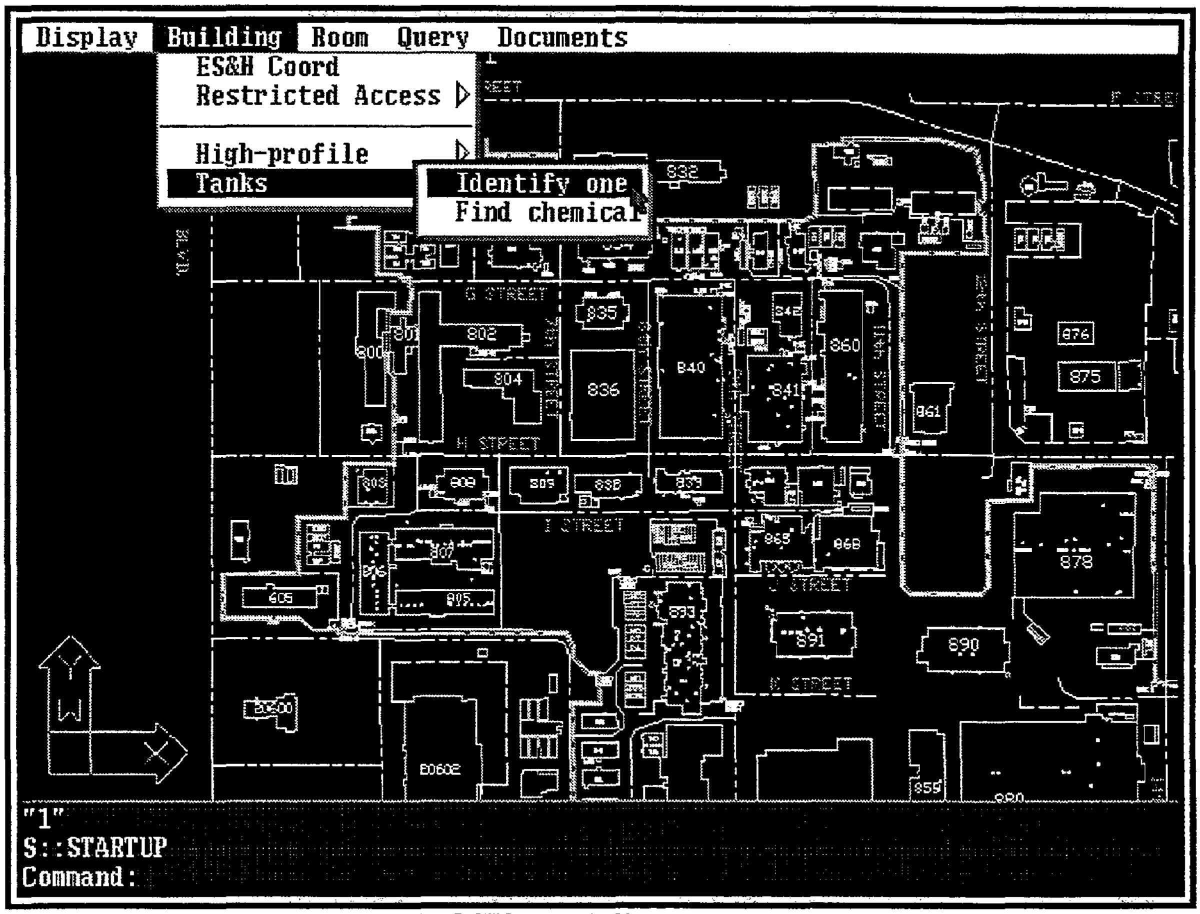

Figure 3: OSIS's Building menu.

Exit - provides a smooth exit from OSIS and saves any changes made to the drawings (e.g., those made while recording an inspection log)

4.1.2 The Building Menu

The building menu, shown in Figure 3, allows the user to ask questions and display information about buildings. It is used when the Tech Area 1 map is the current map. The menu options perform predetermined queries in ArcCAD for the user.

ES&H Coordinator - displays the name and phone number(s) for a building's ES&H coordinator. When this option is selected, the user is prompted to "select a polygon." A building is selected by placing the given cross-hair in a building and clicking with the left mouse button.

Restricted Access - provides information about restricted access buildings. Options are

- Identify one - information about access restrictions is displayed after placing the given cross-hair on a building and clicking the left mouse button
- Highlight all - all buildings with access restrictions are highlighted with red diagonal stripes.

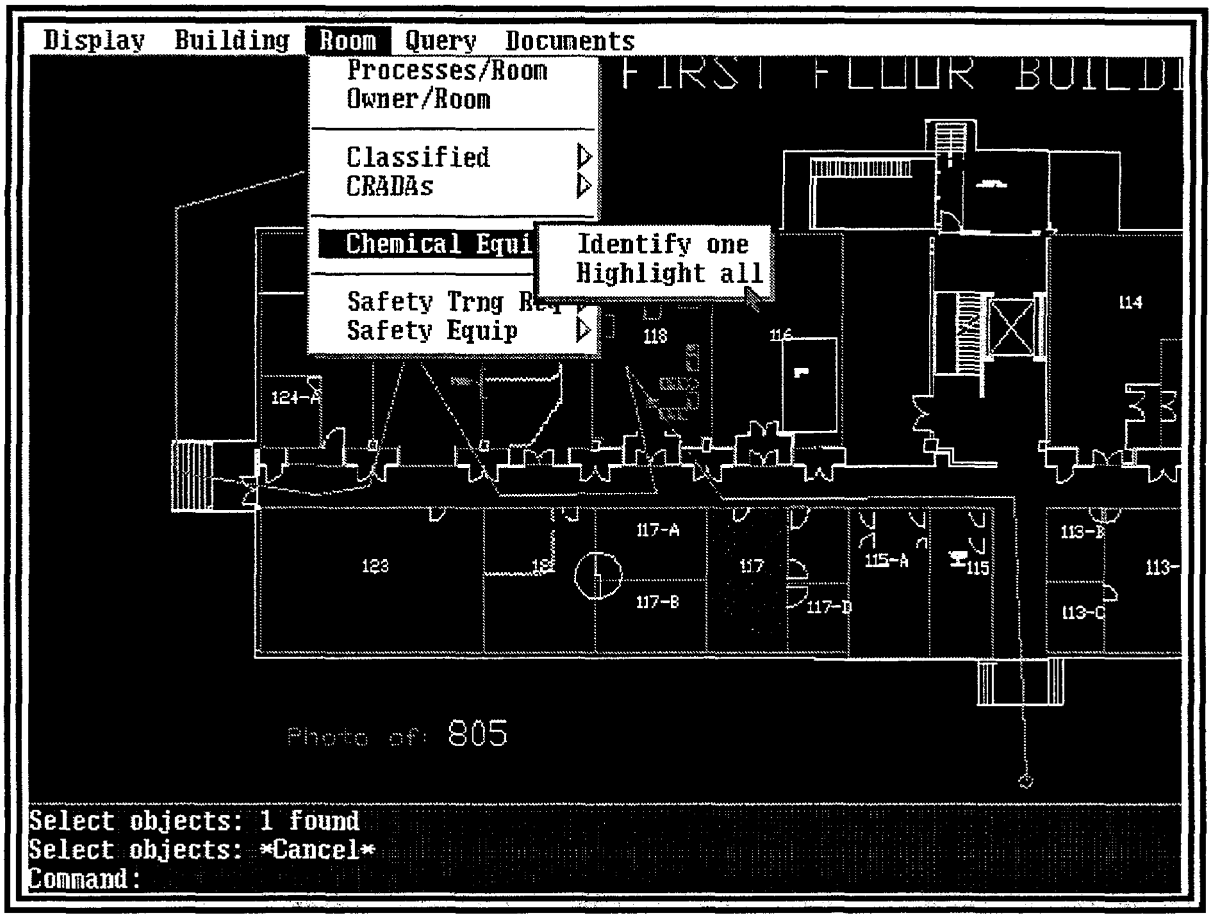

Figure 4: OSIS's Room menu.

High-profile - provides information about high-profile buildings i.e., those that the site has identified as being of possible interest to inspectors because of their physical characteristics. Options are:

- Identify one - information about the buildings characteristics that makes it of potential interest to inspectors is displayed after placing the given cross-hair on a building and clicking the left mouse button.
- Highlight all - all buildings considered of potential interest to inspectors are highlighted with green diagonal stripes.

Tanks - provides information about chemical storage tanks located on the site. Options are:

- Identify one - information about the contents of a tank is displayed after placing the given cross-hair on a tank and clicking the left mouse button.
- Find chemical - this option highlights any tank containing the user-defined chemical.

4.1.3 The Room Menu

The room menu, shown in Figure 4, allows the user to ask questions and display information about rooms. It is used when a building layout is the current map. The menu options perform predetermined queries in ArcCAD for the user.

Processes/Room - displays the process occurring in a room. When this option is selected, the user is prompted to "select a polygon." A room is selected by placing the given cross-hair in a building and clicking with the left mouse button.

Owner/Room - displays the room owner's name and phone number(s). When this option is selected, the user is prompted to "select a polygon." A room is selected by placing the given cross-hair in a room and clicking with the left mouse button

Classified - provides information about the location and nature of classified information. Options are

- Identify one - information about classified information is displayed after placing the given cross-hair on a room and clicking the left mouse button
- Highlight all - all rooms containing classified information are highlighted with red diagonal stripes.

CRADAS - provides information about CRADAs (Cooperative Research and Development Agreements). Options are:

- Identify one - information about CRADAs is displayed after placing the given cross-hair on a room and clicking the left mouse button
- Highlight all - all rooms in which CRADA research is done are highlighted with yellow diagonal stripes

Chemical Equip - provides information about the presence of chemical equipment. Options are:

- Identify one - information about chemical equipment is displayed after placing the given cross-hair on a room and clicking the left mouse button
- Highlight all - all rooms containing chemical equipment in them are highlighted with blue diagonal stripes

Safety Training Req - provides information about what safety training is required before entering an area. Options are:

- Identify one - the type of safety training required is displayed after placing the given cross-hair on a room and clicking the left mouse button
- Highlight all - all rooms which require safety training before they can be entered are highlighted with aqua horizontal stripes

Safety equip - provides information about safety equipment required when in a room. Options are:

- Identify one - the type of safety equipment required is displayed after placing the given cross-hair on a room and clicking the left mouse button
- Highlight all - all rooms which require the use of safety equipment are highlighted with green vertical stripes

4.1.4 The Query Menu

The Query Menu, shown in Figure 5, enables the user to access ArcCAD's query functions from the pull-down menus.

Clear Query - clears any highlighting caused by the canned menus from the display

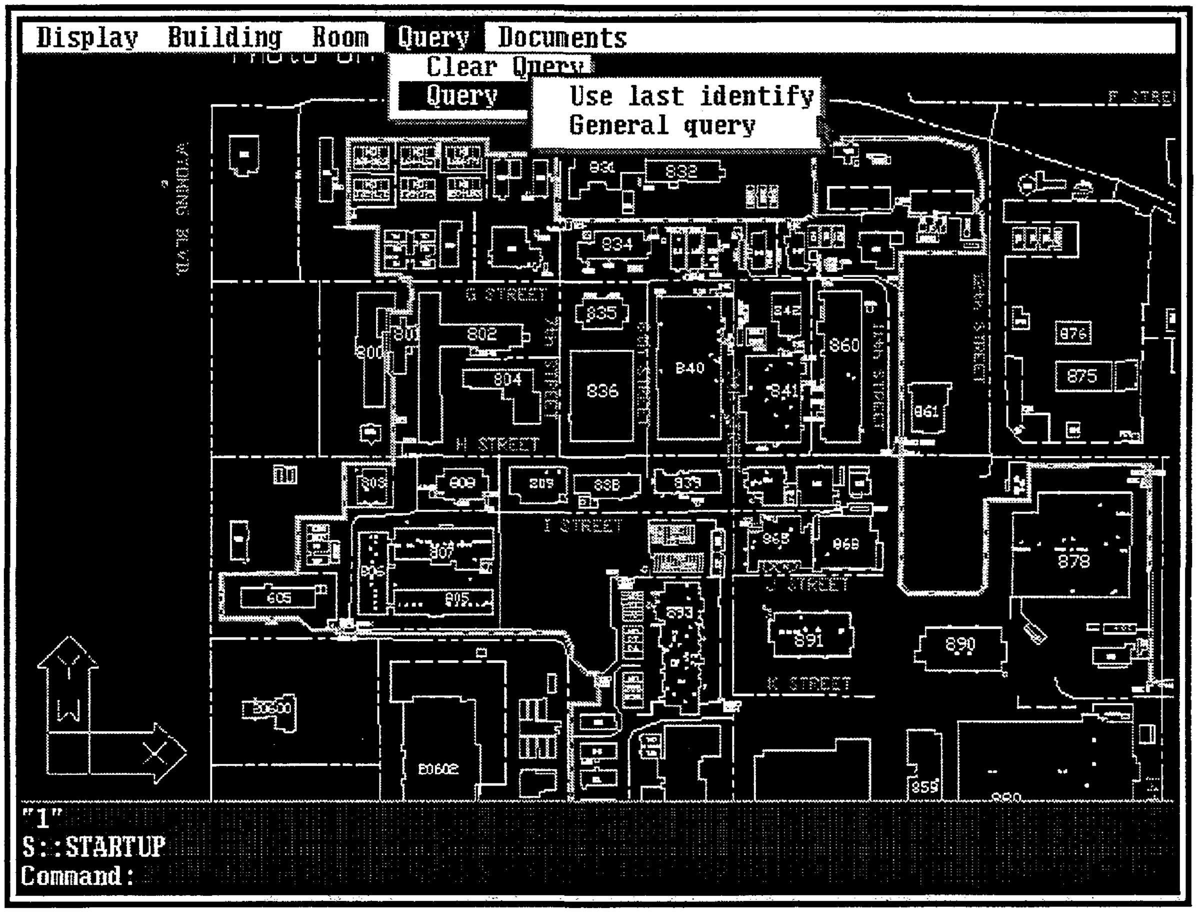

Figure 5: OSIS's Query menu.

Query - allows the user to do more sophisticated queries or queries other than those provided in the pull-down menus. This option requires some knowledge of ArcCAD. Options are:

- Use last identify
- General query

4.1.5 The Documents Menu

The documents menu, shown in Figure 6, allows the user to access and search relevant documents using Folio Views. A list of possible documents are given in the menu but only the bolded one, Treaty, has any text attached to it.

4.1.6 The OSIS Tools Menu

The OSIS Tools menu, shown in Figure 7, provides several utilities including inspection logging, zoom and pan functions for the maps, a change map function and a display photo function.

Trace Route - once the inspection logging function has been activated (using the arrive on map function below) this option allows the user to trace the inspection route on the drawing. The route is traced by clicking the left mouse button on the vertices of the route.

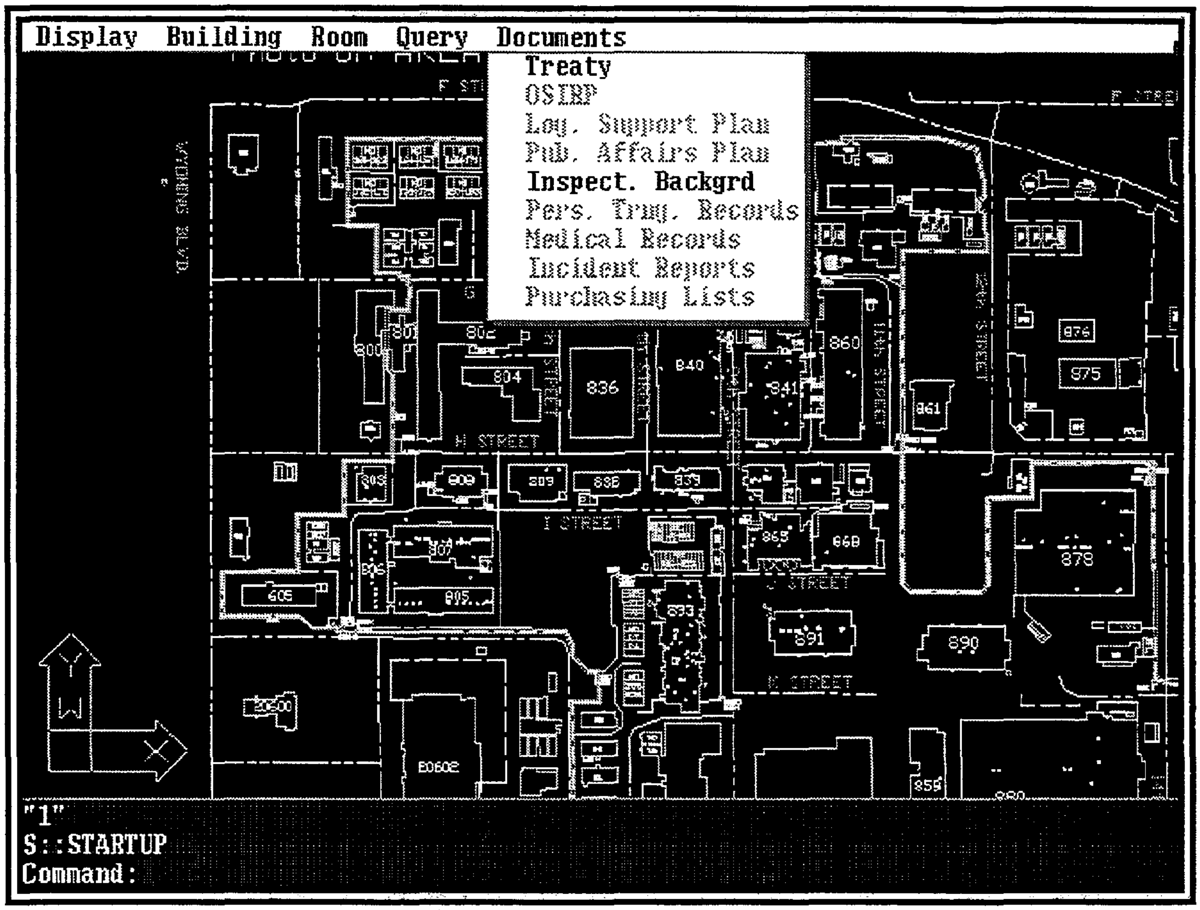

Figure 6: OSIS's Documents menu.

Log - this option contains several of the inspection logging functions. They are:

- Stop - this option puts a time/date stamp on the inspection route
- Comment - this option puts a time/date stamp on the inspection route and prompts the user for text input. This could be used to record inspector's comments.
- Arrive on map - this option activates the inspection logging function. The user is prompted to identify a starting place for tracing the inspection route on the map by placing the cursor in the appropriate place and clicking the left mouse button
- Depart from map - this option terminates the logging function.
- Anomaly - this options puts a time/date stamp on the inspection route and prompts the user for text input. This option is used to document "anomalies" or unusual findings.
- Sample - this option puts a time/date stamp on the inspection route and prompts the user for text input. This option is used to document where and when samples are taken
- Repair - This option allows the user to recover or modify the inspection route being traced on the drawing. Options are:
  - Reconnect - reconnect to the inspection route
  - Erase last leg
  - Adjust track - move the track if it is drawn incorrectly

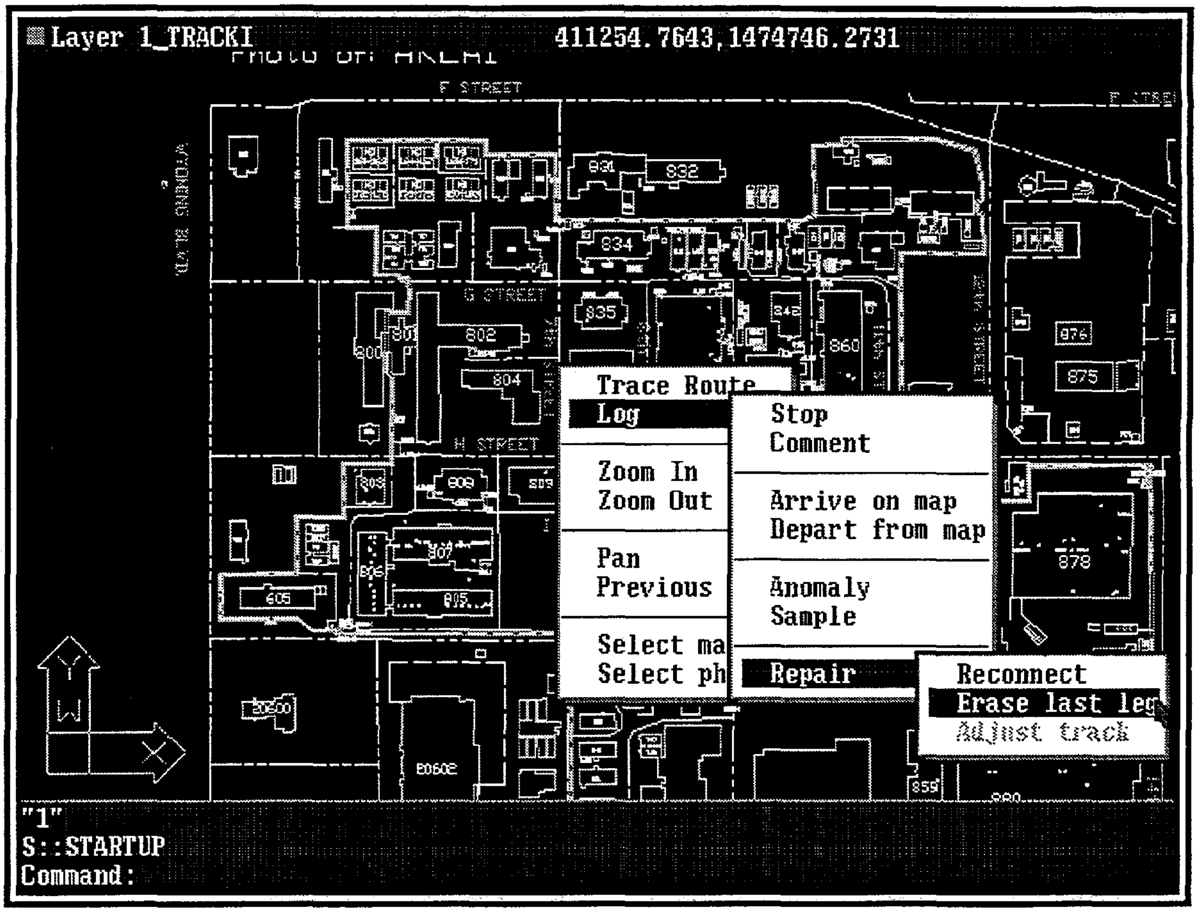

Figure 7: OSIS's Tools Popup menu.

Zoom in - zoom in on the drawing a fixed amount (currently 2x)

Zoom out - zoom out on the drawing a fixed amount (currently 0.5x)

Pan - allows the user to translate the drawing horizontally. The user is prompted to place the cross-hair on the desired center point

Previous view - allows the user to restore the previous view

Select map - allows the user to switch from the Tech Area 1 map to a building layout by pointing and clicking at a building number.
Select photos - allows the user to display a photo by pointing and clicking on a label. There are two kids of labels in OSIS: 1) a building number label on the Tech Area 1 map and 2) the text following a "Photo of" label on any map.

4.2 Inspection tracking function

One of the key features of OSIS is the inspection tracking function that allows an escort or inspector to build an accurate log of the route and events that occurred during the course of an inspection. As described in Section 4.1, the tools that perform the inspection tracking function are available from the OSIS Tools

Popup menu. The tracking tools record information on an AutoCAD drawing layer set aside for this purpose. (There is one such "tracking layer" for each site and each floor.) At the end of an inspection, this tracking information may be saved to a text file using the "EXTRACT" function provided in the DISPLAY menu.

An example of an inspection route and an inspection log file are given in Figures 8 and 9 below.

For each entry in the tracking log file as shown in Figure 9, the type of entry is recorded in the first set of single quotation marks (e.g., 'Comment'). The date and time stamp follows in the following order: year, month, day, hours, minutes, and seconds. For entry types that accept text descriptions from the user, the

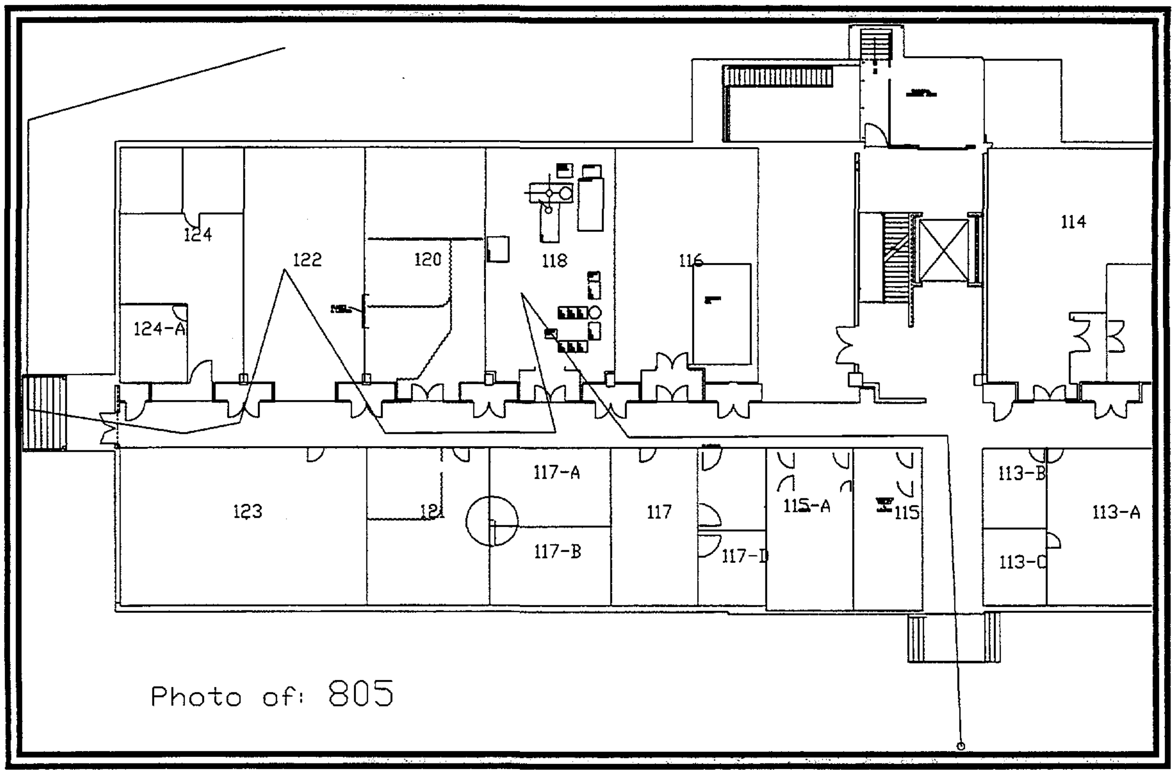

Figure 8: Illustration of the tracking function on a fictional inspection of Building 805.

'Comment', 19940114.1711355,'Spent 15 min looking at equip.', 410759.918,1474095.003, 0.000
'Sample', 19940114.1712217,'', 410801.628,1474073.602, 0.000
'Sample', 19940114.1714009,'Team took three samples, 1from vent hood, 2 from beakers on lab bench', 410794.864,1474095.003, 0.000
'Stop', 19940114.1714330,'', 410867.574,1474027.986, 0.000

Figure 9: An inspection log file that has been extracted from the drawing's tracking layer.

third item in each entry is that description (e.g., 'Spent 15 min looking at equip.'). The last three items in an entry are the X,Y,Z geo-referenced position in feet. Note that the drawings have been referenced to the New Mexico State Plane Datum for the Central Zone and that elevations have been set to "0".

4.3 Sample Screens

Figures 10 and 11 show additional sample screens. They are intended to give the reader a sense of the "look-and-feel" of the OSIS system.

4.4 Programmable Function Keys

Another way of inputting commands that was explored in OSIS was by reprogramming some of the function keys on the PC's keyboard. The batch text file DEF_FUNC.KEY, shown in Figure 12, was created to utilize the ANSI escape sequence (see the MS-DOS 5 manual under ANSI escape sequences for details[4]) and executed via OSIS.BAT. This batch file resides in the OSIS directory and is called up when OSIS begins to run. It then redefines the function keys to execute some of OSIS's commonly used commands. This file must be called in via DOS's "TYPE" command; "TYPE DEF_FUNC.KEY" is the literal command line used in OSIS.BAT.

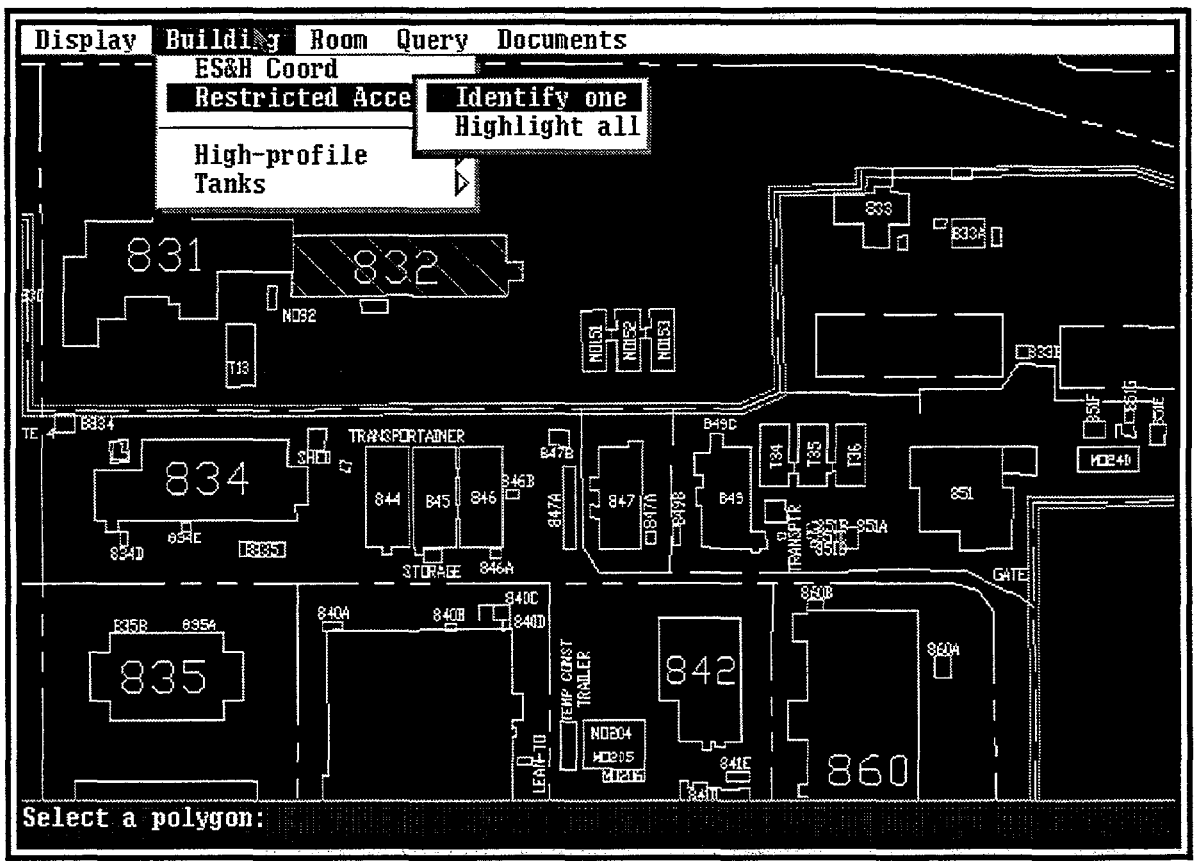

Figure 10: The display after highlighting all of the Restricted Access Buildings (note the crosshatch fill of Building 832). The diagram has been zoomed in.

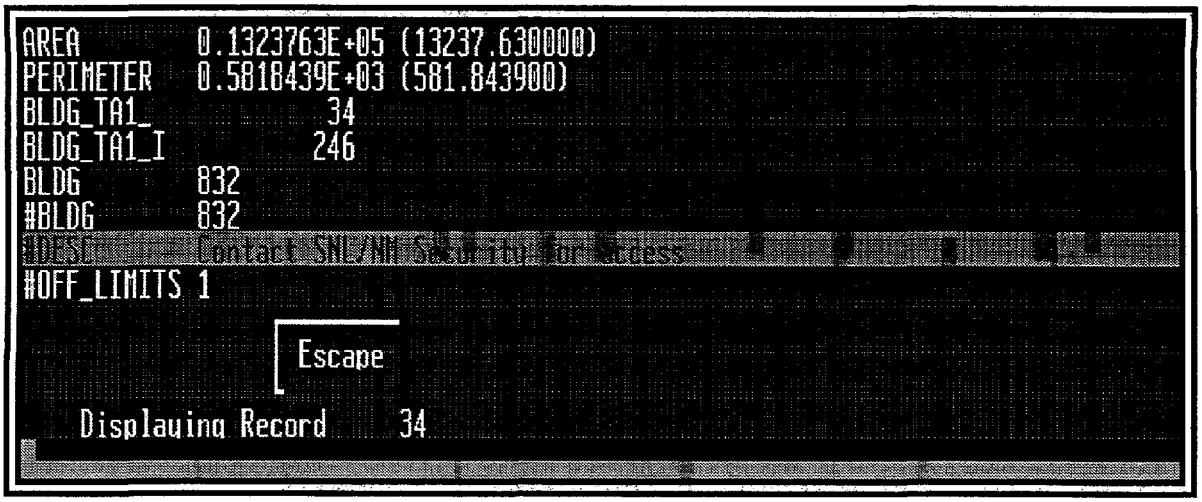

Figure 11: The display after choosing the "Identify one" option in the previous figure.

```
Defining function keys for OSIS

F2          - TRACE ROUTE         [0;60;3;3;"pline @";13p
F2 + Shift - ERASE LAST LEG       [0;85;3;3;"undo 1";13p
F2 + Alt   - RECONNECT            [0;105;3;3;"point end";13p

F3          - LOG ARRIVAL         [0;61;3;3;"arrivelog";13p
F3 + Shift - LOG DEPARTURE        [0;86;3;3;"departlog";13p
F3 + Ctrl  - STOP LOG             [0;96;3;3;"stoplog";13p

F4          - SAMPLE              [0;62;3;3;"samplelog";13p
F4 + Shift - COMMENT              [0;87;3;3;"commentlog";13p
F4 + Ctrl  - ANOMALY              [0;97;3;3;"anomalylog";13p

F5          - ZOOM IN 2.5x        [0;63;3;3;"z 2.5x";13p
F5 + Shift - ZOOM OUT .4x         [0;88;3;3;"z .4x";13p
F5 + Ctrl  - PAN                  [0;98;3;3;"z c";13p
F5 + Alt   - PREVIOUS VIEW        [0;108;3;3;"z p";13p

F6 +        - SELECT MAP          [0;64;3;3;"acadentity";13p
F6 + Shift - SELECT PHOTO         [0;89;3;3;"acadpic";13p
F6 + Ctrl  - TREATY               [0;99;3;3;"folio";13p
```

Figure 12: The batch file DEF_FUNC.KEY that reprograms the PC's function keys.

5.0 Summary

This report described the development of the On-Site Inspection System (OSIS), an information management system to support on-site inspections. The software was based on a Geographic Information System and provides the user a powerful tool for accessing the wide variety of information necessary for hosting an inspection at a complex facility. OSIS provides several important functions including:

- The display of site diagrams and building layouts
- The ability to highlight buildings and rooms on the maps based on certain predetermined features such as access restrictions, presence of classified information, presence of chemical equipment, etc.
- The ability to receive further information about a particular building or room using the "point-and-click" method.
- The ability to access relevant documents on-line
- The ability to display relevant photographs
- The ability to record an inspection log for later review and analysis

One of the surprising lessons learned during this project was that gathering information for the demonstration was actually the most time-consuming step in the project. This is in part because preparing a complex site like Sandia for an inspection is an enormous undertaking: a vast amount of data is required and it resides in a variety of locations. It was also an indication that the commercial software on which this application is based is extremely powerful and flexible; even complex functions like inspection logging can be implemented rather quickly.

In addition to the inspection-hosting function for which it was developed, OSIS has a variety of other potential uses including:

- carrying out inspections at foreign facilities
- supporting inspector training
- familiarizing inspectors with a new site
- emergency response

Appendix A: Detailed Technical Description

This appendix provides a detailed technical description of the ArcCAD implementation of OSIS. The reader is assumed to be familiar with the basic concepts of GIS. For those who are not familiar with these concepts, Chapter 3 of the *ArcCAD User's Guide* provides a good overview.[5]

A.1 ArcCAD Implementation

A.1.1 AutoCAD Layers versus GIS Data Coverages

Drawing layers in the AutoCAD environment are fundamentally different than those in a GIS data coverage. Drawing layers are a concept that CAD Systems (Computer Aided Design) utilize for keeping drawings organized. The layers are analogous to using separate pieces of drafting paper to draw the different components of drawing such as one layer for fences, another for streets, etc. These "separate sheets" are then overlaid in order to view the entire drawing.

A GIS data coverage (or "theme" in ArcCAD terms) carries the layering concept further. The theme of the coverage is chosen not only for its pictorial content, but also for its ability to be linked to a tabular data set which allows the GIS to perform spatial analysis. The graphics data that resides on each layer must be built into a topological format where it's basic components, whether they be a polygon, line or a point, are numbered and encoded with their relative position to each other. This position information is stored in a record table associated with that particular coverage and allows the linking individual graphic entities to other tabular data files.

A.1.2 Coverages (Polygon Themes)

Proper ArcCAD functioning at the Tech Area 1 map level requires building footprint, tanks, and inspection perimeter themes. These themes are labeled BLDG_TA1, TANKS, and PERIM respectively.

Proper functioning at the building layout level requires room footprint themes. Room themes for individual buildings are named Oxxxn, where xxx is the building number and n is the floor. For example, O8902 is the OSIS room theme for the second floor of Building 890. The floor number for basements is 'B'; for roofs, 'R.'

A.1.3 Record Themes

Accessory information to be related to the building, tank, and room polygon themes is stored in dBase III files identified to ArcCAD as record themes. Building ES&H coordinators, building access restrictions, high-profile features, and exterior tanks are data available in these tables for association with the BLDG_TA1 theme. Room owners, processes in rooms, CRADAs in rooms, security concerns, safety equipment required, safety training required, and key chemical equipment (hoods, glove boxes, analytical chemistry labs, etc.) are in other tables for association with appropriate room outline polygon themes, for example, O8902. These record themes are tabulated below.

Data sources. Table A-1 lists sources of each record theme/database.

Table A-1: Data sources for Record Themes

Data	Theme name	Data source
Building ES&H Coordinators	BLDG	HazMat Duty Officers Database, courtesy of Nick Durand, 7045; Nick is no longer in charge of that program
Restricted-access areas	TA1OFLIM	Fictitious data
Tank contents	TANKS	Accurate geographic data but fictitious volumes and contents
High profile facilities	HIGHPROF	Fictitious data
Processes per room	BLDG_PR	PWA databases courtesy of Robyn Davis, 7045
Room owners	BLDG_OW	ASCII files from building owner, scanned by Dick Caudell, but now fictionalized
OpSec	BLDG_OS	Fictitious data for 805 and 890 basement; 890 floors 2 and 4 from room owners, above but now fictionalized
"Chemical" equipment	BLDG_CE	Fictitious data; some information on Equipment layers of facilities maps but more reliable from owners
Safety training required prior to access	BLDG_ST	Fictitious data; available from building and room owners
Safety equipment required for access	BLDG_EQ	Fictitious data; available from building and room owners
CRADAs	BLDG_CR	Fictitious data; available from building and room owners

A.1.4 Data Importation Issues.

Map Importation Into The AutoCAD/ArcCAD Environment:
The map files for the Sandia Tech Area I diagram and building layouts for Buildings 805 and 890 were received in electronic format from Sandia's Facilities Department. The facilities data is created and maintained on an Intergraph System. The selected data was exported from Intergraph into a DXF format. DXF is AutoCAD's Data Exchange Format and has become something of an industry standard for the exchange of graphics files.

Problems were encountered when these files were imported into AutoCAD. The majority of these problems caused by blocks in the body of the exchange file which had not been defined in the exchange file's header. AutoCAD's import utility would fail upon encountering such blocks, with an error message such as "encountered error at line 15556.". A block is typically a collection of graphic entities that are used as a symbol, say for a utility pole, and are inserted into a drawing as a unit as opposed as to recreating the drawing every time you wish to represent a utility pole.

The solution was to edit the DXF file with a text editor, determine what lines in the file comprised the block definition, and then delete the block definition from the file. The data lost upon the deletion of the undefined blocks was of no particular to this project. Note however, that the files could not be imported directly into the PC environment. The files were quite large, the largest being 32 MB, and could not be edited using an MS-DOS text editor. Instead, importation was done using AutoCAD running on a SUN. When the files had been "cleaned up" sufficiently, they were transferred to a PC.

AutoCAD's import program would also fail if the Intergraph file referenced an external drawing such as the locator map on the building layout drawing. The referenced data was not exported along with the building data because it resides in a separate drawing file. Referenced files may be included in Intergraph drawings because that system is programmed to search for a referenced file on a local disk.

There is a now a new piece of Intergraph software which is designed to convert an Intergraph drawing file directly to an AutoCAD drawing file (.DWG); this software may alleviate these problems.

Once the drawings had been imported into AutoCAD, they needed to be further modified in order to remove superfluous drawing information and to make sure they had been constructed properly for use by ArcCAD.

In order for ArcCAD to utilize the drawings graphical representation in an intelligent way, the drawings must be constructed in a very precise manner. Vectors that make up the corners on polygons, for example, must meet at the same point numerically, not just appear to do so on the computer screen.

Facilities provided a layer definition list along with the electronic files which was used to select which particular layers of the data would be convert to the OSIS coverage/layer design. Note that Facilities had up to 64 layers of information included in some of their databases; it is imperative to have these layer definitions before processing diagrams in order to not waste time determining the layers oneself.

In order to create AutoCAD drawings that conformed to ArcCAD's standards regarding closure of polygons, the required layers from the original Intergraph drawing were traced on a new AutoCAD layer. This process is fairly time consuming and requires AutoCAD skills, but was actually found to be more expedient in most cases than trying to modify the actual Intergraph file. Decisions on how to process a drawing were made layer by layer according to the coverage design. Some layers, such as the building outlines on the site map, needed a full rework while others, such as vents and fences, needed little or none.

Another point of which to be aware is that the origin point of the building's floor plan needs to be set to the x,y location of each individual building on the site diagram's graphical database. This is so that each buildings is correctly geo-referenced to the site map.

The elevations on the site map as it came to us were basically nonsensical. The elevations of the buildings' baseline made sense at 5000 ft., for that is Sandia's Tech Area I. elevation, but others such as vents, were 200 ft. above the base line. To compensate, elevations were set to zero throughout the cleanup phase.

In OSIS there are two special layers that were created to meet the portable/mobile nature of the tool. These are N_TRACKING (where N is an integer) and QUERY_SCRATCH. N_TRACKING was designed to store the tracking records of the inspection team and the layer name is utilized in some of the customized AutoLISP routines written for that purpose. Similarly, QUERY_SCRATCH is basically a scratch pad layer that is used to display of the results of queries to the database during the course of the inspection. This layer is also utilized by some of the customized AutoLISP routines. These two type of layers appear in every map used on the system.

The following layer structure was adhered to for the AutoCAD drawings used on OSIS:
<u>Tech Area I:</u>

0
1_TRACKING
BLDG_LABELS
BUILDINGS
DWG_HIST
ESRI_THEMES
FENCES
GATES
LAT_LONG
LEGEND
PERIMETER
QUERY_SCRATCH
STREET_CENTERLINES
STREET_LABELS
TANKS
TEXT
VENTS

Buildings:
0
N_DOORS
N_EQUIPMENT
N_FLOOR_PLAN
N_ROOMS
N_ROOM_LABELS
N_TRACKING
ESRI_THEMES
QUERY_SCRATCH
(N corresponds to the floor number)

Data Cleanup for Record Themes

ArcCAD polygon attribute tables (PATs) for rooms required some manual changes to the ROOM field. As generated by the add features and clean processes using an optional property table, ROOM contains only the text inside the room polygons. In order to differentiate between identical room numbers in different buildings, it was necessary to preface each room number with the building number and a slash ("/"). The exact dBase command syntax was:

```
use Onnnx\PAT
replace all ROOM with 'nnn/' + ROOM
```

where nnn is the building number and x is the floor (b, 1-4, or r). Onnnx\PAT references the correct subdirectory for the building and floor theme in question, for example, O8051\PAT.

Similarly, record themes (from whatever source) often only listed the room number. A nearly identical "replace" command was necessary before concatenating record theme databases into a master file containing all buildings.

In Building 890 general office rooms were most often listed as having an A and a B side. ArcCAD selected only one such label for each room polygon, either A or B. Correct use of record themes of room owners, OpSec, and other features required manually checking for the ArcCAD label and updating the record theme to match, usually by appending a "-A" or "-B". This process ensured that, for example, the OpSec record theme could correctly relate to the proper building and room layout PAT.

A.1.5 Exporting ArcCAD Files to ARC/INFO:
The ArcCAD/AutoCAD system allows two different kinds of graphical data to be displayed simultaneously: one that is purely pictorial (AutoCAD drawing layers) and one that has links to tabular data (ArcCAD coverage). In this environment, one can choose what information needs to be built into a coverage. For example, it was determined during the design of OSIS that users would like to make queries about buildings. Therefore, a theme with building footprints was built. However, no queries about fences were envisioned; it seemed likely that the user would only want to know where the fences were. Therefore, the fences layer was not built into a coverage, but was left an AutoCAD drawing.

This turned out to be a problem when transferring the OSIS data up to the ARC/INFO environment on the base station. In order for ARC/INFO to accept and use the transferred data it needed to be in a coverage. Fences had to be made into a GIS coverage in order to have a successful system transfer.

The exportation of ArcCAD files upward to the base station's ARC/INFO format is a straightforward process, but somewhat lengthy. The EXPORT command in ArcCAD asks whether the file to be transferred is a COVERAGE, RECORD or TEXT file; one specifies the type of file and an output file is generated in ARC/INFO format. This needs to be done for every individual file in the system that needs to be transferred. Once all the files have been exported and transferred to the correct GIS directory, the exchange process is completed by running the IMPORT command under ARC/INFO with the AUTO option. ARC/INFO automatically determines what kind of file is being imported and will covert the transferred file into the proper format, one at a time. It would be worthwhile to write a program that would export and import all the files in a directory.

PC/NFS works very well for transferring ARC/INFO files over ethernet and was recommended by the ESRI representative for this purpose.

A.2 OSIS Files

A.2.1 Batch Files

A.2.1.1 *Autoexec.bat*

Use. Initializes system, especially setting SAGEEDIT, ACAD and ACADCFG environment variables and the FolioView path.

Notes. May require customization for digitizer (mouse) and video drivers—see also CONFIG.SYS.

Partial Contents.

```
C:\DOS\SHARE.EXE /L:500
@ECHO OFF
VERIFY OFF
LOADHIGH C:\MOUSE\MOUSE.COM
PROMPT $P$G
PATH C:\;C:\DOS;C:\VIEWS21;C:\VIEWS21\UTIL;
```

```
VER
SET ACAD=C:\ACAD\SUPPORT;C:\ACAD\FONTS;C:\ACAD\ADS;
SET ACADCFG=C:\ACAD
SET ACADDRV=C:\ACAD\DRV
SET SAGEEDIT=D:\VIEWS21
TYPE C:\OSIS\DEF_FUNC.KEY
```

A.2.1.2 *Osis.bat*

Use. Batch file for OSIS initializes acad and arcad environment variables, starts ArcCAD, and clears environment variables before terminating.

Notes. Because \OSIS is not in the DOS path statement, one must change directories to \OSIS before invoking OSIS.BAT.

File contents.

```
SET ACAD=C:\ACAD\SUPPORT;C:\ACAD\FONTS;C:\ACAD\ADS;
C:\ARCAD\BIN;C:\ARCAD\SOURCE
SET ACADCFG=C:\ACAD
SET ACADDRV=C:\ACAD\DRV
SET ARCAD=C:\ARCAD
\acad\acad ta1
SET ACAD=
SET ACADCFG=
SET ACADDRV=
SET ARCAD=
```

A.2.2 Functional Files

A.2.2.1 *Acad.pgp*

Use. Located in \ACAD\SUPPORT, this file contains command aliases and synonyms for AutoCAD. In particular this file references the Folio Views command alias and points to the directory containing the treaty text (CD-1173.NFO). The file loads once when AutoCAD is started. To implement changes, quit AutoCAD (OSIS) and restart.

Notes. Update path statements for the Folio alias to match system file locations. When adding other documents to the system, add other aliases to reference the new infobases.

File contents.

```
; acad.pgp - External Command and Command Alias definitions

; External Command format:
;   <Command name>,[<DOS request>],<Memory reserve>,[*]<Prompt>,<Return code>

; Examples of External Commands for DOS

CATALOG,DIR /W,       0,File specification: ,0
```

```
DEL,DEL,          0,File to delete: ,4
DIR,DIR,          0,File specification: ,0
EDIT,Edit,        0,File to edit: ,4
SH,,              0,*OS Command: ,4
SHELL,,           0,*OS Command: ,4
TYPE,TYPE,        0,File to list: ,0
Dbase,Dbase,      0,,4
Maxflow,dbase maxflow,0,,4
AS,\as\as,        0,,4
ProbGen,dbase pg,   0,,4
LINGO,go.bat,     0,,4
ArcRet,dbase arcret,  0,,4
Feas,dbase kwikfeas,  0,,4
folio,d:\views21\views d:\treaty\cd-1173.nfo,0,,4
insp,\as\as insp,   0,,4
aap,\osis\aniplay\aaplayhi,0,Script file name: ,4

; Command alias format:
;  <Alias>,*<Full command name>

; Sample aliases for AutoCAD Commands
; These examples reflect the most frequently used commands.
; Each alias uses a small amount of memory, so don't go
; overboard on systems with tight memory.

A,    *ARC
C,    *CIRCLE
CP,   *COPY
DV,   *DVIEW
E,    *ERASE
L,    *LINE
LA,   *LAYER
M,    *MOVE
MS,   *MSPACE
P,    *PAN
PS,   *PSPACE
PL,   *PLINE
R,    *REDRAW
Z,    *ZOOM

3DLINE, *LINE

; easy access to _PKSER (serial number) system variable
SERIAL, *_PKSER

; aliases for 3d.lsp commands to avoid conflicts with AME AutoLoading
BOX,    *AI_BOX
CONE,   *AI_CONE
DISH,   *AI_DISH
```

```
DOME,  *AI_DOME
MESH,  *AI_MESH
PYRAMID, *AI_PYRAMID
SPHERE, *AI_SPHERE
TORUS,  *AI_TORUS
WEDGE,  *AI_WEDGE

; Complex Solids.
SOL,         *SOLIDIFY

; Modification and Query commands.
UNI,          *SOLUNION
UNION,          *SOLUNION
SUB,          *SOLSUB
SUBTRACT,       *SOLSUB
DIF,          *SOLSUB
DIFF,          *SOLSUB
DIFFERENCE,     *SOLSUB
SEP,          *SOLSEP
SEPARATE,       *SOLSEP
SCHP,          *SOLCHP
CHPRIM,         *SOLCHP
MOV,          *SOLMOVE
SL,          *SOLLIST
SLIST,          *SOLLIST
MP,          *SOLMASSP
MASSP,          *SOLMASSP
SA,          *SOLAREA
SAREA,          *SOLAREA
SSV,          *SOLVAR

; Documentation commands.
FEAT,          *SOLFEAT
SU,          *SOLUCS
SUCS,          *SOLUCS

; Model representation commands.
SW,          *SOLWIRE
WIRE,          *SOLWIRE
SM,          *SOLMESH
MESH,          *SOLMESH
```

A.2.2.2 Arcad12.mnu

Use. ArcCAD normally invokes the ARCAD12.MNU file as its default menu from the \ARCAD directory. When a local copy exists (in this case \OSIS\ARCAD12.MNU), the local menu is invoked instead of the general default menu. **Warning:** Do *not* copy \ARCAD\SOURCE\ARCAD12.MNU over \OSIS\ARCAD12.MNU or *vice versa*; the files are vastly different. This file is heavily modified to the point of the elimination of all standard ArcCAD pulldown menus (POP0 through POP9).

Notes. Proper functioning of the local OSIS menu requires careful coordination of related LSP files.

File contents.

```
***Comment

   Modified for OSIS by K. E. Horak, Ogden Environmental
      and T. W. Widney, Sandia National Laboratories/NM
   07/09/93, 07/13/93, 07/16/93, 08/06/93, 08/10/93, 08/20/93,
   08/23/93 to 09/03/93
      See especially POP0-POP5 and SCREEN1. No changes have been made past
      **HEADER (the end of this text block).

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***BUTTONS1
;
$P0=*
^C^C
^B
^O
^G
^D
^E
^T

***BUTTONS2
```

```
$P0=*

***AUX1
;
$P0=*
^C^C
^B
^O
^G
^D
^E
^T

***AUX2
$P0=*

***POP0
[OSI Tools]
[Trace Route]^C^Cpline @ \
[->Log]
  [Stop]^C^Cstoplog
  [Comment]^C^Ccommentlog
  [--]
  [Arrive on map]^C^Carrivelog
  [Depart from map]^C^Cdepartlog
  [--]
  [Anomaly]^C^Canomalylog
  [Sample]^C^Csamplelog
  [--]
  [->Repair]
    [Reconnect]^C^Cpoint end
    [Erase last leg]^C^Cundo 1
    [~<-<-Adjust track]^C^C
[--]
[Zoom In]^C^Czoom c \2x
[Zoom Out]^C^Czoom 0.5x
[--]
[Pan]^C^Czoom c \1x
[Previous View]^C^Czoom p
[--]
[Select map]^C^Cacadentity
[Select photo]^C^Cacadpic

***POP1
[Display]
[->Open maps]
  [Tech. Area 1]^C^C(command "save" "") open ta1
  [Building 805]^C^C(command "save" "") open 805
  [<-Building 890]^C^C(command "save" "") open 890
```

```
[Center map]^C^C(command "view" "restore" "all")
[--]
[->Floors]
  [Basement]^C^Clayer on b_tracking set b_tracking off * y on b_* ;; (setvar "users2" "B")
  [First]^C^Clayer on 1_tracking set 1_tracking off * y on 1_* ;; (setvar "users2" "1")
  [Second]^C^Clayer on 2_tracking set 2_tracking off * y on 2_* ;; (setvar "users2" "2")
  [Third]^C^Clayer on 3_tracking set 3_tracking off * y on 3_* ;; (setvar "users2" "3")
  [Fourth]^C^Clayer on 4_tracking set 4_tracking off * y on 4_* ;; (setvar "users2" "4")
  [<-Roof]^C^Clayer on r_tracking set r_tracking off * y on r_* ;; (setvar "users2" "r")
[--]
[Checkpoints on]^C^Clayer on gates ;
[Checkpoints off]^C^Clayer off gates ;
[--]
[Extract route]^C^Cattext ;;;
[Exit]^C^C(command "save" "") quit

***POP2
[Building]
[ES&H Coord]^C^Crelate off relate on bldg_ta1 bldg bldg linear identify bldg_ta1
[->Restricted Access]
  [Identify one]^C^Cbldg_ra
  [<-Highlight all]^C^Cbldg_ra_all getback
[--]
[->High-profile]
  [Identify one]^C^Cbldg_hp
  [<-Highlight all]^C^Cbldg_hp_all getback
[->Tanks]
  [Identify one]^C^Cidentify tanks
  [<-Find chemical]^C^Cquerytank

***POP3
[Room]
[Processes/Room]^C^Cbldg_pr
[Owner/Room]^C^Cbldg_ow
[--]
[->Classified]
  [Identify one]^C^Cbldg_os
  [<-Highlight all]^C^Cbldg_os_all getback
[->CRADAs]
  [Identify one]^C^Cbldg_cr
  [<-Highlight all]^C^Cbldg_cr_all getback
[--]
[->Chemical Equip]
  [Identify one]^C^Cbldg_ce
  [<-Highlight all]^C^Cbldg_ce_all getback
[--]
[->Safety Trng Req]
  [Identify one]^C^Cbldg_st
  [<-Highlight all]^C^Cbldg_st_all getback
```

```
[->Safety Equip]
  [Identify one]^C^Cbldg_eq
  [<-Highlight all]^C^Cbldg_eq_all getback

***POP4
[Query]
  [Clear Query]^C^Cclr_qry
  [->Query]
    [Use last identify]^C^Clayer set query_scratch ;clearsel reselect ;expression polyshd
;;?;getback
    [<-General query]^C^Clayer set query_scratch ;clearsel ddrelate reselect\ ;expression polyshd
;;?;getback

***POP5
[Documents]
[Treaty]^C^Cfolio
[~OSIRP]^C^C
[~Log. Support Plan]^C^C
[~Pub. Affairs Plan]^C^C
[Inspect. Backgrd]^C^Cinsp
[~Pers. Trng. Records]^C^C
[~Medical Records]^C^C
[~Incident Reports]^C^C
[~Purchasing Lists]^C^C
```

A.2.2.3 *Arcad12.mnl*

Use. Just as ARCAD12.MNU is the default ArcCAD menu, ARCAD12.MNL is the default AutoLISP file. It loads AutoLISP routines when ARCAD12.MNU is called at startup.

Notes. See also STARTUP.LSP.

File Contents.

```
(load "gonzo.lsp")
(load "startup.lsp")
```

A.2.2.4 *Gonzo.lsp*

Use. Customized AutoLISP routines are contained in GONZO.LSP, located in \OSIS. The file is invoked by ARCAD12.MNL each time a new drawing is loaded. Each function is annotated in the listing below.

Notes. When possible, update tracking/time-date stamping functions to use 3D-polylines and change elevation with floor/layer changes.

File Contents.

```
(defun c:gonzo ()Developer's convenience to edit
(command "edit" "gonzo.lsp")this file from command line
```

```
)

(defun c:editarc ()Developer's convenience to edit
(command "edit" "arcad12.mnu")the default menu file
)

(defun c:clr_qry ()
(setq ss1Define a selection set, SS1,
(ssget "X" (list (cons 8 "query_scratch")))containing items
) only on layer QUERY_SCRATCH
(if (not (null ss1))Erase if selection set is not nil
    (command "erase" "previous" "")
(command "redraw") Refresh drawing
  )
)

(defun c:commentlog ()Time-date stamp with comment
(setq str (getstring "\n\nComment> " "1")) Prompt for comment
(setq tds (getvar "cdate")) Get time-date
  (setq fl
    (if
      (not
        (or
(= "B" (getvar "users2"))If not basement nor roof,
(= "R" (getvar "users2"))use layer number as floor
        )
      )
      (getvar "users2")
(if (= "B" (getvar "users2")) "0" "6")Basement=0; roof=60
    )
  )
(setq floor (* (- (distof fl) 1) 10))Elev is 10*(floor-1)
  (command "insert" "stamp" "@" "" "" "" str "Comment" tds)
  (command "change" "last" "" "properties" "elev" floor "")
)

(defun c:stoplog ()Time-date stamp a "stop"
(setq tds (getvar "cdate")) (See CommentLog above)
  (setq fl
    (if
      (not
        (or
          (= "B" (getvar "users2"))
          (= "R" (getvar "users2"))
        )
      )
      (getvar "users2")
        (if (= "B" (getvar "users2")) "0" "6")
```

```
    )
  )
  (setq floor (* (- (distof fl) 1) 10))
  (command "insert" "stamp" "@" "" "" "" "" "Stop" tds)
  (command "change" "last" "" "properties" "elev" floor "")
)

                                        (defun c:arrivelog ()Initialize first tracking point
                                   (setq tds (getvar "cdate")) on a new map or upon re-entry
  (setq fl
    (if
      (not
        (or
          (= "B" (getvar "users2"))
          (= "R" (getvar "users2"))
        )
      )
      (getvar "users2")
        (if (= "B" (getvar "users2")) "0" "6")
    )
  )
  (setq floor (* (- (distof fl) 1) 10))
  (command "insert" "stamp" pause "" "" "" "" "Arrive" tds)
  (command "change" "last" "" "properties" "elev" floor "")
)

                                              (defun c:departlog ()Leave building map
  (setq tds (getvar "cdate"))
  (setq mapname (getvar "dwgname"))
  (setq fl
    (if
      (not
        (or
          (= "B" (getvar "users2"))
          (= "R" (getvar "users2"))
        )
      )
      (getvar "users2")
        (if (= "B" (getvar "users2")) "0" "6")
    )
  )
  (setq floor (* (- (distof fl) 1) 10))
  (command "insert" "stamp" "@" "" "" "" mapname "Depart" tds)
  (command "change" "last" "" "properties" "elev" floor "")
  (command "save")
                                        (command "open" "ta1")Return to TA1 map
)

                                        (defun c:anomalylog ()Time-date stamp an anomaly
```

```
    (setq str (getstring "\nAnomaly:  " "1"))
    (setq tds (getvar "cdate"))
    (setq fl
      (if
        (not
          (or
            (= "B" (getvar "users2"))
            (= "R" (getvar "users2"))
          )
        )
        (getvar "users2")
          (if (= "B" (getvar "users2")) "0" "6")
      )
    )
    (setq floor (* (- (distof fl) 1) 10))
    (command "insert" "stamp" "@" "" "" "" str "Anomaly" tds)
    (command "change" "last" "" "properties" "elev" floor "")
  )

                                      (defun c:samplelog ()Time-date stamp a sampling
                          (setq str (getstring "\nSample:  " "1")) location with text note
    (setq tds (getvar "cdate"))
    (setq fl
      (if
        (not
          (or
            (= "B" (getvar "users2"))
            (= "R" (getvar "users2"))
          )
        )
        (getvar "users2")
          (if (= "B" (getvar "users2")) "0" "6")
      )
    )
    (setq floor (* (- (distof fl) 1) 10))
    (command "insert" "stamp" "@" "" "" "" str "Sample" tds)
    (command "change" "last" "" "properties" "elev" floor "")
  )

                          (defun c:AcadEntity()Open a map associated with a text name
                                   (setq e (entsel))User selects an object (must be text)
    (setq entdat (entget (car e)))
                        (setq filename (cdr (assoc '1 entdat)))Obtain text string for entity
                                               (Command "save" "ta1")Save TA1 map
                                     (Command "open" filename)Open selected map
  )

                          (defun c:GetBack()Return to current tracking layer after query
                                    (setq v2 (getvar "users2"))Obtain floor number
```

```
(setq layername (strcat v2 "_" "tracking"))Generate layer name
(command "layer" "on" layername "")Turn tracking layer on
(command "layer" "set" layername "")Make tracking layer current
)

(defun c:bldg_stIdentify safety training required in a room
(setq v1 (getvar "users1"))Building number
(setq v2 (getvar "users2"))Floor number
(setq themename (strcat "O" v1 v2))Theme name, e.g., O8902
(cmd (list "relate" "off"))ArcCAD command strings
(cmd (list "relate" "on" themename "bldg_st" "room" "linear"))
(cmd (list "identify" themename))
)

(defun c:bldg_ra()Identify restricted-access buildings in TA1
(cmd (list "relate" "off"))
(cmd (list "relate" "on" "bldg_ta1" "ta1oflim" "bldg" "linear"))
(cmd (list "identify" "bldg_ta1"))
)

(defun c:bldg_hp()Identify high-profile buildings in TA1
(cmd (list "relate" "off"))
(cmd (list "relate" "on" "bldg_ta1" "highprof" "bldg" "linear"))
(cmd (list "identify" "bldg_ta1"))
)

(defun c:bldg_ra_all()Highlight all restricted access bldgs
(cmd (list "relate" "off"))
(cmd (list "relate" "on" "bldg_ta1" "ta1oflim" "bldg" "linear"))
(cmd (list "clearsel"))
(cmd (list "reselect" "bldg_ta1" "expression" "#off_limits = 1"))
(cmd (list "polyshd" "bldg_ta1" "symbol" "39"))
)

(defun c:bldg_hp_all()Highlight all high-profile bldgs
(cmd (list "relate" "off"))
(cmd (list "relate" "on" "bldg_ta1" "highprof" "bldg" "linear"))
(cmd (list "clearsel"))
(cmd (list "reselect" "bldg_ta1" "expression" "#hp = 1"))
(cmd (list "polyshd" "bldg_ta1" "symbol" "38"))
)

(defun c:bldg_ce()Identify "chemical" equipment per room
(setq v1 (getvar "users1"))
(setq v2 (getvar "users2"))
(setq themename (strcat "O" v1 v2))
(cmd (list "relate" "off"))
(cmd (list "relate" "on" themename "bldg_ce" "room" "linear"))
(cmd (list "identify" themename))
```

```
)

                                   (defun c:bldg_pr()Identify processes per room
  (setq v1 (getvar "users1"))
  (setq v2 (getvar "users2"))
  (setq themename (strcat "O" v1 v2))
  (cmd (list "relate" "off"))
  (cmd (list "relate" "on" themename "bldg_pr" "room" "linear"))
  (cmd (list "identify" themename))
)

                                       (defun c:bldg_ow()Identify room owners
  (setq v1 (getvar "users1"))
  (setq v2 (getvar "users2"))
  (setq themename (strcat "O" v1 v2))
  (cmd (list "relate" "off"))
  (cmd (list "relate" "on" themename "bldg_ow" "room" "linear"))
  (cmd (list "identify" themename))
)

                            (defun c:bldg_os()Identify security concerns per room
  (setq v1 (getvar "users1"))
  (setq v2 (getvar "users2"))
  (setq themename (strcat "O" v1 v2))
  (cmd (list "relate" "off"))
  (cmd (list "relate" "on" themename "bldg_os" "room" "linear"))
  (cmd (list "identify" themename))
)

                                (defun c:bldg_cr()Identify CRADA info per room
  (setq v1 (getvar "users1"))
  (setq v2 (getvar "users2"))
  (setq themename (strcat "O" v1 v2))
  (cmd (list "relate" "off"))
  (cmd (list "relate" "on" themename "bldg_cr" "room" "linear"))
  (cmd (list "identify" themename))
)

                            (defun c:bldg_eq()Identify safety equipment per room
  (setq v1 (getvar "users1"))
  (setq v2 (getvar "users2"))
  (setq themename (strcat "O" v1 v2))
  (cmd (list "relate" "off"))
  (cmd (list "relate" "on" themename "bldg_eq" "room" "linear"))
  (cmd (list "identify" themename))
)

                            (defun c:bldg_os_all ()Highligh all rooms with OpSec
  (setq v1 (getvar "users1"))
```

```
    (setq v2 (getvar "users2"))
    (setq themename (strcat "O" v1 v2))
    (command "layer" "set" "query_scratch" "")
    (cmd (list "relate" "off"))
    (cmd (list "relate" "on" themename "bldg_os" "room" "linear"))
    (cmd (list "clearsel"))
    (cmd (list "reselect" themename "expression" "#os = 1"))
    (cmd (list "polyshd" themename "symbol" "50"))
)

                    (defun c:bldg_cr_all ()Highlight all rooms with CRADAs
    (setq v1 (getvar "users1"))
    (setq v2 (getvar "users2"))
    (setq themename (strcat "O" v1 v2))
    (command "layer" "set" "query_scratch" "")
    (cmd (list "relate" "off"))
    (cmd (list "relate" "on" themename "bldg_cr" "room" "linear"))
    (cmd (list "clearsel"))
    (cmd (list "reselect" themename "expression" "#cr = 1"))
    (cmd (list "polyshd" themename "symbol" "37"))
)

            (defun c:bldg_eq_all ()Highlight rooms with safety equip. requirements
    (setq v1 (getvar "users1"))
    (setq v2 (getvar "users2"))
    (setq themename (strcat "O" v1 v2))
    (command "layer" "set" "query_scratch" "")
    (cmd (list "relate" "off"))
    (cmd (list "relate" "on" themename "bldg_eq" "room" "linear"))
    (cmd (list "clearsel"))
    (cmd (list "reselect" themename "expression" "#eq = 1"))
    (cmd (list "polyshd" themename "symbol" "24"))
)

            (defun c:bldg_ce_all ()Highlight all rooms with "chemical" equipment
    (setq v1 (getvar "users1"))
    (setq v2 (getvar "users2"))
    (setq themename (strcat "O" v1 v2))
    (command "layer" "set" "query_scratch" "")
    (cmd (list "relate" "off"))
    (cmd (list "relate" "on" themename "bldg_ce" "room" "linear"))
    (cmd (list "clearsel"))
    (cmd (list "reselect" themename "expression" "#ce = 1"))
    (cmd (list "polyshd" themename "symbol" "23"))
)

              (defun c:bldg_st_all()Highlight rooms with required safety training
    (setq v1 (getvar "users1"))
    (setq v2 (getvar "users2"))
```

```
    (setq themename (strcat "O" v1 v2))
    (command "layer" "set" "query_scratch" "")
    (cmd (list "relate" "off"))
    (cmd (list "relate" "on" themename "bldg_st" "room" "linear"))
    (cmd (list "clearsel"))
    (cmd (list "reselect" themename "expression" "#st = 1"))
    (cmd (list "polyshd" themename "symbol" "11"))
)

                                        (defun c:AcadPic()Select map text entity and view
                                              (setq e (entsel))corresponding photograph
    (setq entdat (entget (car e)))
    (setq filename (cdr (assoc '1 entdat)))
                                        (Command "aap" filename)See ACAD.PGP for this alias
)

                              (defun c:querytank()Search for a tank containing a specified chemical
    (setq chemical (getstring "\nChemical name:  " "1"))
    ( etq querystring (strcat "contents CN '" chemical "'"))  _Ä¿
    (com and "layer" "set" "query_scratch" "")          ³
    (cmd (list "relate" "off"))                     ³
    (cmd (list "clearsel"))                         ³
    (cmd (list "reselect" "tanks" "expression" querystring))__ÄÄÙ
    (cmd (list "polyshd" "tanks" "symbol" "2"))
    (command "layer" "set" "1_tracking" "")
)
```

A.2.2.5 *Startup.lsp*

Use. This AutoLISP file is loaded each time a drawing is opened.

Notes. This file usurps ArcCAD's own S::STARTUP function. Instead it loads ARCAD.LSP and ARCSETUP.LSP explicitly and runs ARCSETUP before setting Users1 to the drawing name and Users2 to "1" (the first floor). Also, several layer commands are given to initialize the drawing.

File Contents.

```
(defun s::startup ()
  (load "arcad")
  (load "arcsetup")
  (arcsetup)
  (setq drawname (getvar "dwgname"))
  (setvar "users1" drawname)
  (command "layer" "on" "1_tracking" "set" "1_tracking" "")
  (if (/= drawname "TA1")
        (command "layer" "off" "*" "yes" "on" "1_*" "")
  )
  (setvar "users2" "1")
)
```

References

1. Conference on Disarmament, *Draft Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction*, CD/1173, 3 September 1992.
2. For further information on the contents of an OSIRP, see J. M. Taylor and P. R. Dobranich, *An Updated, Annotated Outline of an On-site Inspection Readiness Plan*, SAND91-1437 (Albuquerque: Sandia National Laboratories) September 1991. (OUO)
3. H. Bray, Information *Model for On-Site Inspection*, Vol. 2, SAND 92-2239 (Albuquerque: Sandia National Laboratories) February 1994?.
4. See for example, *Microsoft Corporation, MS-DOS 5.0 User's Guide and Reference, Version 5, Gateway Edition* (Microsoft Corporation, 1991) pp. 262-266.
5. Environmental Systems Research Institute, Inc., *ArcCAD User's Guide*, (Redlands, CA: Environmental Systems Research Institute, Inc., 1992) pp 3-1 to 3-47.

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