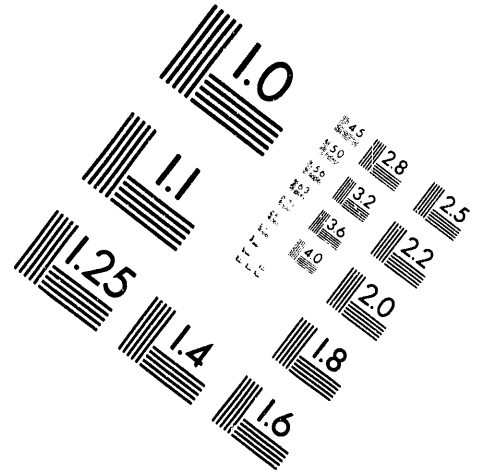
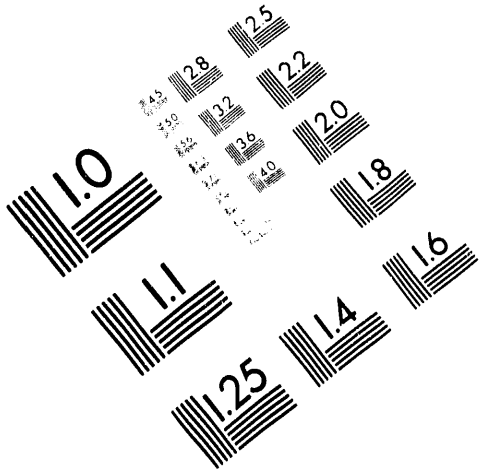




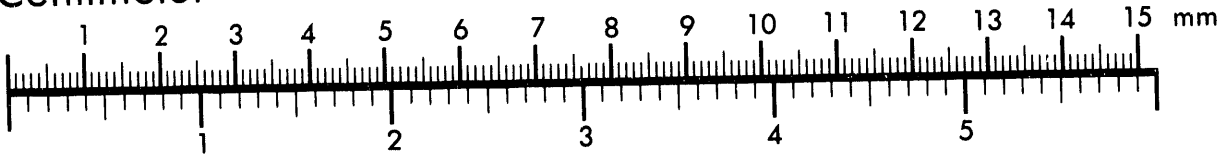
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**Association for Information and Image Management**

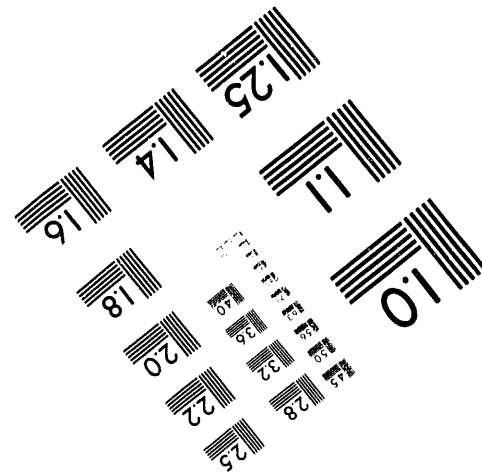
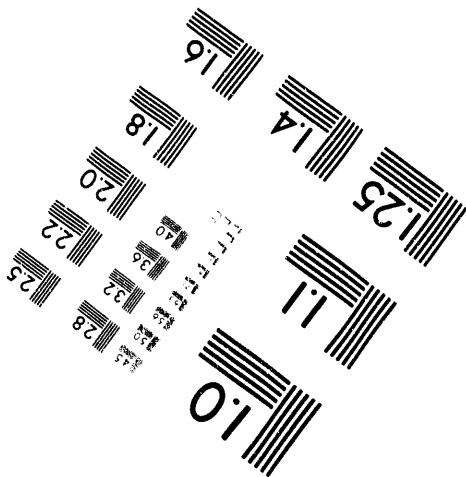
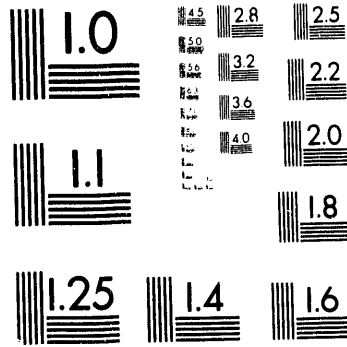
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Silver Spring, Maryland 20910  
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BY APPLIED IMAGE, INC.

**1 of 1**

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For presentation at SDM 92, A Planning Workshop, Scientific Data Management Workshop, 1992, The Role of Metadata in Managing Large Environmental Sciences Data Sets, Salt Lake City, UT, November 3-5, 1992.

## Design and Implementation of a Computer Based Site Operations Log for the ARM Program

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### 1. INTRODUCTION

The Atmospheric Radiation Measurement (ARM) Program is a Department of Energy (DOE) research effort to reduce the uncertainties found in general circulation and other models due to the effects of clouds and solar radiation (DOE 1990, Patrinos et al. 1990). ARM will provide an experimental testbed for the study of important atmospheric effects, particularly cloud and radiative processes, and testing of parameterizations of the processes for use in atmospheric models. The design of the testbed known as the Clouds and Radiation Testbed (CART), calls for five, long-term field data collection sites. The first site, located in the Southern Great Plains (SGP) in Lamont, OK began operation in the spring of 1992. The ARM site selection process is discussed in DOE 1991.

The CART Data Environment (CDE) is the element of the testbed which acquires the basic observations from the instruments and processes them to meet the ARM requirements. A formal design process was used to develop a description of the logical requirements for the CDE. The requirements and design of the CDE are discussed in Melton et al. (1991 and 1992).

This paper discusses the design and prototype implementation of a part of the CDE known as the site operations log, which records metadata defining the environment within which the data produced by the instruments is collected.

### 2. OVERVIEW OF THE CDE

The CDE has three major physical elements: the site data system, the experiment center and the ARM data archive. (Melton et al. 1992).

The site data system is situated at the SGP site; as other sites are added to CART, new portions of the site data system will be put in place to handle observations from the new sites. The site data system ingests data from the instruments, controls the operation of the instruments and provides the site operator with tools to aid him in operating the site and insuring the production of high quality data. The site operations log is a part of the site data system. Quality assessment and flagging of data streams is done in the site data system. Data from the instruments and the log are forwarded to the experiment center and the data archive.

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The experiment center is situated at Pacific Northwest Laboratory in Richland, WA. Its primary task is providing the ARM science team with the measurements needed to perform their research. These measurements incorporate data from the site as well as from other sources of data such as satellite data. The experiment center carries out higher levels of data quality assessment on the data received from the site data system.

The ARM data archive is the long term repository of CART data. It will provide data retrospectively to the ARM science team and the general scientific community.

### 3. PURPOSE OF THE SITE OPERATIONS LOG

The site operations log (the "log") captures information about changes in status of objects associated with the operation of the site. These objects include the site environment, the instruments located at the site, the site data system, the data streams generated by the site data system and the site personnel. The log is an electronic analog to a logbook or lab notebook, recording information about the actual data ingested from the instruments, i.e. "metadata".

The log serves both as a tool in the operation of the site and a source of information for the analysis of the data collected at the site.

### 4. CONTENTS OF THE SITE OPERATIONS LOG

A facilitated design session was held to determine what information should be captured in the log. Those involved in the design session included representatives of the various types of users of the log as well as members of the CART data management team. The types of information which were determined to be needed were structured into classes of information about the site in general, the instruments located at the site, the data streams generated by the site data system, and the facilities that make up the site.

Information about the site as a whole was further subdivided into information about things such as meteorological conditions at the site, the site data system, personnel and staffing, surface conditions and environmental, safety and health warnings.

Information about the instruments was subdivided into categories such as alarms, changes in location, changes in mode or configuration and status forecasts.

### 5. FUNCTIONALITY OF THE PROTOTYPE IMPLEMENTATION OF THE LOG

The prototype implementation of the log was designed to satisfy the following requirements.

- Entries should all be of the form:
  - date-time stamp
  - source of entry
  - subject of entry
  - contents of entry.
- Entries may be generated automatically by computers which are part of the site data system or manually by personnel operating the site.
- Entries from the log are to be forwarded to the ARM archive and experiment center at regular intervals.

- An event-driven continuous stream of entries in the log should be available for *ad hoc* users.

## 6. METHOD OF IMPLEMENTATION

In order to have something up and running quickly, it was decided to take advantage of the UNIX™ mail utility to generate automatic entries. A c-callable version of sendmail is provided to generate electronic mail messages with the added capability of supplying a date-time stamp and originators in the call different from the environment in which the electronic message is being generated. This allows messages to reflect the true originator and time of origin of the information in the message. Automatically executed scripts do the necessary file manipulations and cleanups.

The software is based on a user account, assumed to be on a Sun SPARC™ workstation; that user receives electronic mail messages intended for the log. Each of the electronic mail messages is reformatted for transfer to an Empress™ data base and also forwarded via normal electronic mail forwarding mechanisms, without manual intervention.

The Empress™ data base provides a graphical user interface (GUI) for manual log entries. These entries are also converted to electronic mail messages.

As entries are made to the log, they are displayed on the operator's workstation. A capability also exists to send entries to a printer at predefined time intervals. Files containing entries for each day are kept in mail "mbox" form so that they can be examined using either the UNIX™ mail utility or the Sun™ DeskSet™ Environment for OpenWindows™ Mail Tool.

The flow of entries into the log is shown in Figure 1.

## 7. EXPERIENCE WITH THE PROTOTYPE LOG

### 7.1 IMPLEMENTATION

The original implementation was done in approximately three person months. Changes since then have occupied approximately another two person months. The most difficult part of the implementation has been interfacing to the other parts of the site data system which were designed and implemented by other members of the CART Data Management Team.

### 7.2 USE

Training users of the log has been straightforward since initial use has been based on use of the mail facilities with which most of them were already familiar.

## 8. FUTURE PLANS

As the operator becomes more experienced in operating the site, it is expected that there will be the need for greater structure than is currently provided in the manual entries.

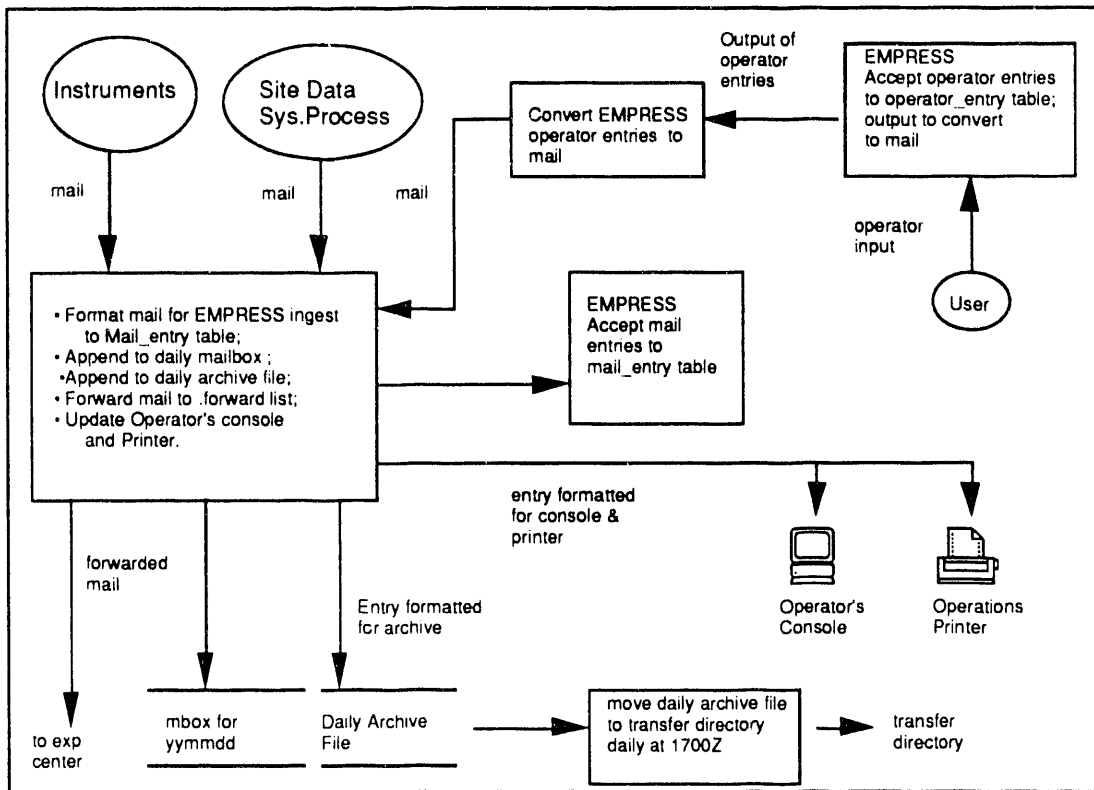


Figure 1. Flow of entries into the Site Operations Log

As the needs of the various users of the information of the log become clearer, it is planned to provide special purpose reports of selected entries in the log for them. Such requests can be divided by temporal requirements as follows:

Event driven: When information about specified objects are entered into the log, a report of the entry will be generated.

As requested: The user will request certain information from the log - e.g. the past performance of an instrument.

At regular intervals: A report will be generated at pre-specified intervals. An example would be to provide information to a daily operations plan.

#### ACKNOWLEDGMENTS

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