



U.S. Department of Energy
Office of Inspector General
Office of Audits and Inspections

AUDIT REPORT

Atmospheric Radiation Measurement
Climate Research Facility

OAI-M-16-10

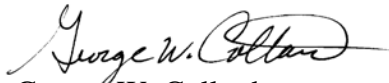
May 2016



Department of Energy
Washington, DC 20585

May 16, 2016

MEMORANDUM FOR THE DIRECTOR, OFFICE OF SCIENCE

FROM: 
George W. Collard
Deputy Inspector General
for Audits and Inspections
Office of Inspector General

SUBJECT: INFORMATION: Audit Report on the “Atmospheric Radiation
Measurement Climate Research Facility”

BACKGROUND

The Department of Energy’s Office of Science (Science) supports the Atmospheric Radiation Measurement (ARM) Climate Research Facility. The ARM Facility was established in 1989 to provide strategically located observatories for studying the Earth’s climate. It supports the Department’s climate mission by providing comprehensive sets of observations in diverse climatic regimes and the associated data infrastructure to support the research community. The ARM Facility was designated as a scientific user facility in 2003 and includes a network of long-term, fixed sites; mobile observation facilities that are typically deployed for about a year at a time; and an aerial facility that augments these ground-based observation sites.

The raw data collected through routine operations and scientific field experiments are stored in and distributed through the ARM Data Archive (Archive). Two types of data are collected for the Archive, internal data that is collected from program instruments at the sites and external data collected from users who bring their own instruments to perform projects, called field campaigns, at the sites. Nine national laboratories manage aspects of the ARM Facility, including Oak Ridge National Laboratory (ORNL), which manages the Archive, and Argonne National Laboratory (Argonne), which manages the Southern Great Plains site in Oklahoma. The Pacific Northwest National Laboratory (PNNL) provides overall technical direction and manages the ARM Aerial Facility, procures capital equipment used at all ARM Facility sites, and processes final technical reports generated by the program. The ARM Facility’s budget for fiscal year 2015 was about \$67 million. Given the importance of climate research, we initiated this audit to determine whether Science effectively managed the ARM Facility.

RESULTS OF AUDIT

Nothing material came to our attention to indicate that Science’s management of the ARM Facility was not generally effective. However, we determined that the ARM Facility did not always obtain climate data sets from external users of its sites for inclusion in the Archive.

Moreover, final technical reports of the external projects were not always obtained and, when reports were acquired, they were not always shared with other researchers and the public through the Department’s repository at the Office of Scientific and Technical Information (OSTI). We also found that the ARM Facility had not fully addressed external recommendations to establish an off-site backup of the Archive.

On a positive note, we found that the ARM Facility project proposals were selected based on the recommendations of review panels. In addition, we did not find any questioned costs during our review of fiscal year 2014 costs incurred for the operation of the Southern Great Plains site.

Data and Reports

The ARM Facility had not obtained all of the raw data sets and final technical reports from the external users of its sites. ARM Field Campaign Guidelines require external users to submit data and final technical reports within 6 months of the completion of the field campaign. Moreover, Department Order 241.1B, *Scientific and Technical Information Management*, requires that final technical reports be submitted to the Department’s repository at OSTI.

As shown in the following table, there were 141 field campaigns by external users between October 2010 and May 2015 that had been completed for at least 6 months at the time of our review. Of these 141 field campaigns, the ARM Facility had not received data for 62 (44 percent). Similarly, the ARM Facility had not received 100 final technical reports (71 percent).

STATUS OF RAW DATA SETS AND FINAL TECHNICAL REPORTS FROM EXTERNAL USERS OF ARM FACILITY SITES OCTOBER 2010 THROUGH MAY 2015		
	Raw Data Sets	Final Technical Reports
Field Campaigns Completed for 6 Months	141	141
Raw Data Sets/Reports Received	79	41
Raw Data Sets/Reports Not Received	62	100
Percentages Not Received	44%	71%

The majority of the data and final reports that had not been received were well past the submission deadline of 6 months. Specifically, the ARM Facility had been waiting more than a year for 51 of the 62 raw-data sets and 87 of the 100 final technical reports. Furthermore, we found that only 6 of the 41 final technical reports received by the ARM Facility were sent to OSTI to be shared with other researchers and the public as required by Department policy. While most of the reports that were not sent were under program review, five finalized reports available on the ARM Facility's Web site had not been sent to OSTI.

We concluded that the ARM Facility’s policy and procedures did not go far enough to secure data and final reports from external users. For example, the ARM Facility did not require external users to sign formal user agreements detailing the requirements to provide data and final reports. If data and final reports were not received within 6 months, the ARM Science liaison’s procedure was to ask the user three times over the next 6 months to provide them. We were informed by an ARM official that after a year, the liaison stopped asking. As pointed out by

ARM Facility officials, there were no negative consequences for not submitting data or final reports. Delinquent users were not required to pay for using ARM Facility sites nor were they denied future access to the sites.

Furthermore, although the ARM Facility had a procedure to send final reports to OSTI, personnel did not always follow the procedure. According to an ARM Facility official, the position responsible for transmitting reports to OSTI had been vacant for several months and, prior to that time, an oversight by the ARM Facility's Communications Group had resulted in only documents generated by PNNL being sent to OSTI. ARM Facility officials stated that they were working to ensure that the procedure was fully implemented in the future. The Government Accountability Office (GAO) expressed the importance of sharing climate data in its report *Climate Change Research – Agencies Have Data-Sharing Policies but Could Do More to Enhance the Availability of Data from Federally Funded Research* (GAO-07-1172, September 2007). The audit noted that, while Federal agencies (including the Department) had taken steps to foster data sharing, they had not routinely monitored whether researchers made their data available.

Data Archive Backup

The ARM Facility had not fully addressed external recommendations related to the establishment of an off-site backup of the Archive. The Archive at ORNL stored climate data dating back to 1992. According to external peer reviews of the ARM Facility, this data could not be reproduced if it was lost or destroyed. At the time of our review, the only complete backup of the Archive was located at ORNL. Thus, reviewers have recommended that the ARM Facility establish an off-site backup of the Archive to ensure that the data would not be lost in the case of a catastrophic event at ORNL. The most recent triennial review of the ARM Facility in 2014 focused on establishing an off-site backup of the Archive. It recommended that the ARM Facility evaluate and implement an automated procedure for backing up data within a group of independently operated database systems connected to share and exchange information, considering both existing and future needs. In response, the ARM Facility selected Argonne as the location for the off-site backup and began creating and shipping copies of data files on tape to Argonne on a monthly basis. Archive officials expected it to take about 6 months to complete a full off-site backup of the historical data. Thereafter, the Archive would make monthly shipments of current data.

Based on our review, however, the process selected for backing up the Archive did not fully address the recommendation of the external review. For example, the process was not automated, as it required creating backup tapes that must be manually packaged and then shipped to Argonne monthly. The decision to ship backup tapes also added the risk of the tapes being lost or damaged during transit. In addition, the backup process did not connect the off-site backup to the Archive. Under the current plan, Argonne will store the received backup tapes in a vault. If needed after an emergency, the backup tapes would be packaged and reshipped to ORNL. Furthermore, Archive officials expected the volume of climate data to increase exponentially in the future. While the tape backup process could be scaled to accommodate larger amounts of data, the ARM Facility manager acknowledged that the current process may not be the most efficient way of backing up the Archive in the future.

Our review of documents and discussions with ARM Facility management determined that their focus was the short-term concern of creating an off-site backup, rather than the future needs of the program. They did not fully consider the alternatives to creating and mailing tape backups, such as automating the backups through interconnected databases. During our discussions with ARM Facility officials, we learned that the Department's Energy Sciences Network (ESnet) system is already used to exchange data between ARM Facility sites, Argonne, and ORNL. The ESnet system is funded by Science and managed by Lawrence Berkeley National Laboratory to service the entire national laboratory system, its supercomputing facilities, and its major scientific instruments. Using this system to transmit backup copies of the processed data to Argonne would minimize the delays in creating backup tapes, as well as the risk of loss associated with transporting the tapes. Although it could not provide any supporting documentation, management told us it had considered the use of ESnet; however, preliminary findings showed that Argonne did not have sufficient storage capacity. Management informed us it had recently learned that Argonne would be getting additional storage capacity in 2017 and, at that time, management would re-evaluate upgrading the current tape-based offsite strategy to a file server based backup using ESnet data transfer methods.

Impact

Failure to obtain data and final technical reports from the external users could hinder the achievement of the ARM Facility mission to improve climate and earth system research modeling by providing timely data to the climate research community. In its *Fiscal Year 2016 Congressional Budget Request*, the Department highlighted that data from the Archive contributed to improving the resolution, sophistication, and certainty of climate projections. Furthermore, the sharing of research results within the scientific community is one of the underlying tenets of Science's policy not to charge for its user facilities. As we stated in our report on *The Department's Management of Scientific User Facilities* (OAS-L-14-02, February 2014), failure to ensure public dissemination of all results could lead to duplicative or unproductive research projects that ultimately prevent these valuable resources from being used more productively.

Furthermore, the lack of a complete off-site backup of the Archive could lead to the loss of critical and irreplaceable climate observations should a catastrophic event happen at ORNL. Although ARM Facility sites have the capability to retain their most recent data and these capabilities are being upgraded, we noted that the current plan requiring monthly shipments of backup tapes from ORNL to Argonne ensures the remote off-site backup will always be incomplete as data from the most recent month will not have been archived offsite.

RECOMMENDATIONS

To address the issues noted in this report, we recommend that the Director of the Office of Science, ensure that the Atmospheric Radiation Measurement Climate Research Facility Program Manager:

1. Develops and implements procedures to ensure that data and final technical reports are received from external users of ARM Facility sites;

2. Follows its policy to transmit all final technical reports received from external users to OSTI; and
3. Reassesses its strategy for off-site backup of the Archive to ensure it fully addresses the peer review recommendations and meets the ARM Facility's future needs.

MANAGEMENT RESPONSE

Management concurred with the report's recommendations and indicated that it had corrected or planned corrective actions to address the identified issues. Management stated that, based on our initial findings, the ARM Facility Program Manager updated procedures to ensure that data and final technical reports are received from external users of ARM Facility sites. The ARM Program Manager will also receive quarterly updates on the status of reports received, finalized, and submitted to OSTI. Finally, management stated that the ARM Facility will conduct an analysis of the options for the off-site backup of the Archive, including reviewing the use of ESnet to develop a networked backup. The resulting report will consider efficiency, cost, risk of losing data, ARM Facility's future data needs, and the peer review recommendations.

Management's formal comments are included in Attachment 3.

AUDITOR COMMENTS

We consider management's comments and planned corrective actions to be responsive to our findings and recommendations.

Attachments

cc: Deputy Secretary
Under Secretary for Science and Energy
Chief of Staff

OBJECTIVE, SCOPE, AND METHODOLOGY

OBJECTIVE

The objective of this audit was to determine whether the Office of Science effectively managed its Atmospheric Radiation Measurement (ARM) Climate Research Facility.

SCOPE

We conducted the audit from April 2015 through May 2016 at the Department of Energy's Office of Science in Germantown, Maryland; Argonne National Laboratory in Argonne, Illinois; the ARM Data Archive (Archive), located at Oak Ridge National Laboratory in Oak Ridge, Tennessee; and the ARM Facility's Southern Great Plains site in Lamont, Oklahoma. The scope of the audit covered the operation of the ARM Facility for fiscal years (FY) 2011 through 2015. We conducted this audit under Office of Inspector General project number A15CH030.

METHODOLOGY

To accomplish the audit objective, we:

- Reviewed applicable laws, regulations, and Department policies related to the ARM Facility;
- Held discussions with key Department, laboratory, and contractor personnel;
- Conducted site visits to Argonne National Laboratory, the Archive at Oak Ridge National Laboratory, and the Southern Great Plains site;
- Reviewed field campaigns active from October 2010 through May 2015 to determine whether the ARM Facility received the raw-data sets and final technical reports that were due; and
- Selected and reviewed judgmental samples of 50 property items located at the Southern Great Plains site, 45 financial transactions for costs reimbursed for the operation of the Southern Great Plains site in FY 2014, and 11 project proposals submitted to the ARM Facility in FY 2014 (because these samples were not statistical in nature, we could not project the results of our analysis to the population).

We conducted this performance audit in accordance with generally accepted Government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objective. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objective. Accordingly, we assessed significant internal controls and compliance with laws and regulations necessary to satisfy the audit objective. In particular, we assessed the implementation of the *GPRA Modernization Act of 2010* and found that Science had not established performance measures for the ARM Facility.

Because our review was limited, it would not necessarily have disclosed all internal control deficiencies that may have existed at the time of our audit. We relied on computer-processed data to achieve our audit objectives. Accordingly, we conducted an assessment of the data by comparing it to source documents and determined the data was reliable for our purposes.

Management waived an exit conference on April 11, 2016.

RELATED REPORTS

Office of Inspector General

- Audit Report on [*The Department's Management of Scientific User Facilities*](#) (OAS-L-14-02, February 2014). The audit found that Oak Ridge National Laboratory and Brookhaven National Laboratory had not always publicly disseminated research results for nonproprietary research projects at Department of Energy user facilities. Both laboratories had user agreements in place that required all nonproprietary research projects to report results, regardless of the outcome. However, neither laboratory enforced the user agreements nor had a process for tracking the results of completed or terminated research projects to ultimate public dissemination. As a result, the public and the scientific community may have been deprived of valuable scientific information derived from fundamental research performed at user facilities.

Government Accountability Office

- Report on [*Climate Change Research - Agencies Have Data-Sharing Policies but Could Do More to Enhance the Availability of Data from Federally Funded Research*](#) (GAO-07-1172, September 2007). This report identified concerns with data-sharing policies at four Federal agencies, including those of the Department of Energy. The report stated that, while these agencies had taken steps to foster data sharing, they had not routinely monitored whether researchers made their data available, and the agencies did not fully address key obstacles and disincentives to data sharing. Because the agencies did not monitor data sharing, they lacked evidence on the extent to which researchers were making data available to others. Government Accountability Office recommended the agencies develop mechanisms to be systematically notified when data was archived, so that agency officials have current information about the extent of data availability in order to adjust data-sharing policies over time to best meet the needs of researchers and the communities that use their data.


MANAGEMENT COMMENTS



Department of Energy
Office of Science
Washington, DC 20585

APR 07 2016

MEMORANDUM FOR GEORGE W. COLLARD
DEPUTY INSPECTOR GENERAL
FOR AUDITS AND INSPECTIONS
OFFICE OF INSPECTOR GENERAL

FROM: PATRICIA M. DEHMER 
DEPUTY DIRECTOR
FOR SCIENCE PROGRAMS
OFFICE OF SCIENCE

SUBJECT: Response to Inspector General's Draft Report, "Atmospheric
Radiation Measurement Climate Research Facility"

Thank you for the opportunity to review and comment on the subject draft report. The Office of Science (SC) response to the recommendations follows:

Recommendation 1: Ensure that the Atmospheric Radiation Measurement Climate Research Facility Program Manager develops and implements procedures to ensure that data and final technical reports are received from external users of ARM Facility sites.

Management Response: Concur

SC is committed to sharing of research data and results. ARM has put an emphasis on obtaining overdue reports/data from external users over the past several months and has received 32 of the missing data sets and 45 of the missing reports discussed in the draft report.

Action Plan: Based on the initial findings during the Inspector General audit, ARM has updated its procedures so that: 1) the requirement for data and reports to be submitted within 6 months of the end of the project is clear to the Principal Investigator (PI) when the project is accepted; 2) PIs with missing data or reports from campaigns that ended in 2012 or later will be asked to submit these before any new projects will be reviewed by ARM; 3) reminders on due dates for data/reports are sent to PIs immediately after their campaigns end, one month before the deadline, and at the deadline; 4) if data/reports are not provided by 2 weeks after the deadline, the ARM Program Managers will be immediately contacted for further action; and 5) ARM will provide a quarterly update to the ARM Program Manager on status of data and reports received to ensure the new procedures are being followed.

Estimated Completion Date: Completed

Recommendation 2: Ensure that the Atmospheric Radiation Measurement Climate Research Facility Program Manager follows its policy to transmit all final technical reports received from external users to OSTI.

Management Response: Concur

SC agrees that final technical reports from ARM campaigns should be submitted to OSTI. Over the last several months ARM has put an emphasis on this policy and 34 campaign reports were processed and sent to OSTI by ARM communications staff between December 2015 and March 2016.

Action Plan: To ensure that ARM follows its policy that all final technical reports received from external users are transmitted to OSTI, ARM will provide a quarterly update to the ARM Program Manager on the status of reports received, finalized and submitted to OSTI. Additionally, ARM will streamline the technical report process by simplifying the required information in the final report for small (total costs < \$100k) campaigns to reduce time and effort of ARM staff for technical editing and/or formatting.

Estimated Completion Date: September 30, 2016

Recommendation 3: Ensure that the Atmospheric Radiation Measurement Climate Research Facility Program Manager reassesses its strategy for off-site backup of the Archive to ensure it fully addresses the peer review recommendations and meets the ARM Facility's future needs.

Management Response: Concur

ARM's existing backup strategy (which is a combination of an onsite tape backup at ORNL, off-site tape backup at ANL, and data storage at the ARM measurement sites that backs up the most recently collected data) meets the requirement of ensuring that ARM data is not lost. However, SC acknowledges that in designing this strategy, ARM did not fully consider network options for the off-site backup as recommended in the most recent triennial review.

Action Plan: ARM will conduct an analysis of options for off-site backup, including reviewing the use of ESnet to develop a networked backup, and will provide a written report on available options to the ARM Program Manager. The report will consider efficiency, cost, risk of losing data, ARM's future data needs, and the peer review recommendations.

Estimated Completion Date: December 30, 2016

If you have any questions on these comments, please contact Sally McFarlane at 301-903-0943.

FEEDBACK

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