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## Precipitation Monitoring at Yucca Mountain

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University and Community College System of Nevada (UCCSN)  
~~Implementing Procedure (IP)~~ 2-11/04  
Scientific Investigation Plan

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[Redacted] 23 Jan 04  
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Technical Task Representative, Drew Coleman Approval Date

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Project Director, Donald Baepfer Approval Date

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QA Manager, Amy Smieciniski Approval Date

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**REVISION HISTORY**

<b>Revision Number</b>	<b>Effective Date</b>	<b>Description and Reason for Change</b>
0	02/20/04	Initial Issue

## **1.0 SCOPE, OBJECTIVES AND SUBTASKS**

**Scope and Objectives** – This work will be conducted under Task ORD-FY04-007, “Precipitation Monitoring at Yucca Mountain”. The objective of this task is to measure, with known accuracy, the accumulation and timing of precipitation around Yucca Mountain using tipping bucket rain gauges. The data are used as part of the overall work supporting the net infiltration modeling Analysis Model Report, *Simulation of Net Infiltration for Modern and Potential Future Climates*, and the Performance Confirmation Plan. This work is subject to UCCSN QA program requirements. This SIP presents an independent confirmatory study supporting previously gathered information.

The Harry Reid Center (HRC) will continue operation of the Yucca Mountain Precipitation Monitoring network, including data collection, data submittal, equipment maintenance and calibration. Of the 17 existing rain gauge stations, 14 are located in Area 25 on the Nevada Test Site; the remaining 3 stations are located on BLM-owned land north of Yucca Mountain in the Crater Flats area.

**Task List** - Primary activities involved in task ORD-FY04-007, “Precipitation Monitoring at Yucca Mountain” include:

- Conducting calibrations and operational checks of dataloggers and precipitation gauges, as required for qualified data;
- Ensuring equipment in the field through regular inspection and preventative maintenance;
- Maintain appropriate records to document work being performed;
- Collect and submit final data to the Technical Data Management System (TDMS) via Technical Data Archive (TDA);
- Submit final records to the Records Processing Center (RPC), as required.

## **2.0 APPROACH**

The precipitation gauge network is designed to provide spatial coverage of the Yucca Mountain immediate area and to capture specific rainfall events in relation to the areas of greatest expected natural infiltration. The gauge network was established following the U.S. Environmental Protection Agency (EPA) 1995 “Onsite Program Guidance for Regulatory Modeling Applications and Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV, Meteorological Measurements.” (TIC# 210292) Gauges were installed in accordance with approved technical procedure YMP-USGS-HP-180.

Data will be retrieved from each station via laptop computer or compatible handheld device at least quarterly; more frequent collection intervals are recommended to allow for regular site inspection. Data will be managed in accordance with *QAP 3.1, “Control of Electronic Data.”* Data shall be edited and technically reviewed then submitted to UCCSN/YMP Technical Data Archive and UCCSN Records. All

records will be submitted to the Records Processing Center at the end of the task. Data files will be visually checked each time files are transferred to ensure integrity. Specific information regarding data downloads and manipulation will be documented in the associated scientific notebook or appropriate QA records. No data reductions beyond simple hand-reproducible calculations will be performed. Any reports generated as a result of this task will be written in accordance with *QAP-3.4, "Technical Reports"*. Equipment will be operated and calibrated in accordance with *QAP-12.0, "Control of Measuring and Test Equipment."* Dataloggers will be calibrated and documented according to manufacturer's range and specifications by a qualified supplier.

Quarterly operational checks will be performed and documented for precipitation gauges in the field to ensure continued operation within the established standards for accuracy.

### **3.0 STANDARDS**

The data shall meet the input requirements specified in the unsaturated zone (UZ) flow and transport models. As such, the specific operational standard for the tipping bucket gauges is a resolution of 0.01 inch (0.254 mm) and an accuracy of  $\pm 10\%$ . This is consistent with guidelines for meteorological monitoring.

Data are irrecoverable and cannot be reproduced through testing or experimentation. Functional compliance may be demonstrated by the programmatic review of gauge and datalogger calibration documentation.

No other standards are specified for this activity.

### **4.0 IMPLEMENTING PROCEDURES/ DOCUMENTS**

All work will be performed in accordance with the implementing procedure, IPLV-032, *Precipitation Monitoring Using Tipping Bucket Rain Gauges*.

### **5.0 EQUIPMENT**

***Equipment Used*** - The precipitation monitoring network consists of 17 field stations, each consisting of a tipping bucket rain gauge, datalogger, enclosure, storage module, 12-volt battery, battery charger and solar panel. Tracking of individual serial numbers of equipment in use are referenced in the appropriate QA records or location as delineated by *QAP-12.0, "Control of Measuring and Testing Equipment"*.

Tipping bucket rain gauges are manufactured by Qualimetrics Inc., and are either model 6011-B (standard gauge) or 6041-B (propane heated gauge). Each gauge has a simple twin-bucket mechanism causing the buckets to tip back and forth, closing a switch, as rainfall is funneled in. The switch closure sends an electronic signal to a datalogger that records the data and time of the tip.

Dataloggers in use with this network are manufactured by Campbell Scientific Inc., model CR10 or CR10X. A storage module attached to the datalogger records a copy of all the data. Storage modules provide a backup copy of the data in the event of a problem with the datalogger.

**Calibration Requirements** – Rain gauge calibration checks will be performed by UCCSN personnel in accordance with IPLV-032, “*Precipitation Monitoring Using Tipping Bucket Rain Gauges*.” Campbell dataloggers will be calibrated every two years, +/- 1 month, by Campbell Scientific or other qualified supplier in accordance with QAP-12.0, “*Control of Measuring and Test Equipment*.” Campbell Scientific is currently on the Qualified Supplier List. Procurement will be obtained in accordance with QAP-7.0 “*Control of Quality Affecting Procurement and Receipt*”.

Personnel operating the rain gauges must have a knowledge of tipping-bucket precipitation gage and datalogger operation, along with programmatic controls. No other special controls, processes or skills are required other than those determined through the implementation of QAP-2.1 “*Qualification, Indoctrination and Training of Personnel*.”

**Protective Measures** - Datalogger units are stored in raised enclosures, protecting equipment from inclement weather. Ground level wiring is run through a length of PVC pipe to protect from small animals. Access to most stations is restricted due to their location in Area 25 of the Nevada Test Site. Four remaining stations in the Crater Flat are located on BLM owned land. Due to the remote location of the other stations in the Crater Flat area, tampering is not anticipated to be a problem, although it has occurred. In the event of a tampering incident, the integrity of the data is ensured by firstly, writing a backup copy to the storage module, and secondly, incorporating an identifier in the program that will indicate any programming changes.

## **6.0 HOLD POINTS/ DECISION POINTS**

**Hold Points** - There are no prerequisites or hold points associated with this task. Decision points associated with operational checks and any actions taken will be documented in the scientific notebook or other QA record.

**Environmental Conditions** – Operational checks of rain gauges should not be undertaken during periods of rain or snowfall. During very windy conditions, operational checks should be performed with gauge cover in place.

## **7.0 RECORDS AND DELIVERABLES**

All QA records will be handled in accordance with QAP-17.0. Records designated as QA records in the UCCSN QAPs and IPs listed include but are not limited to:

- Hard copies and/or electronic media containing reduced concentration data including calibrations and QC results;
- Calibration and checks for each gauge and datalogger used to collect data;

- Data review check sheets;
- Maintenance records;
- Quality-affecting reports.

Deliverables are submitted to DOE in accordance with the cooperative agreement.

- Data packages including all supporting information to be submitted in accordance with *QAP-3.6, "Submittal of Data."*;
- Quality-affecting reports;
- Non-Q progress reports.

## **8.0 VERIFICATIONS AND REVIEWS**

Internal verification of all data will be performed to check compliance to the procedures and to verify the accuracy of data reproduction. Internal technical reviews will be performed and documented on the data and scientific notebook generated in this task. Any data generated or submitted without full internal verification will be labeled as "preliminary data". Pertinent QA records or sections of the scientific notebooks will be reviewed in accordance with *QAP-3.0* prior to submission of data. Other QA records may include maintenance records, rain gauge worksheets, or others as deemed necessary.

## **9.0 SOFTWARE**

No software will be developed in this study. Software packages used in this study include:

- Microsoft Excel spreadsheet software used for data presentation and graphical representation;
- Instrumentation and interface software associated with the Campbell dataloggers;
- Copies of datalogger programs (instruction sets) used in the collection of this data will be submitted as part of the data package submittal.

## **10.0 INTERFACE CONTROLS**

### ***External Interfaces –***

DOE Technical Task Representative: Drew Coleman

### ***Internal Interfaces:***

PI: Klaus Stetzenbach

Quality Control Specialist: Ingrid Wengatz

Investigator: Amanda Brandt

Technicians: As needed

## **11.0 OTHER REQUIREMENTS**

All applicable QA controls will be applied.

***Accuracy, Precision, and Representativeness*** - Regular calibration and operational checks ensure the gauges are accurate within  $\pm 10\%$ . This is the standard accepted level for meteorological measurements established by the EPA. In addition to verification provided by operational checks, data collected at three stations (407, 412 and 419) will be compared to adjacent storage gauges as an indication of precision. Data collected are intended to represent specific rainfall events in relation to the areas of greatest expected natural infiltration in the immediate area of Yucca.

***Potential Sources of Error and Uncertainty*** – The tipping bucket rain gauge is limited to the measurement of precipitation accumulations greater than or equal to the resolution of the gauge (0.01 inch). Events yielding very small amounts of precipitation may not be detected. This amount is not significant enough to affect the accuracy level of these gauges.

During the occurrence of frozen precipitation, an accurate measurement of precipitation rate substantially decreases.

***Schedules*** – Data collection and gauge operational checks will be conducted quarterly, supplemented with annual gauge checks and station maintenance. Dataloggers will be calibrated every two years. Data and supporting information will be submitted annually.

***Procurement and Subcontracts*** – No subcontracts will be used for this task. Procurements will be required for purchase of additional gauges and datalogger calibration services, and will be generated in accordance with QAP-7.0 “*Control of Quality Affecting Procurement and Receipt.*”

### **References**

QAP-2.1 “*Qualification, Indoctrination and Training of Personnel.*”

QAP-3.0, “*Scientific Investigation Control*”

QAP-3.1, “*Control of Electronic Data*”

QAP-3.4, “*Technical Reports*”

QAP-3.6, “*Submittal of Data*”

QAP-7.0, “*Control of Quality-Affecting Procurement and Receipt*”

QAP-12.0, “*Control of Measuring and Test Equipment.*”

QAP-17.0, “*Quality Assurance Records*”

*IPLV-032, Precipitation Monitoring Using Tipping Bucket Rain Gauges*