Amchitka Independent Science Plan: Radiation Anti-Cross Contamination Quality Control and Assurance Plan

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I. Background and Logic for a Continuous Anti-Cross Contamination Procedure, 6/8/04- Burger Implementation Plan, 8/17/04- Volz Appendix to Anti-Cross Contamination Methods

The prevention of cross-contamination of biological samples that were processed on wet or dry benches in the hold of the Ocean Explorer and in the Burger preparation laboratory at Rutgers University was a primary concern of the CRESP Amchitka Independent Science Plan, Biological Implementation Plan and a major quality assurance factor. If samples were encountered that had a particularly high level of radioactive contamination, they create the potential to mix with other samples. Shipboard and laboratory procedures to assure that radiation from one sample did not contaminate another sample were outlined in detail in the CRESP Amchitka Independent Science Plan, Biological Implementation Plan and included the cleaning of instruments, tabletops and using new sheets of contractor's plastic to process each sample composite.

It is essential to the validity of the study that remnants of one sample do not mix with other samples. Mixing could produce results that indicate that samples with little or no actual activity have a higher activity or dilute the activity of a sample with a high activity that was processed after a sample with lower activity. The established anti-cross contamination procedures were overseen by Chief Biological Scientist Joanna Burger, PhD and were meticulously followed both on board ship and in the laboratory.

To insure that radiological cross contamination of samples did not occur aboard the Ocean Explorer or in the laboratory, radiological measurement procedures were developed to:

- Determine if ambient radiation levels in processing areas were above background levels.
- Determine if laboratory tables installed by B&N Fisheries on the Ocean Explorer or existing benches in the Burger laboratory used for sample preparation contained preexisting radiation activity levels above background.
- Scan biological samples for activity prior to processing, compositing and packaging.
- Insure that laboratory surfaces were free of surface contamination following processing of samples and cleaning over the course of both the expedition and laboratory phases.

Personnel hazards from handling possibly contaminated samples

were expected to be minimal over the course of the expedition. Expedition radiation dosimetry results add weight to this pre-trip hypothesis. The procedures outlined above are also a secondary check on radiation exposure to both expedition and laboratory personnel involved in handling specimens.

II. Shipboard Anti-Cross Contamination Methods, 6/8/04- Burger Implementation Plan, 8/17/04- Volz Appendix to Anti-Cross Contamination Methods

Biological samples brought on board the Ocean Explorer were scanned on deck with a Ludlum Model 44-10 NaI gamma scintillation probe and in the hold with a Ludlum Model 44-9 Alpha, Beta and Gamma Detector. The activity of all samples was noted on the Chain of Custody forms that accompanied all samples through packaging and storage on the Ocean Explorer and cooler packing and ultimate transport to Rutgers University. Copies of all COC forms showing sample activity are on file with the expedition's data manager Vikram Vyas. Prior to biological sample processing, background ambient radiation levels in the Ocean Explorer's hold were taken using a Ludlum Model 44-10 NaI gamma scintillation probe and all working surfaces were scanned using a Ludlum Model 44-9 Alpha, Beta and Gamma Detector. The hold contained four wet laboratory stations and 2 dry stations, one used by the dive team for specimen identification and one for data entry. Laboratory tabletop scanning occurred continuously over the course of the expedition as new specimens were laid on the stainless steel or High Density Molecular Weight (HDMW) surfaces for processing. Additional surface scanning using the Ludlum 44-9 Detector was also done during composite processing and dissections at both stainless steel and HDMW laboratory tops and at processing stations covered with 25 mil contractors plastic.
As an additional precaution against cross-contamination, laboratory tabletops were wiped after cleaning, either between sample/composite preparations or at the beginning or end of a day, with 2 inch diameter filter paper discs supplied by Acme Distributors, Kingston, TN. These samples were immediately placed on the top sliding shelf of a Ludlum 2 inch disc source holder and read using the Ludlum Model 44-9 Detector. The filter paper discs were than archived in scintillation vials and marked according to the date and time taken and associated table number. Archived anti-cross contamination samples were sent to Vanderbilt University for corroboration analysis by liquid scintillation analysis (LSA) per shipment procedures outlined in section X. LSA has a much lower limit of detection than the handheld Ludlum Model 44-9 Detector

III. Quality Control Procedures to Prevent Cross-Contamination During Laboratory Preparation and Handling of Biological, Water and Sediment Samples for Radionuclide Analysis, Final Version November 2, 2004, C.D. Volz, Approved by CRESP

A. Introduction

Extensive monitoring measures, as well as practice measures, were employed on the Ocean Explorer to determine if surface contamination had occurred and could reasonably affect analysis outcomes. It is thus equally important to insure that cross-

contamination of laboratory tabletops or equipment does not occur in downstream sample preparation phases of the project and have procedures in place to be able to identify cross-contamination if it does occur as quickly as possible and document and rectify the problem.

B. Ambient Radiation Monitoring and Contamination Assessment

Ambient radiation monitoring will be performed in laboratories processing biological, sediment and water samples once before sample processing begins. This ambient monitoring will assure that there are no detectable preexisting sources of radioactivity in the laboratory. Readings of at least 5 minutes each will be taken in the vicinity of each bench site where samples will be processed and sinks where equipment will be washed. Readings will also be taken in rooms with open access to the laboratory and in the hallway leading into the laboratory.

On the same day ambient laboratory monitoring is performed, 3 randomly selected areas of the laboratory building will undergo ambient monitoring (one reading should be taken on the ground floor or in the basement if occupied). Additionally ambient radiation monitoring will be performed in 3 campus buildings and in 3 outdoor areas chosen randomly within one-quarter mile of the laboratory.

Ambient outdoor, indoor in other buildings, indoor in more remote areas of the laboratory building and within the laboratory readings will be compared to determine if readings in the preparation area are above background or in some way indicate a radiation source, which should be investigated before processing begins. This procedure will be performed <u>once</u> before the processing of samples begins and need not be performed again unless there is direct evidence of laboratory contamination by a sample. This situation is only a remote possibility since all samples brought to a preparation laboratory were scanned on the Ocean Explorer using the Ludlum 44-9 Alpha, Beta, Gamma Pancake and Gamma Scintillation Probe. It may be possible that homogenization of tissue and especially bone grinding will release Alpha emitters that are presently inside the tissue and bone and would not have been picked up in the “on boat” screening procedure.

In addition to ambient monitoring, a radiation safety officer of the University will be interviewed relative to other radionuclides used in the laboratory building and their procedures to isolate these sources. University radiation health officials may perform additional sampling in laboratories processing Amchitka samples. These results should be kept by the processing laboratory and Anti Cross-Contamination procedures followed if a source is found.

C. End of Day Procedures, Cleaning and Wipe Sampling and Analysis of Wipe Samples

Sample preparation surfaces and equipment will be cleaned (cleaning to include a detergent/water rinse, solvent rinse and de-ionized water rinse) following preparation

of samples, which are to be analyzed separately or between composite preparation and at the conclusion of each day.

Following “end of day cleaning”, all equipment and surfaces used will be scanned using the Ludlum Model 44-9 Alpha, Beta and Gamma Detector. This scanning will be done as close to the surface as possible. Any reading above the MDA of 237 cpm (see below MDA formula) on detector 1 will require re-cleaning and re-scanning of the surface or equipment.

Calculations for MDA for Cs 137, gamma

$$MDA = 2.71 + 4.66 \sqrt{(R_b)(2t)} / (2t)(\varepsilon)(A/100)$$

Where R_b= Typical background (50cpm).

t = Time Constant (minutes), the time constant of the instrument is 30 seconds up to 1100 cpm.

ε = Efficiency of 44-9 probe (.001).

A = Active area of probe (15 cm^2).

MDA = 237,270 dpm/100cm^2

Upper Meter Reading for Cleaning = 237,270 dpm/cm^2 × .001 ≈ 237 cpm

Once the surface reads below 237 cpm as measured using the handheld Pancake Counter, laboratory tabletops will be wiped with 2 inch diameter filter paper discs supplied by Acme Distributors, Kingston, TN. These samples will immediately be placed on the top sliding shelf of a Ludlum 2 inch disc source holder (stainless steel) and read using the Ludlum Model 44-9 Detector. If any readings exceed 237 cpm the laboratory surface will be re-cleaned and re-sampled.

A log of the activity of these samples will be kept in the laboratory, it will include the day and time the reading was taken, the bench number or equipment identifier, the results of the test and the signature of the technician running the test.
An example of a sample identifier is 8/15-1600-1-SB
This refers to the sample being taken and read on the 15th of August at 4pm, the reading was taken on preparation surface 1 and the technician was Sean Burke.
This log will also be kept electronically on Excel spreadsheet in a form acceptable to the data manager.

D. Archiving of Wipe Samples/ Liquid Scintillation Analysis at Vanderbilt

After in laboratory reading, end of day wipe samples will be placed in scintillation vials and immediately capped. Each vial will be assigned a discrete number, starting with CC-1 and continuing through CC-X., this number will be entered in the corresponding field of the laboratory cross-contamination log and also in the Excel spreadsheet, so that sample results can be correlated with identifying information,

the project data manager will receive biweekly updates of this information. It is anticipated that 140 end of day wipe samples (2 per day times 20 days per month times 3.5 months) will be generated over the course of sample preparation. Additionally, 10% or approximately 14 blanks will be made in the preparation laboratory; these will be randomly assigned to the total list of numbers by the laboratory manager.

Batches of scintillation vials for analysis will be sent bi-weekly via federal express or other carrier that can provide tracking and 2nd day delivery. Samples will be counted within a 24 hour time period at the Vanderbilt laboratory. Samples with activity higher than expected background or indicating specific activity will be reported to the processing laboratory the next business day. In addition to Vanderbilt's internal tracking procedures an electronic copy of the results of the Liquid Scintillation Analysis will be forwarded to the preparation laboratory and the project data manager

IV. Chain of Custody and Shipping Procedures for Anti-Cross Contamination Wipe Samples, Final Version November 2, 2004, C.D. Volz, CRESP Approved

A. Introduction

The following procedures are a supplement to the **Quality Control Procedures to Prevent Cross-Contamination During Laboratory Preparation and Handling of Biological, Water and Sediment Samples for Radionuclide Analysis**, developed by D. Volz. The procedures contained in this document describe the Chain of Custody and shipment procedures to be followed by:

- D. Volz for shipment of wipe samples, contained in scintillation vials, to Vanderbilt University for liquid scintillation counting. These samples will be sent to Vanderbilt in one shipment and are wipe samples taken during the expedition, from preparation surfaces aboard the Ocean Explorer.
- J. Burger for bi-weekly shipment of wipe samples, contained in scintillation vials, to Vanderbilt University for liquid scintillation counting. These samples are "end of the day" samples and will be taken from each workstation used during that day.

B. Analysis Laboratory

All wipe samples will be analyzed at Vanderbilt University's, Department of Civil and Environmental Engineering .Samples should be sent to;

David Kossen, PhD
Department of Civil and Environmental Engineering
Vanderbilt University
1161 21st Avenue South
Nashville, TN 37232-2675

C. Chain of Custody Form

All wipe samples will be sent to Vanderbilt University will be accompanied by the Chain of Custody Form, shown as figure 1.

D. Chain of Custody Form Retention and Distribution

- D. Volz will retain the original Anti-Cross Contamination forms , for wipe samples taken on the Ocean Explorer and will generate new Chain of Custody forms, which will be sent forward with the scintillation vials to Vanderbilt. Dan V. will make 2 copies of the new Chain of Custody forms; he will keep 1 and send 1 to the data manager V. Vyas.
- J. Burger or a designated staff member will generate Chain of Custody forms, which will be sent forward with the scintillation vials to Vanderbilt. J. Burger will make two copies of the Chain of Custody forms, she will keep 1 and send one to the data manager V. Vyas.

E. Request for Analysis

All packages sent to Vanderbilt for analysis will contain a request that the vials/contents be analyzed by liquid scintillation counting.

F. Shipment of Wipe Sample Scintillation Vials

Wipe Sample Scintillation Vials will be shipped to Vanderbilt University via FedEx. The shipping process will involve the following steps for documentation of shipped samples and notification:

1. D. Volz and J. Burger or a designated person from her group will make a telephone call to a designated person at the receiving laboratory to inform them of the shipment and expected date of arrival.
2. On receipt of shipment, the receiving laboratory will send an electronic confirmation of arrival to the distribution list identified below. The confirmation must include formal acknowledgement that the receiver is in custody of the specimens listed in the COC forms. Missing or broken packages must be reported to CRESP PI and David Kosson at the earliest instance.
3. Vikram Vyas will transmit information from electronic confirmations to Yuri Mun for inclusion in the electronic tracking system developed for this project. All communications to Data Management must be addressed to Vikram Vyas.

Distribution lists:
For shipments from University of Pittsburgh or Rutgers to VU:

Shipping Address:	Email notification to
	Charles Powers
Dept of Civil and Environmental	David Kosson
Engineering	Vikram Vyas
Vanderbilt University	Michael Stabin
400 24th Street South	Joanna Burger
Nashville, TN 37235	Conrad Volz
	CC to Lisa Bliss
ATTENTION: Roseanne DeLapp	Mike Gochfeld
(615) 322-3189	

V. Quality Control and Data Validation, Final Version November 2, 2004, C.D. Volz, CRESP Approved

A. Each shipment of samples will include at least one blank for every 10 wipe samples. These blanks will receive wipe sample identification numbers in the same sequence as wipe samples taken on board the Ocean Explorer or in the Burger laboratory. Blanks will be inserted randomly into each shipment of samples. This way the identity of the blank will not be known to the analytical laboratory personnel.
B. After wipe samples contained in each shipment are checked against the accompanying Chain of Custody form by the VU laboratory manager, they may proceed to be analyzed.
C. After liquid scintillation counting, the wipe sample data will be reported to the laboratory manager for internal validation, to note any irregularities (blanks out of tolerance, switched results, etc.) or cases in which a result of interest is close to detection limits and should be counted for a longer period. Internal validation includes:

    - Verification that the appropriate numbers of blanks (blind and internal controls) were included.
    - Verification that instrument background readings were in a normal range during the analyses.
    - Verification of equipment calibration and logs during the analyses.
    - Verification of sample identities.
    - Evaluation of data internal consistency, sample blank values.

VI. Reporting of Results, Final Version November 2, 2004, C.D. Volz, CRESP Approved

Upon completion of data validation and acceptance by M. Stabin, final wipe sample data for each batch will be sent via e-mail to Joanna Burger, Mike Gochfeld, Conrad Volz, Chuck Powers and to Vikram Vyas for entry into the project data base. As previously described in the Quality Control procedures the preparation laboratory will be notified of any result showing specific activity or activity significantly over background the next business day.

Figure 1, CHAIN OF CUSTODY FORM, ANTI-CROSS CONTAMINATION WIPE SAMPLES

Wipe Sample Number	Date Taken	Local Time	Table Number	Collected By:	Initial Screening By:	Wipe Activity cpm	Wipe Activity µR/hr	Stored By:	Shipped to VU By: /Date	Received at VU By: /Date	Analyzed at VU By: /Date