American Radiolabeled
Chemicals, Inc.

101 ARC Drive
Saint Louis, MO 63146 USA
Phone: 314-991-4545 or 800-331-6661
Fax: 314-991-4692 or 800-999-9925
Web: http://www.arc-inc.com
Email: arcinc@arc-inc.com

2 August 2013

U. S. Nuclear Regulatory Commission
Region III
2443 Warrenville Road, Suite 210
Lisle, IL 60532-4352

Attention: Kevin Null

Reference: License No: 24-21362-01

Subject: Reply to RFAI

This letter is in response to your Request For Additional Information (RFAI) with respect to our request for renewal of our license.

Sincerely,

Surendra K. Gupta, PhD
President
American Radiolabeled Chemicals

American Radiolabeled Chemicals, Inc (ARC) is pleased to present the following information in response to your Request For Additional Information (RFAI) dated 9 July 2013.

In order to preserve clarity, each question will be repeated before each answer.

SECTION A **CNWRA Recommendations**

1. ***Identify when you started tracking the four sampling stations located on building 400 separately, and provide the assessments of public dose from each sampler since you instituted this change;***

   As can be seen from the data in Attachment 1, all four sampling stations were tracked from the beginning. The results of using the four separately can be seen in Attachment 2, a copy of the letter sent to Region III and to Document Control Desk

2. ***You did not address this issue. It was recommended that you conduct air sampling at the warehouse located south of ARC, and that the sampling be conducted each of the four seasons. In your response, you simply stated that ARC uses COMPLY which used 16 data points around the facility. Is one of those data points located at the warehouse?***

   The two stacks (Bldg 100/200 and Bldg 300) are sufficiently far apart that two instances of COMPLY are run, therefore the distances from each stack to the nearest receptor in each segment are measured the ware house in question is one of these buildings. Distances were measured on aerial photographs using clear plastic overlays defining each segment. If an air intake could be identified, the distance was measured to the intake. If no intake could be identified , then the closest portion of the building was used to determine the distance. The results are as follows:

   Building 100/200

Segment	Wind From	Distance (meters)
N	S	73.43
NNE	SSW	80.19
NE	SW	147.02
ENE	WSW	146.85

E	W	146.85
ESE	WNW	165.0
SE	NW	165.0
SSE	NNW	200.0
S	N	70.08
SSW	NNE	46.73
SW	NE	60.14
WSW	ENE	200.0
W	E	200.0
WNW	ESE	59.85
NW	SE	46.55
NNW	SSE	86.78

Building 300

Segment	Wind From	Distance (meters)
N	S	106.8
NNE	SSW	80.1
NE	SW	106.8
ENE	WSW	160.2
E	W	160.2
ESE	WNW	133.5
SE	NW	60.8
SSE	NNW	80.1
SSW	NNE	160.2
SW	NE	160.2

WSW	ENE	160.2
W	E	80.1
WNW	ESE	80.1
NW	SE	34.91
NNW	SSE	27.68

3. ***Describe the "production methods" that the chemists have implemented that address the recommendation that ARC modify its handing procedures or use additional, cost-effective engineered controls to reduce radionuclide emissions from its facilities to keep exposures ALARA. Please illustrate how and why these new/revised "production methods" have worked to reduce the calculated annual public dose, and commit to full implementation of these "production methods."***

   In Attachment 2, these methods are listed and the commitment made

   Attachment 3 shows the effect of these methods.

   Attachment 4 is a document given to the Deputy Administrator on her trip to ARC

SECTION B **Storage of Surface-Contaminated Objects (SCO)**

Please describe plans to address the storage capacity issues for SCO, as well as plans for shipment of SCO items for final disposal.

At present, the definition of SCO in the SOPs is too broad, This requires unnecessary storage of objects. ARCs intent is to define several classes of material such as Intermittent use material; instrument awaiting repair and contaminated equipment waiting installation. These classes would not require movement to the storage area.

Recent waste shipments included approximately 1900 pounds of SCO material.

Over the past months, all items of presently defined SCO have been moved to the designated storage area.

When the SeaLand container is returned, An additional shipment off DAW and SCOs will be made.

SECTION C **Building 300 Stack Blower**

1. ***Please submit a copy of the procedure that has been developed to address the inspectors' concerns about the potential impact on occupational radiation dose if the stack blower fails.***

The draft procedure is presented as attachment 5

2. Also, submit a timeline for following through on your plan to hire a contractor to directly measure the volume of air released from the building 300 stack per unit time.

Due to time and man power constraints no contractor has been identified as yet, ARC is planning on accomplishing this goal in the September time frame.

A. SECTION D **Status of Building 300 Annex**

Please confirm our understanding that building 300 annex is not currently being used to process and handle radioactive material. Since NRC approval of building 300 annex would be a significant undertaking, it would be preferable to conduct such a review as an action that would be separate from this application for license renewal.

Amendment 47, by making our letter of 1 Nov 2011 part of the license, has all ready approved use of RAM in the Annex. Such use is limited to analytical level amounts.

SECTION E **Radioactive Material**

1. ***You did not include a request for authorization for Fe-55 or Fe-59. Please confirm that you no longer need authorization for these two nuclides and submit evidence these both have been properly disposed of and that you do not possess these nuclides in any form.***

This was an error on our part, there should be no change to the amount, use or form of these nuclides

2. ***We are in receipt of ARC's revised decommissioning financial assurance (DFA). It has been processed in by our office as a separate action, and will be***

reviewed by our staff independently of your application for license renewal. Correspondence from us regarding your revised DFA independent of this renewal will be addressed to you under separate letter.

ARC will reply at that time.

SECTION F **Purpose For Which Licensed Material Will Be Used**

1. ***Confirm that license number 24-21362-02E (exempt distribution) is still active and that you need to retain authorization to possess material under 24-21362-02 incident to distribution of labeled compounds under the exempt distribution license.***

   License 24-21362-02E is still active and ARC needs to retain authorization to possess material under 24-21362-02 incident to distribution of labeled compounds under the exempt distribution license.

2. ***Provide an update and/or status on the authorization granted in item 9. A. and E., i.e., related to outdoor site construction and beautification activities.***

   ARC continues to maintain and beautify the property planting and / or removal of trees shrubs, plants, etc. therefore the authorization granted in item 9. A. and E., i.e., related to outdoor site construction and beautification activities. Is still needed

SECTION G **Individuals Responsible For Radiation Safety Program and Their Training and Experience**

1. ***For Class 1 workers under the section "All Other Radiation Workers", define what you mean by the statement that these workers may use radioactive aterial under "general supervision" of an authorized user.***

   "All Other Radiation Workers" are non-chemists, the authorized user must assign the task and be periodically informed of the progress of the task.

2. ***For Class 2 workers under the same section, please define what you mean when you say that these workers may use radioactive material only under "direct supervision" of a Class 1 worker.***

   The class 1 worker **must** be in the same laboratory as the class 2 worker and **should** be in line of sight.

3. ***For both Class 1 and 2 workers, a statement is made that both may use material "within their area of responsibility." Please define what the "area or responsibility" is for both.***

   Janitorial personnel may not perform chemical production work; maintenance personnel do not perform production; Shipping personnel do not perform maintenance

4. ***A process has been established whereby a Class 1 or 2 worker may receive a recommendation for a radiation worker upgrade if either has demonstrated good handling techniques with radioactive materials and has satisfactorily completed on-the-job training." Please describe criteria that will be used by an authorized user to determine when a Class 1 or 2 worker has met these expectations.***

   This up to the judgment of the individual's supervisor. No "set in stone" criteria are used. Criteria are obviously different for Chemists, lab techs, maint. personnel, shipping personnel, and janitorial personnel.

SECTION H **Training Program**

1. ***Describe in detail the "radiation safety indoctrination" that is given to new employees by the RSO.***

   New employee training is a one on one session with the deputy RSO, taking approximately 3 hours to complete. Training subjects range from the nature of radioactive material, contamination vs. radiation, proper PPE usage, entering and exiting the lab, common ways people may get contaminated, using GM meters, body surveys, liquid waste discharging, waste reduction, spill procedures, and general license requirements. There are 4 quizzes given and a hands on demonstration of how to enter the lab and properly remove PPE when leaving the lab. After all quizzes are passed and the PPE demonstration completed, a tour of the lab is given by the deputy RSO. The tour of the lab consists of showing the general layout, the differences between hot and cold trash cans, where to put non-aqueous waste if a chemist, and general job functions, for instance how to dispense liquid nitrogen, how to transfer RAM between buildings, how often to change gloves, and an introduction to fellow employees. For the first week a member of radiation safety helps them enter and exit the lab, to ensure that proper techniques are used and no bad habits are formed.

2. ***Describe in detail the "refresher training" that is given every year, and to whom the training is provided.***

   The refresher training is a 15 question quiz consisting of questions surrounding, liquid waste discharges, spill procedures, bioassay requirements, the nature of radioactive material, common methods of personal contamination, entering and exiting the lab, class 1 vs class 2 radiation workers, and annual dose limits. The training is provided to all radiation workers and is given during an all staff meeting and is open reference.

3. ***Provide examples of written exams that are given to evaluate the effectiveness of training.***

   The four exams given will be added as an attachment. See attachment 12, Entry Exams.

SECTION I **Facilities and Equipment**

1. ***For each building where radioactive material may be received, please describe (through the use of a diagram) where the receipt and storage areas are located.***

   All incoming mail and packages are delivered to the main office in Building 400. Any package marked as radioactive, as UN2910, or suspected of containing RAM is transferred to the RAM shipping area for survey, opening, inventory and issue to the chemist requesting the item.
   See Attachment 6

2. ***Submit a diagram of buildings 100 and 200 which illustrates the ventilation (air supply and exhaust systems) and how the system connect between the two buildings.***

   Attachment 7, in two pages shows the exhaust system for building 100/200 (they are essentially one building). The makeup air ducting is parallel to the exhaust duct. The make up air enters the lab at each hood forming a vertical air curtain the width of the hood. This curtain flows down between the chemist and the hood and is then exhausted through the hood.

3. ***Describe filtration that is used for radioactive air effluent exhaust for all buildings; how filters are checked for saturation, and filter change-out procedures.***

   All Exhaust filtration was removed approximately 11 years ago with NRC approval.

4. ***Describe the minimum air flow that will be maintained for the radioactive air effluent exhaust systems.***

   Mandatory minimum flow is 100 LFPM at the hood face. The ALARA goal is 150 LFPM which is maintained. Hood flows are checked twice a day during the HP walk-thru, and they are recorded weekly. The weekly results are on file and are part of the weekly summary report.

5. ***Describe the ventilation systems for building 300 and 300 annex.***

The makeup air ducting is parallel to the exhaust duct. The make up air enters the lab at each hood forming a vertical air curtain the width of the hood. This curtain flows down between the chemist and the hood and is then exhausted through the hood.

There are three separate exhaust systems and two make up air systems.

Exhaust – Building 300, see Attachment 8
Annex RAM not in service , see Attachment 9
Annex RAM, not in service, see Attachment 9

Make-up Building 300, parallel to exhaust
Annex, not in service, see Attachment 9

SECTION J **Audit Program**

In your application you provided a brief statement committing to a third party audit program. Please describe in greater detail, the following:

1) The purpose and content of the audit; and

The audit program fulfills the requirement for an annual review of the Radiation Protection Program.

2) How the results of the audit will be communicated to the RSO and RSC, and;

There are discussions with the RSO during the course of the audit. There is an exit meeting with the RSC. Upon receipt of the audit report it is discussed during a meeting of the RSC.

3) ARC's process or program for addressing issues or areas of improvement that are identified by the auditor.

During the meeting discussing the audit report, Recommendations are discussed, accepted recommendations are assigned with a timeline for completion.

SECTION K **Radiation Protection Program**

Item 2.1.j.: ***An authorized user is defined, in part, as someone who "directly supervises the use of licensed material." Define the term "directly supervises."***

Delete the word "directly"

Item 3: ***Provide a list by name of the members of the Radiation Safety Committee (RSC).***

Surendra K Gupta, PhD, President ARC, Chair RSC

Regis A Greenwood, CHP, RSO, Vice Chair RSC, AU

Janard Selvasekeran, PhD, Vice President ARC, 300 Lab Manager, AU

Kamal Das, PhD, Vice President ARC, 100 Lab Manager, AU

Donald Lite III, Deputy RSO

Deepesh Poudel, HP Tech

Describe the RSC's roles and responsibilities in reviewing the radiation protection program and addressing issues that have been identified either internally by ARC employees, or through external organizations, e.g., the NRC of other regulatory agencies, external auditors, etc., and taking corrective actions.

Section 3.2.4 of the RPP submitted with the update, dated 29 June 2012, to the Renewal Request responds to this question in great detail.

Item 3.3.3.5 ***Confirm that the results of the RSO's annual review of the Radiation Protection Program (RPP) will be documented. Submit a copy of the report of the audit that was conducted by the RSO in 2012.***

This requirement has been rolled into the annual third party audit. The auditor works with the RSO on evaluating the RPP.

A copy of the most recent audit report is presented as Attachment 10.

Identify who the third party auditor was for 2012 and who it will be for 2013. Describe their qualifications.

Auditor for 2012 was Jeffrey S Vollmer, CHP, it is very likely to be the same person for 2013.

Mr Vollmer is Health Physics Supervisor at Grand Gulf Nuclear Station and is Certified in Comprehensive Health Physics.

Describe the process for communicating results of the annual review conducted by the RSO and the yearly third party audit, to the RSC. Describe the process that the RSC will use to address recommendations made from both the annual review and third party audit.

As previously noted the annual review and the yearly third party audit have been combined.

There are formal exit meetings with the RSC. When a written report is received, it is reviewed by the RSC.

Recommendations are reviewed and discussed by the RSC.

Any recommendation requiring change to the program, change to any SOP, any new use of RAM is then written up as a request for license amendment and is sent to Region III to wait for approval.

Item 3.3.3.7 ***Describe the content of the summary reports and the frequency at which they will be issued.***

Time and manpower permitting, the Summary Report is issued weekly.

A typical report is given as Attachment 11

Item 3.3.3.8 ***Confirm that safety evaluations that the RSO makes of any new synthesis proposal will be documented.***

Such safety evaluations will be documented.

Items 3.3.4.5 & 6 Describe the content of on-the-job (OJT) training and confirm that it will be documented.

This up to the judgment of the individual's supervisor. No "set in stone" criteria are used. Criteria are obviously different for Chemists, lab techs, maint. personnel, shipping personnel, and janitorial personnel.

Any change in grade of employees will be documented in the RSC minutes of the session which changed the grade

Item 3.3.4.8 Provide examples of the types of records that will be maintained with regard to the radiation protection program.

All correspondence with regulatory agencies is kept indefinitely.

Records are maintained of 42 surveys taken Daily Weekly and monthly.

Record relating to calculating dose to employees or the public are maintained forever.

All other records are maintained for five years.

3.4.10 and 11 Confirm that the president of ARC has given the RSO the authority to stop operations that threaten safety or are not in compliance with NRC regulations or ARC's license.

Such authority as found in sections 3.4.10 and 3.4.11 of the RPP, and in paragraphs 20 and 22b of the license has been confirmed b y the President of ARC

Item 3.3.5 Confirm that the president of ARC has given the assistant RSO, in the absence of the RSO. stop work authority.

Such authority has been confirmed.

Item 3.3.6 Confirm that any of the RSO's duties that are performed by an outside consultant will only be performed under the direct supervision, i.e., with the RSO physically present on site, of the RSO.

Any of the RSO's duties performed by an outside consultant will be performed under the direct supervision of the RSO (or by the assistant RSO in the RSO's absence).

Item 4.2.2.6 ***A statement is made in this next section that areas and equipment will be decontaminated at the "next practical time" if contamination is above certain levels. Be more definitive as to what "next practical time" means. In order to avoid the accumulation of contaminated areas and equipment to the point at which it becomes out of control, please establish a "no later than" date/policy.***

Quoting from the RPP

"4.2.1.6 ACTION LEVEL

At this level, areas and equipment are decontaminated at the next practical time if contamination is above the following levels.

NOTE:

For Contaminated Restricted Areas, this would be at the time of weekend cleaning.

For all others, decontamination will take place immediately, if possible, but not more than 24 hours shall elapse

Access to the area or item will be restricted during the cleaning. If the area or item cannot be cleaned immediately, it shall be posted commensurate with the level of contamination."

Item 5.2.3 ***Describe the types of the probes that will be used to perform personal contamination surveys.***

"Pancake" geometry thin window G-M detectors.

Item 5.2.3.2 ***Describe instrumentation that will be used (including probes) for surveying items that will be taken from laboratories to prevent transfer of contamination. Define the threshold for determining when***

contaminated items can or cannot be transferred from contaminated to non-contaminated areas.

"Pancake" and "banana" type thin window G-M detectors with appropriate rate meters.

Wipe samples counted on LS-6500 LSC.

Items to be transferred must be less than 1000 dpm/100 cm^2 loose (spreadable) and total no more than 5000 dpm/ 100 cm^2 loose and fixed combined. From Table P-5 of NUREG-1556 vol 12.

Item 5.7.2.3 ***Define "high energy beta emitter", and describe the types of beta shields that will be used.***

Essentially at ARC, "high energy beta emitters" are limited to various compounds labeled with P^{32}.

The shields used are approximately one half inch thick Lucite.

Item 6.1 ***This item discusses ARC's training program. A statement is made that "the extent of training is dependent upon their experience and training with radioactive material and their educational background." Please establish and submit criteria that will be used to evaluate a person's previous experience and training with radioactive material in order to determine how much training he/she should receive at ARC. In addition, regardless of a person's previous experience and training, there must be a certain degree of training that should be required for all employees.***

A chemist with 10 years experience with labeling compounds does note need the same amount of training as a newly graduated Bachelor in Chemistry.

A CHP does not need the same training as a high school graduate hired as an HP tech.

A janitor does not need the same training as a chemist.

As ARC is a small company with less than 34 full time employees, required training is decided on a case by case basis.

All new hires that will be working in the labs receive site specific training.

Item 9.1.2 ***Submit a copy of your program for training employees in the use of the compactor. Confirm that the manufacturer's instructions will be followed.***

Maintenance persons Parris Ratliff and Richard Hymer are able to use the compactor. Radiation safety staff members RSO Regis Greenwood, Deputy RSO Donald Lite, and HP Tech Deepesh Poudel are able to use the compactor. All other staff may not use the trash compactor.

The instruction manual is posted near the compactor location for quick reference.

Item 9.2.7 ***Define the monthly and yearly limit values for each radionuclide that can be discharged as liquid waste.***

See 10 CFR 20.2003 and 10 CFR 20.2005

Item 9.4.1.4 ***Identify the fume hoods in building 200 that are designated for waste evaporation. List the radionuclides that will undergo the evaporation process.***

All four fume hoods in the Bldg 200 liquid waste processing area are designated for waste evaporation.

Nuclides are H^3 and C^{14}. All other nuclides have half lives below the limit for decay in storage.

tem 9.4.1.2 ***Describe your program for monitoring air effluent released from non-aqueous liquid waste.***

All four fume hoods in the Bldg 200 liquid waste processing area are designated for waste evaporation, these hood exhausts are trunked into the Building 100/200 stack, and are analyzed as part of the normal effluent The samplers run 24/7/365 and are analyzed weekly.

Item 9.4.1.6 ***Describe the personal contamination surveys that will be performed after an individual performs liquid waste evaporation operations.***

All personnel exiting the liquid waste evaporation area do sso through the normal exit from building 100. All survey requirements are the same for any exit from the lab.

Item 9.4.2.2 ***Describe the process for analyzing low level aqueous waste to determine if it may be discharged into the sanitary sewer.***

SECTION L Standard Operating Procedures

Several SOPs were reviewed between the original request for renewal and the update to this request dated 29 June 2012. In most cases these requested changes to the SOPs of concern render some of the questions below moot. The justification for these changes was included in the update, and are repeated as Attachment 13

SOP-01 ***Dry Solid Radioactive Waste Compaction Program***

Identify individuals by title, who can directly use the compactor and those who cannot.

Maintenance persons Parris Ratliff and Richard Hymer are able to use the compactor. Radiation safety staff members RSO Regis Greenwood, Deputy RSO Donald Lite, and HP Tech Deepesh Poudel are able to use the compactor. All other staff may not use the trash compactor.

Confirm the ARC has and will follow the manufacturer's instruction manual for the compactor.

The instruction manual is posted near the compactor location for quick reference.

Describe the criteria that will be followed for determining whether or not the floor area should be surveyed. Include a description of the types of surveys that will be performed (ref. 3.2.13)

The criteria for cleaning would be the action limits using the sum of fractions for each isotope listed in 3.2.13 (10,000 dpm H3; 50,000 dpm C14). At the present time ARC has an amendment request to delete this paragraph, because at the time it was written this area was cleaned on an "as needed" basis. Presently it is cleaned every other week and this paragraph is not needed.

Provide a list of radionuclides that can be compacted.

The radionuclides allowed to be compacted are H3 and C14. All other isotopes used by ARC are short lived isotopes and go through a decay in storage program, see SOP -17 for reference.

Describe the location of the compactor and associated air supply and exhaust systems, air effluent monitoring that will be conducted, and any exhaust filtration that exists.

The compactor is located inside of a 1 inch thick plastic box with an open front. The box is connected to the stack exhaust line and vents to the atmosphere along with the hood exhaust. Each morning when the hood flows are checked in the labs, the box is checked to ensure air is flowing. The air supply comes from the general room air which is supplied by the make-up air system. The compactor is located a few feet from the building 200 evaporation hoods and an air sampling point labeled "EVAP" on the weekly air sample record, is located approximately 6.5-7 feet in the air in the approximate center of the 4 evaporation hoods and the compactor. There is no separate exhaust filtration, all exhaust is via the stack. See attachment 14, Building 200 floor plan.

SOP-02 ***In Vitro Bioassay Program***

Submit a bioassay program for other radionuclides listed on your license, e.g., iodine-125, or provide justification for not including these nuclides in the program.

Based upon historical data and past use of dosimeters, it is not likely that radiation workers will receive an excess of 10% of the annual limit. These other nuclides are handled in very small quantities of activity and by select employees (the packaging chemists, lab managers, radiation safety for decay in storage) so bioassay for these other nuclides is not required.

Describe the criteria for determining which ARC employees will be required to provide a urine sample each Monday (ref. 4.1)

ARC employees which handle radioactivity in its unfinished form are required to participate in the bioassay program. Unfinished form is defined in 3.0 in which it states, "Unfinished form includes handling By-product Material in any fashion from receipt of raw material until the product is labeled for shipment."

Submit the counting protocol 3, which was not included with this SOP (ref. 4.2)

The bioassay counting protocol #3 is attached. The results are multiplied so that 1.00 is equal to 1 mrem. The action limit for a weekly sample is 100 mrem (52 weeks – 2 weeks vacation = 50; 5,000mrem / 50 weeks = 100mrem). See attachment 15, Bioassay Protocol.

<u>SOP-03</u> C-14 and H-3 Air Monitoring Program

Describe the procedure that will followed for calibrating the rotameter, and the frequency at which it will be calibrated (ref. 1.1)

An air flow calibrator purchased from F&J Specialty, Inc. is set up in series before the rotameter. Stack samplers are calibrated annually and general lab samplers are calibrated as needed.

Describe how you will determine if an area may have concentrations exceeding 10% of permissible limits that would require air sampling, and describe your procedure for checking air sampling stations (ref 2.1).

The process of checking air samplers is seeing if the rotameter is properly functioning and air is bubbling through the liquid. Because our calculated dose to the public is not likely to exceed 10%, no outdoor air monitoring is required. Inside the lab 24 hours a day we monitor certain points where the air concentrations are likely to be highest. This includes the areas in which chemists perform syntheses and work most of the day. Twice weekly lab wipes are performed by radiation safety staff to see if any areas have higher than normal activity levels, and therefore a possibility of higher air concentrations.

Describe criteria that will be used to determine the frequency at which air sampling will be performed (ref 3.1)

Air sampling is performed 24 hours per day, 7 days per week, 365 days per year. The only time air sampling is not done is for the approximately 15-20 minutes every week when the sampling liquid is changed. After dark adaption is done overnight it is then assayed for radioactive concentrations.

Distinguish the difference between continuous air sampling (ref 3.2) and intermittent air sampling (ref 3.3). Describe criteria that will be used to determine which will be implemented.

In lab 100 there are four sampling points; in lab 300 there are five; and in building 200 there are two sampling points. All of these run 24 hours and are considered

continuous. If a situation occurred where out of the ordinary work was being done (for instance major construction being performed, etc.), another sampling line may be set up for intermittent use. However the 11 continuous air sampling lines will not be shut down and will remain operable.

SOP-06 ***Program For Picking up and Receiving and Opening Incoming Radioactive Materials***

Your action levels are provided in cpm per square area; however, NRC regulations are in dpm per square area. Provide action levels in dpm per square area, and describe the procedure for converting instrument readings (cpm) to activity (dpm) (ref 1.6).

ARC wipes 100 sq. cm. so the action limit using DPM would be 2200 dpm/100cm^2 for any beta or gamma emitter. In order for an LSC to determine which isotope is decaying, it must have a counting curve for that specific isotope and must be assayed using a program which is specifically looking for that isotope. $E_{average}$ is approx. 6keV H3 and 50keV C14, which means the range is from 0-18 keV H3 and 0-150 keV C14. If you assayed a sample on dual channel for H3/C14 any beta particle which is greater than 150 keV will not be measured. This is fine for a company with a possession license for only H3 and C14, but ARC is licensed to use I-125, P-32, P-33, Cr-51 and others. If a vial or box is contaminated with P-32 which has a 1.709 MeV Beta and it is assayed on the dual channel DPM for H3/C14 it will read virtually nothing, except for the very small fraction of emissions less than 150 keV. In order for us to properly check the contaminations levels in DPM for each isotope on our license we would need to assay the same wipe 6-7 times on each isotope channel. Instead we utilize a "wide channel" which checks for all emissions from 0-3MeV which will cover all the isotopes allowed for use at ARC. Energy is proportional to counter efficiency, so H3 having the least energetic beta will have the lowest efficiency for the LSC. The efficiency is approximately 47%, so 2,200dpm/100cm^2 * 0.47 = 1,034 cpm/100cm^2 ; this number was rounded down for simplicity to 1,000cpm/100cm^2. This is the reason why ARC measures in units of CPM instead of DPM, because measuring in DPM would limit the range of isotopes we can check for, using the wide channel on CPM allows us to check against all the isotopes licensed for use at ARC.

Therefore, the limits given are slightly more conservative than those stated by NRC.

Define what you mean by "higher than expected" (ref 2.7 & 2.1.3).

The expected values are less than the action limit. The action limit being 1,000cpm/100cm2 wipe test for all boxes; X<0.5 mR/hr on contact and X<0.1 mR/hr at one meter for UN2910 and White-I UN2915 packages; 0.5<X<50 mR/hr on contact and 0.1<X<1 mR/hr at one meter for Yellow-II UN2915 packages. If any of

these 3 measurements is higher than what is expected (for instance a UN2910 package reading 0.8 mR/hr on contact) then the RSO must be informed.

Describe the type of probe that will be used for surveying packages (ref 2.15).

The survey meter used is calibrated for C-14 on an mR/hr scale, attached is a "Hot Dog" style probe. The survey meter used is calibrated annually by a third party as required by the SOP's. ARC has two meters ready for use, one to serve as a backup.

SOP-07 Liquid Waste Disposal Program

Describe the training that maintenance personnel will receive in taking and analyzing samples safely and accurately (ref 4.0).

A hands on demonstration is given to all maintenance personnel on proper sampling techniques. Important points include, how to properly sample using a pipette, cross contaminating the vial, cross contaminating the sample by reusing pipette tips, checking pH, and checking against daily discharge limits. A page with the recommended daily discharge limits is posted on the LSC, this page is updated approximately monthly, though more frequently as the year ends and the license limit is approached. The recommended daily limit is based on totally activity discharged to date and how many days left in year. It is a recommended daily limit because not every day radioactivity is discharged to the sewer and the limit is rarely exceeded, this gives some leeway when discharging each day.

SOP-08 Radioactive Waste Program

Describe who, by title, will be authorized to use the compactor, and the details of the training that they will receive (ref 1.2.1)

Maintenance workers Parris Ratliff and Richard Hymer, radiation safety members RSO Regis Greenwood, Deputy RSO Donald Lite and HP Tech Deepesh Poudel have been trained in using the compactor. The user manual is posted near the trash compactor and it is used during all new employee training. Training consists of opening and closing, proper ventilation and contamination control.

Describe the probe that will be used to survey waste that is held for decay (ref 3.1.6)

The decay in storage program can be reviewed in more detail under SOP-17. The probe used for release is the same probe/meter combination which is used for all daily, weekly and monthly surveys. It is calibrated for C-14 on a kdpm scale by a third party annually in accordance with SOP. It utilizes a "pancake" probe meter face.

Describe how non-aqueous liquid waste effluent that is released to an unrestricted area is monitored. Why and how can it be released to an unrestricted area? Describe specifically what unrestricted areas you are referring to (ref 4.1.2).

Each building is kept under negative pressure taking out through the stack exhaust approximately 12,000 cubic feet of air and bringing in approximately 10,000 cubic feet of air through the make-up air system. Each building has a stack which blows out the air to the atmosphere. After the blower engine, but before the top of the stack a sample line is inserted into the flow of the air. There are two lines for each stack, one connected to a machine which picks up H3 and the other for C14. The stacks run 24 hours a day and the sampling runs 24 hours a day. Sampling periods are weekly. Based upon these samples of stack effluent we are able to use the COMPLY code and have determined that the dose to the public for our facility is less than 10 mrem in a year The unrestricted area would be the general atmosphere, in an industrial park on the ARC property site which is a controlled area.

Item 4.2.2 makes a reference to RPP Section 3.3.4.12. The RPP stops at Section 3.3.4.11. If there is a section 3.3.4.12, please revise the RPP accordingly and submit the revision for our review.

You must be looking at an older copy of the RPP. Throughout the SOP's and RPP a statement would say "RSO, or designee". As requested by the NRC a paragraph was added to the supervisory duties of the RSO, section 3.3.4.12 of the RPP. In this paragraph it further explains the designee and who that may be. The full text says, "3.3.4.12 The RSO may designate individuals to perform any of the duties listed in 3.3.3 or 3.3.4 above. The final responsibility for the designee's actions and the requirement for oversight of these actions remains with the RSO. As the persons available for use as RSO designee may vary from time to time, a table of the present personnel is included as Appendix A."

<u>SOP-10</u> ARC Shipping Program

Your action levels are provided in cpm per square area; however, NRC regulations are in dpm per square area. Provide action levels in dpm per square area, and describe the procedure for converting instrument readings (cpm) to activity (dpm) (ref 4.1.2 & 4.1.4)

In order for an LSC to determine what the activity is in dpm, it must know what isotope it is being checked against and the efficiency of said isotope. ARC has a license to possess several different isotopes (H3, C14, S35, P32, P33, I125, Cr51, etc.) in order for a wipe to be assayed in DPM it would need to be assayed for each isotope. If we

just assayed it on dual channel DPM for H3/C14 (energy range of 0-150keV) then some P32 contamination with an $E_{average}$ of 1.709 MeV would be out of the range and not read on the machine. By utilizing a wide channel on CPM we are able to measure all of the isotopes in use by ARC at one time. Efficiency of the LSC is proportional to energy, so the least energetic one, H3, has the lowest efficiency. The efficiency is approximately 47% so converting 2200dpm/100cm2 * 0.47 = 1,034cpm/100cm2; this is rounded down to 1,000cpm. The instrument used is Beckman Coulter LS6500 which is maintained under service agreement by Beckman Coulter personnel annually.

The limits used are, after calculation slightly more conservative than those stated by the NRC.

SOP-12 ***In vivo Bioassay Program***

In your application you requested authorization for 1.5 curies of iodine-125 for manufacturing and synthesis of radiolabeled compounds, yet you stated that this SOP is no longer applicable and that it would be reinstated in the event that ARC begins processing significant amounts of radio-iodines. Unless you describe specific controls on the type and amount of unlabeled and labeled iodine-125 that can be reprocessed by an individual at any one time, you must submit a bioassay program for iodine-125.

I-125 is purchased from the supplier in several forms, as an example Sodium Iodide, in water or alcohol solutions.

Orders for I-125 are dispensed from stock bottles and that is the only contact.

If a custom synthesis is needed the actual; use at any one time of I-125 for labeling of compounds is in the 1-2 millicurie range.

Over several years, individuals performing custom syntheses were monitored by thyroid measurement. The usual measure intake corresponded to less than 1 mrem.

Based on these measurements and the infrequent custom work, no formal program was needed.

SOP-18 ***Liquid Waste Evaporation Program***

Describe how effluent that is released to an unrestricted is monitored. Explain why and how effluent would be released to an unrestricted area from this process (ref 1.2).

All evaporation hoods are located in B200. The exhaust system for these hoods is connected to main stack exhaust for the whole building. Air sampling takes place just after the blower engine but before the top of the stack. Air samples are taken 24 hours a day measured at week long intervals. These results are used in COMPLY to calculate our dose to the public. The evaporation area also has an air sampling point measuring the air concentrations for workers processing liquid waste. See attachment 14, Building 200 floor plan.

Identify the fume hoods where this process will take place (ref 1.4), and describe minimum fume hood flow rate that will be maintained and how you will verify that this flow rate will be maintained.

There are four hoods located in building 200. Each hood connected to main exhaust stack line. The minimum hood face velocity as required by the SOP's is 100 linear feet per minute. Everyday a walkthrough is performed in the morning and at night. During these times the face velocity is checked on all hoods including these four. Once a week a written record of the hood face velocities is taken, including specific flow rates and widths of the hood face. SEE attachment 14, Building 200 floor plan.

Describe all filtration that is used for air effluent and the method and frequency for checking filtration for saturation.

There is no filtration used. Filters were removed, with NRC approval, approximately eleven years ago.

SOP-26 ***Beta/Gamma TLD Monitoring***

Provide an assessment which demonstrates that occupational workers are not likely to exceed 10 percent of the yearly limit for whole body and extremity exposure to high energy beta emitters authorized on your license, and iodine125.

Select individuals, those processing high energy beta emitters, wore body and ring TLDs for approximately six months. No individual of this group exceeded 5% of the annual limit during this period.

Normally workers are exposed only to H^3 and C^{14}, the Beta average of which will not penetrate the skin.

SOP-29 ***Storage of Surface Contaminated Objects***

In order to prevent long term storage of surface contaminated objects (SCO) please develop and submit a plan which will describe the timely disposition of objects that will not be re-used and will be discarded as radioactive waste. Also, describe a timeline for making decisions about SCO that is being held for potential future use. A plan should be developed to avoid holding SCO for too long whereby you experience storage and/or potential safety issues (ref 4.0)

If a broken electronic equipment is stored for future use as parts, then it may be stored as long as there is a working electronic device that may need spare parts. If an item has been set aside for disposal, then it should first be decontaminated to releasable levels. If it cannot be decontaminated then it should be disposed of as radioactive waste.

Procedures are being developed to further define SCO and the need for storage. Under the existing SOPs, a strict determination would result in all of the lab equipment and furniture being classedas SCO and moved to storage..

SOP-30 ***Release of Material***

Describe the probes that will be coupled to the GM meter to scan equipment (ref 2.1).

The probe used is "pancake" style probe attached to a GM meter calibrated for C-14 cpm. The meter will be calibrated annually by a third party in accordance with SOP.

Confirm that actions levels for the release of material will be based on liquid scintillation counter results from smears taken on the equipment, and not GM meter survey readings.

Section 2.3 of this SOP specifies that the areas which have highest contamination readings (as found by the GM meter) will be wipe tested and counted in the Beckman Coulter LS6500 currently in use by HP staff. According to section 3.0 "Release Levels" the release level is based on both wipe samples and survey meter results. Therefore it must be below 1,000dpm/100cm2 of removable contamination for wipe results **AND** it must be below 5,000 dpm TOTAL by direct scan with a GM meter.

See Table P-5 in Appendix P to NUREG-1556 Vol 12.

SOP-31 ***Protocol for Packaging and Shipping Items to Japan***

Explain the significance of the action level of 200 counts for wipes that are taken on primary containers. What is the conversion to dpm? How does the value relate to background? What type of instrument is used to analyze the wipes? (ref 2.1.2.3 and 2.1.2.4; 2.2.5.3 and 2.2.5.4; 2.3.1.4 and 2.3.1.5; and 3.1.1)

In Japan, the JRIA receives all incoming radioactive shipments.The significance of choosing 200 counts as the action limit on primary containers is a number agreed upon by the JRIA and ARC. This number came from no regulation or law it is just an action limit decided by the JRIA and ARC. The efficiency of the isotope the LSC is counting is proportional to energy, therefore the least energetic emission will have the lowest efficiency. H3 has the lowest average energy beta particle and the efficiency is approximately 47%; therefore 200cpm / 0.47 = 426dpm assuming that the contamination is only H3. The efficiency of P32 ($E_{average}$ = 1.709MeV) is greater than 99%, so if it's P32 contamination then it's approximately 200dpm. So a value of 200cpm will have a dpm range of 200-426dpm, depending on the isotope. There is no background subtraction for the final value of the wipe test, however background typically is no more than 60cpm. As can be seen, these limits are much more conservative than those in the NRC regulations

The instrument used to analyze the wipes is a Beckman Coulter LS6500. A calibration is run each business day and the records are retained and it is under service agreement with Beckman Coulter.

<u>SOP-32</u> Segregation of Dry Active Waste

This procedure includes action levels of 150 counts and 150 cpm for direct survey readings. Explain the significance in choosing these actions levels. How do they relate to background? What type of probe is used?

This action level was chosen because background is approximately 150cpm inside the lab, so 150cpm above background would make it twice the background. Twice background is statistically significant. In item 2.3 of this SOP it states, "...place any item with 150, or greater, counts per minute above background..." Background is typically around 150cpm in the laboratory. So if the background read 150cpm then the action limit would be 300cpm. The probe used is "pancake" type of probe. The GM meter is calibrated annually by a third party.

SOP-33 ***Use of Protective Clothing and Equipment***

You have established a personal contamination survey action level of twice background for individuals who exit a restricted area. Our expectation is that individual who exit any restricted are should be free of contamination after removal of protective clothing and that survey readings should be at background. Please provide an explanation why you have chosen a threshold that is twice background, or modify your procedure (ref 4.3).

This is based on the statistics of counting and the time constant of the electronics used. With a moving pancake probe and a background count time of under a minute, account of approximately 0.9 times background above the given background is necessary to state that there is a difference from background at the 90% confidence level. Therefore 1.0 x bkg above background is convenient.

SOP-34 ***Surface Soil Sampling for Site Characterization***

Modify this procedure to include action levels, with a description of the type of action that will be taken. Commit to submitting all of the raw data results to the NRC any time that you exceed a threshold and are required to perform an action. Please modify the procedure by committing to submit results of the surveys that indicate you exceeded a threshold, and include a description of the action that will be taken.

ARC feels that a site remediation plan warrants very specific details which cannot fit in any single description or action plan. ARC will therefore commit to sending an action plan to the Decommissioning Branch Region III, NRC if any soil samples show levels above the action limit. ARC has amended SOP-34 to say, "5.1 The action level for any single sampling location will be twice the activity from the previous sample in the same location."

In SOP-34 part 5.0 Confirmatory Sampling, part 5.2 says, "Results of sampling will be submitted to the Decommissioning Branch Region III, NRC." Therefore the raw data is required to be sent to the NRC whether a threshold has been exceeded or not. This section will be amended to require the data to bew kept on file and only sent if Action Levels are exceeded

SOP-36 ***Excavation and Backfill of Soil Due to Gas Line Repair***

It is our understanding that this was a procedure that was developed in order to address an issue with a leaking gas line that has since be repaired. This procedure does not appear to be applicable anymore. Please delete the procedure or provide justification why you would like it to remain active.

The SOP will be deleted.

SOP-41 ***Inventory of Surface Contaminated Objects***

Please modify the note under item 4.0 to state that the "analysis and labeling must take place prior to transport of the SCO to the processing facility."

The SOP has been modified to read, "NOTE: The analysis and labeling must take place prior to transport of the SCO to the processing facility."

Attachment 1

2010 INTAKE AIR (to date)

Tritium

Date Range	SouthEast	South	North	NorthWest	Mean
12/18/9-1/10/10	1.50E-07	9.40E-08	2.00E-08	1.80E-08	7.05E-08
1/10/10-2/4/10	8.60E-09	4.40E-09	6.10E-09	6.10E-09	6.30E-09
2/4/10-3/310	5.00E-08	8.90E-09	3.00E-09	2.10E-09	1.60E-08
3/3/10-3/17/10	4.90E-09	1.50E-08	1.30E-09	5.90E-10	5.45E-09
3/17/10-3/30/10	1.30E-08	8.10E-09	5.30E-09	1.20E-08	9.60E-09
3/30/10-4/13/10	1.50E-08	1.80E-08	9.30E-09	1.20E-08	1.36E-08
4/13/10-4/27/10	9.50E-09	1.50E-08	5.10E-09	2.00E-08	1.24E-08
4/27/10-5/11/10	4.60E-07	2.80E-07	1.20E-07	6.50E-08	2.31E-07
5/11/10-5/25/10	1.30E-08	1.10E-08	1.10E-08	1.20E-08	1.18E-08
5/25/10-6/10/10	1.40E-07	3.70E-08	2.60E-08	1.80E-08	5.53E-08
6/10/10-6/24/10	5.10E-08	2.40E-08	1.30E-08	8.60E-09	2.42E-08
6/24/10-7/7/10	1.90E-08	1.50E-08	8.60E-09	7.00E-09	1.24E-08
7/7/10-7/15/10	8.70E-09	7.80E-09	7.10E-09	9.30E-09	8.23E-09
7/15/10-7/27/10	2.10E-07	6.20E-08	4.10E-08	4.90E-08	9.05E-08
7/27/10-8/6/10	1.40E-07	8.80E-08	2.60E-08	1.60E-08	6.75E-08

Grand Mean of All Samples 4.23E-08

Appendix B to 10CFR20 gives the Effluent limit for Tritium as 1.00E-07 this is equal to the 50 mrem limit for the general public. The 10 mrem constraint would be met if the limit is reduced to 20% of this value, or

2.00E-08

Then the uncorrected dose is the grand mean divided by the reduced limit times 10 mrem or 2.12E+01

The occupancy factor for this industrial park 50/168 or 2.98E-01

There fore the dose to the general Public from Tritium is the reduced limit dose muiltiplied by the occupancy Factor, Or

6.30E+00 mrem in a year

Carbon-14

Date Range	SouthEast	South	North	NorthWest	Mean
12/18/9-1/10/10	0.00E+00	2.90E-11	0.00E+00	6.40E-11	2.33E-11
1/10/10-2/4/10	2.90E-10	1.30E-10	2.30E-10	4.60E-10	2.78E-10
2/4/10-3/310	1.70E-10	1.60E-10	1.40E-10	4.00E-11	1.28E-10
3/3/10-3/17/10	0.00E+00	1.80E-10	2.80E-11	0.00E+00	5.20E-11
3/17/10-3/30/10	3.60E-10	1.80E-10	3.50E-10	5.80E-10	3.68E-10
3/30/10-4/13/10	6.10E-10	4.50E-10	5.90E-10	3.00E-10	4.88E-10
4/13/10-4/27/10	5.70E-10	4.90E-10	4.10E-10	7.30E-10	5.50E-10
4/27/10-5/11/10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5/11/10-5/25/10	9.70E-10	5.70E-10	1.30E-09	2.20E-09	1.26E-09
5/25/10-6/10/10	0.00E+00	1.10E-10	5.00E-10	8.20E-10	3.58E-10
6/10/10-6/24/10	9.80E-10	3.80E-10	4.10E-10	6.90E-10	6.15E-10
6/24/10-7/7/10	9.60E-10	5.80E-09	5.80E-10	2.90E-10	1.91E-09
7/7/10-7/15/10	5.50E-10	3.40E-10	5.30E-10	3.80E-10	4.50E-10
7/15/10-7/27/10	8.80E-11	2.60E-10	2.40E-09	1.20E-09	9.87E-10
7/27/140-8/6/10	3.60E-10	1.10E-09	5.30E-09	9.80E-10	1.94E-09

Grand Mean of All Samples 6.26E-10

Appendix B to 10CFR20 gives the Effluent limit for C-14 as 3.00E-09 this is equal to the 50 mrem limit for the general public. The 10 mrem constraint would be met if the limit is reduced to 20% of this value, or

6.00E-10

Then the uncorrected dose is the grand mean divided by the reduced limit times 10 mrem or 1.04E+01

The occupancy factor for this industrial park 50/168 or 2.98E-01

There fore the dose to the general Public from Tritium is the reduced limit dose muiltiplied by the occupancy Factor, Or

3.11E+00 mrem in a year

The total for both nuclides is then 9.41E+00 mrem in a year.

2009 INTAKE AIR

Tritium

Date Range	SouthEast	South	North	NorthWest	Mean
12/28/08-1/11/09	3.80E-08	4.60E-09	1.70E-08	2.40E-08	2.09E-08
1/11/09-2/15/09	4.50E-09	4.20E-08	4.50E-08	5.10E-08	3.56E-08
2/15/09-3/8/09	8.20E-09	4.30E-09	2.20E-08	1.30E-08	1.19E-08
3/8/09-4/10/09	6.10E-09	3.80E-09	5.10E-09	1.60E-08	7.75E-09
4/10/09-4/24/09	3.50E-08	1.70E-08	1.70E-08	1.60E-08	2.13E-08
4/24/09-5/7/09	3.80E-09	1.50E-08	1.00E-08	3.30E-08	1.55E-08
5/7/09-5/21/09	3.30E-08	4.30E-08	2.30E-08	1.90E-08	2.95E-08
5/21/09-6/12/09	8.10E-09	6.90E-09	3.10E-09	1.40E-08	8.03E-09
6/12/09-7/2/09	1.60E-09	8.30E-09	7.90E-10	2.30E-09	3.25E-09
7/2/09-7/16/09	1.00E-08	3.80E-08	1.30E-08	1.20E-08	1.83E-08
7/16/09-7/30/09	1.30E-08	9.30E-09	1.50E-08	1.00E-08	1.18E-08
7/30/09-8/18/09	1.25E-08	5.30E-08	1.20E-08	2.20E-08	2.49E-08
8/18/09-9/4/09	2.10E-08	4.40E-08	9.70E-09	1.40E-08	2.22E-08
9/4/09-9/18/09	1.80E-07	6.60E-08	1.00E-07	1.60E-07	1.27E-07
9/18/09-10/10/09	7.60E-08	7.70E-08	6.10E-08	7.00E-08	7.10E-08
10/10/09-11/12/09	4.90E-08	5.30E-08	4.40E-08	4.00E-08	4.65E-08
11/12/09-12/18/09	1.20E-09	3.70E-09	2.30E-09	2.00E-09	2.30E-09

Grand Mean of All Samples 2.81E-08

Appendix B to 10CFR20 gives the Effluent limit for Tritium as 1.00E-07 this is equal to the 50 mrem limit for the general public. The 10 mrem constraint would be met if the limit is reduced to 20% of this value, or

2.00E-08

Then the uncorrected dose is the grand mean divided by the reduced limit times 10 mrem or 1.40E+01

The occupancy factor for this industrial park 50/168 or 2.98E-01

There fore the dose to the general Public from Tritium is the reduced limit dose muiltiplied by the occupancy Factor, Or

4.18E+00 mrem in a year

Carbon-14

Date Range	SouthEast	South	North	NorthWest	Mean
12/28/08-1/11/09	4.10E-10	1.90E-10	2.50E-10	2.40E-09	8.13E-10
1/11/09-2/15/09	4.80E-10	8.70E-10	4.60E-10	8.60E-10	6.68E-10
2/15/09-3/8/09	0.00E+00	0.00E+00	2.40E-11	9.10E-11	2.88E-11
3/8/09-4/10/09	2.70E-10	1.90E-10	8.40E-11	1.30E-10	1.69E-10
4/10/09-4/24/09	5.20E-10	3.50E-10	3.30E-10	3.70E-10	3.93E-10
4/24/09-5/7/09	3.50E-10	3.50E-10	5.90E-10	3.00E-10	3.98E-10
5/7/09-5/21/09	8.70E-11	1.80E-10	0.00E+00	4.10E-11	7.70E-11
5/21/09-6/12/09	3.90E-10	4.00E-13	2.30E-11	4.50E-11	1.15E-10
6/12/09-7/2/09	2.70E-11	1.50E-10	7.10E-11	2.60E-11	6.85E-11
7/2/09-7/16/09	4.70E-10	9.70E-10	7.40E-10	4.30E-10	6.53E-10
7/16/09-7/30/09	9.10E-10	2.60E-10	7.40E-10	1.80E-10	5.23E-10
7/30/09-8/18/09	2.10E-10	1.40E-10	7.60E-10	3.70E-10	3.70E-10
8/18/09-9/4/09	1.10E-10	3.90E-10	3.80E-10	1.00E-09	4.70E-10
9/4/09-9/18/09	6.40E-10	1.80E-09	7.50E-10	6.50E-10	9.60E-10
9/18/09-10/10/09	8.20E-10	1.10E-09	9.90E-10	5.8/e-10	9.70E-10
10/10/09-11/12/09	5.60E-10	9.50E-10	3.90E-10	5.10E-10	6.03E-10
11/12/09-12/18/09	1.30E-11	1.10E-11	0.00E+00	0.00E+00	6.00E-12

Grand Mean of All Samples 4.28E-10

Appendix B to 10CFR20 gives the Effluent limit for C-14 as 3.00E-09 this is equal to the 50 mrem limit for the general public. The 10 mrem constraint would be met if the limit is reduced to 20% of this value, or

6.00E-10

Then the uncorrected dose is the grand mean divided by the reduced limit times 10 mrem or 7.14E+00

The occupancy factor for this industrial park 50/168 or 2.98E-01

There fore the dose to the general Public from Tritium is the reduced limit dose muiltiplied by the occupancy Factor, Or

2.12E+00 mrem in a year

The total for both nuclides is then 6.30E+00 mrem in a year.

2008 INTAKE AIR

Tritium

Date Range	SouthEast	South	North	NorthWest	Mean
12/31/07-1/14/08	2.60E-08		5.30E-09	3.30E-08	2.14E-08
1/14/08-2/18/08	1.30E-08		9.30E-10	9.90E-10	4.97E-09
2/18/08-3/3/08	4.20E-09		0.00E+00	2.60E-08	1.01E-08
3/3/08-3/18/08	3.10E-08		4.70E-09	1.40E-08	1.66E-08
3/18/08-3/31/08	4.10E-08		5.50E-09	3.80E-08	2.82E-08
3/31/08-4/21/08	2.90E-08		2.40E-08	1.30E-08	2.20E-08
4/21/08-5/10/08	4.60E-08		1.60E-08	8.00E-08	4.73E-08
5/10/08-5/28/08	3.60E-08		5.90E-08	1.70E-08	3.73E-08
5/28/08-6/12/08	4.20E-08		5.50E-08	5.40E-08	5.03E-08
6/12/08-6/26/08	3.00E-08		1.60E-08	4.70E-08	3.10E-08
6/26/08-7/7/08	4.70E-08		1.80E-08	8.80E-09	2.46E-08
7/7/08-7/29/08	8.80E-09		1.20E-08	7.20E-09	9.33E-09
7/29/08-8/12/08	7.40E-08		8.70E-09	9.10E-09	3.06E-08
8/12/08/8/26/08	3.00E-08		1.50E-08	1.70E-08	2.07E-08
8/26/08-9/9/08	3.90E-07		3.20E-07	7.00E-08	2.60E-07
9/9/08-9/24/08	1.20E-08		1.50E-08	4.50E-09	1.05E-08
9/24/08-10/08/08	1.10E-08		5.00E-08	1.70E-08	2.60E-08
10/08/08-11/12/08	1.30E-08	1.40E-08	8.50E-09	3.30E-09	9.70E-09
11/12/08-12/1/08	4.80E-09	1.80E-08	1.80E-08	4.70E-09	1.14E-08
12/1/08-12/15/08	4.80E-09	6.30E-09	1.20E-08	7.40E-09	7.63E-09

Grand Mean of All Samples 3.40E-08

Appendix B to 10CFR20 gives the Effluent limit for Tritium as 1.00E-07 this is equal to the 50 mrem limit for the general public. The 10 mrem constraint would be met if the limit is reduced to 20% of this value, or

2.00E-08

Then the uncorrected dose is the grand mean divided by the reduced limit times 10 mrem or 1.70E+01

The occupancy factor for this industrial park 50/168 or 2.98E-01

There fore the dose to the general Public from Tritium is the reduced limit dose muiltiplied by the occupancy Factor, Or

5.06E+00 mrem in a year

Carbon-14

Date Range	SouthEast	South	North	NorthWest	Mean
12/31/07-1/14/08	1.90E-10		1.00E-10	2.90E-10	1.93E-10
1/14/08-2/18/08	3.50E-11		5.00E-11	5.40E-10	2.08E-10
2/18/08-3/3/08	4.00E-10		0.00E+00	2.00E-09	8.00E-10
3/3/08-3/18/08	5.00E-11		1.30E-10	1.90E-09	6.93E-10
3/18/08-3/31/08	8.60E-11		8.00E-11	3.80E-10	1.82E-10
3/31/08-4/21/08	8.20E-11		3.60E-10	2.30E-10	2.24E-10
4/21/08-5/10/08	4.30E-10		5.00E-10	6.50E-10	5.27E-10
5/10/08-5/28/08	9.70E-11		2.10E-10	3.90E-10	2.32E-10
5/28/08-6/12/08	2.50E-09		7.80E-10	6.90E-10	1.32E-09
6/12/08-6/26/08	3.40E-10		1.40E-10	7.40E-11	1.85E-10
6/26/08-7/7/08	4.20E-10		8.80E-11	1.80E-10	2.29E-10
7/7/08-7/29/08	3.80E-10		5.90E-10	1.70E-10	3.80E-10
7/29/08-8/12/08	3.80E-10		5.20E-10	3.90E-10	4.30E-10
8/12/08/8/26/08	1.20E-09		1.50E-09	1.70E-09	1.47E-09
8/26/08-9/9/08	4.50E-10			8.50E-09	4.48E-09
9/9/08-9/24/08	5.70E-10		3.40E-10	3.40E-10	4.17E-10
9/24/08-10/08/08	1.50E-09		1.50E-10	3.80E-10	6.77E-10
10/08/08-11/12/08	4.90E-10	1.20E-10	4.70E-10	1.50E-10	3.08E-10
11/12/08-12/1/08	5.80E-10	4.00E-10	8.00E-10	2.30E-10	5.03E-10
12/1/08-12/15/08	4.10E-10	1.40E-10	5.90E-10	2.50E-10	3.48E-10

Grand Mean of All Samples 6.90E-10

Appendix B to 10CFR20 gives the Effluent limit for C-14 as 3.00E-09 this is equal to the 50 mrem limit for the general public. The 10 mrem constraint would be met if the limit is reduced to 20% of this value, or

6.00E-10

Then the uncorrected dose is the grand mean divided by the reduced limit times 10 mrem or 1.15E+01

The occupancy factor for this industrial park 50/168 or 2.98E-01

There fore the dose to the general Public from C-14 is the reduced limit dose muiltiplied by the occupancy Factor, Or

3.42E+00 mrem in a year

The total for both nuclides is then 8.48E+00 mrem in a year.

2007 INTAKE AIR

Tritium

Date Range	SouthEast	South	North	NorthWest	Mean
12/26/06-1/8/07	1.60E-08		9.80E-09	1.00E-08	9.63E-10
1/8/07-1/26/07	0.00E+00		2.20E-09	6.90E-10	9.63E-10
1/26/07-2/9/07	7.50E-09		1.90E-09	1.20E-09	3.53E-09
2/9/07-2/23/07	2.00E-08		7.00E-09	2.10E-09	9.70E-09
2/23/07-3/10/07	8.90E-08		4.00E-08	3.90E-09	4.43E-08
3/10/07-3/24/07	1.40E-08	2.30E-08	1.30E-08	6.80E-09	1.42E-08
3/24/07-4/8/07	4.00E-09	7.20E-09	1.10E-08	2.00E-09	6.05E-09
4/8/07-4/23/07	5.80E-09	1.60E-08	9.40E-09	4.40E-09	8.90E-09
4/23/07-5/7/07	2.20E-08	4.70E-08	1.10E-08	1.00E-08	2.25E-08
5/7/07-5/21/07	9.50E-09	1.60E-09	1.30E-08	7.70E-09	7.95E-09
5/21/07-6/4/07	9.70E-09	3.00E-09	2.40E-08	9.60E-09	1.16E-08
6/4/07-6/18/07	8.50E-09	4.50E-09	1.30E-08	2.50E-08	1.28E-08
6/18/07-7/2/07					
7/2/07-7/16/07	7.50E-09		1.30E-08	1.80E-08	1.28E-08
7/16/07-7/31/07	1.30E-09		3.60E-09	4.00E-10	1.77E-09
7/31/07-8/13/07	5.60E-09		1.20E-08	1.60E-08	1.12E-08
8/13/07-8/27/07	3.00E-09		3.30E-08	8.40E-09	1.48E-08
8/27/07-9/10/07	8.80E-09		2.60E-09	5.90E-08	2.35E-08
9/10/07-9/28/07	6.40E-09		1.10E-08	3.50E-09	6.97E-09
9/28/07-10/8/07	3.30E-08		2.20E-08	1.00E-08	2.17E-08
10/8/07-10/23/07	9.70E-09		2.20E-08	1.40E-08	1.52E-08
10/23/07-11/5/07	4.60E-09		7.70E-09	4.80E-09	5.70E-09
11/5/07-11/19/07	7.50E-09		3.30E-09	6.60E-09	5.80E-09
11/19/07-12/3/07	3.20E-09		8.90E-09	6.50E-09	6.20E-09
12/3/07-12/17/07	4.00E-09		4.50E-09	3.70E-09	4.07E-09
12/17/07-12/31/07	6.30E-09		7.40E-09	9.80E-09	7.83E-09

Grand Mean of All Samples 1.12E-08

Appendix B to 10CFR20 gives the Effluent limit for Tritium as 1.00E-07 this is equal to the 50 mrem limit for the general public. The 10 mrem constraint would be met if the limit is reduced to 20% of this value, or

2.00E-08

Then the uncorrected dose is the grand mean divided by the reduced limit times 10 mrem or 5.62E+00

The occupancy factor for this industrial park 50/168 or 2.98E-01

There fore the dose to the general Public from Tritium is the reduced limit dose muiltiplied by the occupancy Factor, Or

1.67E+00 mrem in a year

Carbon-14

Date Range	SouthEast	South	North	NorthWest	Mean
12/26/06-1/8/07	1.30E-09		3.80E-10	4.00E-10	6.93E-10
1/8/07-1/26/07	1.11E-09		9.20E-11	6.10E-10	6.04E-10
1/26/07-2/9/07	1.70E-09		8.90E-10	6.10E-10	1.07E-09
2/9/07-2/23/07	1.30E-09		3.50E-10	7.30E-11	5.74E-10
2/23/07-3/10/07	4.70E-10		0.00E+00	5.30E-10	3.33E-10
3/10/07-3/24/07	5.00E-10	6.80E-10	8.30E-10	6.10E-10	6.55E-10
3/24/07-4/8/07	3.90E-10	3.80E-10	3.00E-10	1.60E-10	3.08E-10
4/8/07-4/23/07	1.30E-10	6.90E-10	1.10E-10	6.20E-11	2.48E-10
4/23/07-5/7/07	8.60E-10	2.40E-09	3.40E-10	3.90E-10	9.98E-10
5/7/07-5/21/07	2.70E-10	4.80E-10	4.50E-10	5.70E-10	4.43E-10
5/21/07-6/4/07	9.30E-10	1.30E-09	2.80E-10	1.10E-09	9.03E-10
6/4/07-6/18/07	4.00E-10	5.40E-10	1.10E-10	6.10E-10	4.15E-10
6/18/07-7/2/07					
7/2/07-7/16/07	2.70E-10		1.40E-10	1.70E-09	7.03E-10
7/16/07-7/31/07	2.40E-10		3.60E-09	4.00E-10	1.41E-09
7/31/07-8/13/07	3.40E-10		3.10E-10	5.70E-10	4.07E-10
8/13/07-8/27/07	2.10E-10		3.50E-10	8.50E-10	4.70E-10
8/27/07-9/10/07	1.80E-10		5.10E-11	1.40E-09	5.44E-10
9/10/07-9/28/07	2.20E-10		1.60E-10	2.80E-10	2.20E-10
9/28/07-10/8/07	2.80E-10		1.30E-09	2.40E-10	6.07E-10
10/8/07-10/23/07	3.30E-10		2.40E-10	2.50E-10	2.73E-10
10/23/07-11/5/07	1.90E-10		1.60E-10	6.80E-10	3.43E-10
11/5/07-11/19/07	3.10E-10		1.40E-10	9.40E-10	4.63E-10
11/19/07-12/3/07	5.30E-10		7.10E-10	2.50E-09	1.25E-09
12/3/07-12/17/07	6.90E-10		3.00E-10	2.10E-10	4.00E-10
12/17/07-12/31/07	1.50E-10		2.60E-10	1.40E-09	6.03E-10

Grand Mean of All Samples 5.97E-10

Appendix B to 10CFR20 gives the Effluent limit for C-14 as 3.00E-09 this is equal to the 50 mrem limit for the general public. The 10 mrem constraint would be met if the limit is reduced to 20% of this value, or

6.00E-10

Then the uncorrected dose is the grand mean divided by the reduced limit times 10 mrem or 9.96E+00

The occupancy factor for this industrial park 50/168 or 2.98E-01

There fore the dose to the general Public from C-14 is the reduced limit dose muiltiplied by the occupancy Factor, Or

2.96E+00 mrem in a year

The total for both nuclides is then 4.64E+00 mrem in a year.

2006 INTAKE AIR

Tritium

Date Range	SouthEast	South	North	NorthWest	Mean
12/31/05-1/16/06	2.00E-09	5.10E-09	5.40E-09	3.20E-10	4.55E-09
1/16/06-1/30/06	3.90E-10	2.40E-09	6.90E-09	8.50E-09	4.55E-09
1/30/06-2/13/06	1.40E-12	3.60E-12	1.30E-12	5.30E-09	1.33E-09
2/13/06-2/28/06	3.70E-09	2.70E-09	9.80E-09	1.40E-08	7.55E-09
2/28/06-3/20/06	1.10E-09	4.50E-09	5.90E-09	3.40E-08	1.14E-08
3/20/06-4/3/06	6.90E-09	8.80E-09	4.70E-09	3.70E-08	1.44E-08
4/3/06-4/17/06	7.50E-09	1.20E-08	2.00E-08	1.20E-08	1.29E-08
4/17/06-5/1/06					
5/1/06-5/15/06	2.20E-08	1.10E-08	5.30E-09	8.90E-09	1.18E-08
5/15/06-5/30/06		1.30E-08	1.10E-08	1.00E-08	1.13E-08
5/30/06-6/12/06	1.00E-08	1.10E-08	1.50E-08	1.50E-08	1.28E-08
6/12/06-6/26/06	1.30E-08	1.10E-08	9.60E-09	1.40E-08	1.19E-08
6/26/06-7/10/06	1.30E-08	1.10E-08	7.00E-09	8.40E-09	9.85E-09
7/10/06-7/24/06	1.20E-08	2.40E-08	2.00E-08	2.20E-08	1.95E-08
7/24/06-8/7/06	4.90E-09	1.20E-08	1.40E-08	1.50E-08	1.15E-08
8/7/06-8/21/06	5.60E-08	1.60E-08	1.40E-08	2.30E-08	2.73E-08
8/21/06-9/5/06	8.70E-08	4.90E-08	2.80E-08	2.10E-08	4.63E-08
9/5/06-+9/18/06	2.10E-08	3.00E-08	1.10E-08	1.60E-08	1.95E-08
9/18/06-10/2/06	1.20E-08	1.80E-08	2.50E-08	1.30E-08	1.70E-08
10/2/06-10/18/06	5.50E-09	4.20E-08	1.20E-08	7.30E-09	1.67E-08
10/18/06-10/30/06	7.00E-09	3.10E-08	6.70E-09	4.70E-09	1.24E-08
10/30/06-11/14/06	1.30E-08		2.10E-08	9.50E-09	1.45E-08
11/14/06-11/27/06	8.40E-09	1.30E-08	9.20E-09	4.40E-09	8.75E-09
11/27/06-12/11/06	1.20E-08		1.20E-08	1.20E-08	1.20E-08
12/11/06-12/25/06	3.40E-09		7.50E-09	4.00E-09	4.97E-09

Grand Mean of All Samples 1.35E-08

Appendix B to 10CFR20 gives the Effluent limit for Tritium as 1.00E-07 this is equal to the 50 mrem limit for the general public. The 10 mrem constraint would be met if the limit is reduced to 20% of this value, or

2.00E-08

Then the uncorrected dose is the grand mean divided by the reduced limit times 10 mrem or 6.76E+00

The occupancy factor for this industrial park 50/168 or 2.98E-01

There fore the dose to the general Public from Tritium is the reduced limit dose muiltiplied by the occupancy Factor, Or

2.01E+00 mrem in a year

Carbon-14

Date Range	SouthEast	South	North	NorthWest	Mean
12/31/05-1/16/06	8.00E-11	2.60E-10	2.10E-10	1.60E-10	1.78E-10
1/16/06-1/30/06	2.50E-11	1.20E-10	2.00E-10	5.40E-10	2.21E-10
1/30/06-2/13/06	5.40E-10	8.10E-10	3.00E-10	8.70E-11	4.34E-10
2/13/06-2/28/06	4.70E-11	2.40E-10	5.80E-11	4.30E-10	1.94E-10
2/28/06-3/20/06	1.50E-13	5.00E-11	7.80E-11	2.00E-10	8.20E-11
3/20/06-4/3/06	6.20E-11	2.20E-11	7.60E-12	8.60E-13	2.31E-11
4/3/06-4/17/06	6.40E-11	1.30E-10	3.60E-10	3.20E-10	2.19E-10
4/17/06-5/1/06					
5/1/06-5/15/06	5.70E-10	1.70E-10	3.80E-10	7.90E-10	4.78E-10
5/15/06-5/30/06		2.00E-10	4.50E-10	5.50E-10	4.00E-10
5/30/06-6/12/06	3.50E-10	2.30E-09	1.20E-10	7.20E-10	8.73E-10
6/12/06-6/26/06	6.00E-10	8.40E-10	2.50E-10	2.90E-10	4.95E-10
6/26/06-7/10/06	6.40E-10	4.40E-10	2.30E-10	1.10E-09	6.03E-10
7/10/06-7/24/06	7.80E-10	2.90E-10	3.30E-10	2.70E-10	4.18E-10
7/24/06-8/7/06	1.90E-09	9.50E-10	5.10E-10	1.80E-10	8.85E-10
8/7/06-8/21/06	6.70E-10	3.10E-10	3.70E-10	6.80E-10	5.08E-10
8/21/06-9/5/06	7.80E-10	4.50E-10	1.20E-09	1.50E-09	9.83E-10
9/5/06-+9/18/06	7.00E-10	3.20E-10	1.60E-09	4.60E-10	7.70E-10
9/18/06-10/2/06	6.30E-10	1.90E-09	2.50E-09	8.90E-10	1.48E-09
10/2/06-10/18/06	3.50E-10	1.10E-09	2.90E-10	2.90E-10	5.08E-10
10/18/06-10/30/06	4.30E-10	1.10E-09	3.50E-10	1.50E-10	5.08E-10
10/30/06-11/14/06	2.00E-10	0.00E+00	1.60E-10	8.10E-11	1.10E-10
11/14/06-11/27/06	2.60E-10	2.10E-09	4.80E-11	4.30E-11	6.13E-10
11/27/06-12/11/06	5.00E-10		7.30E-10	2.10E-10	4.80E-10
12/11/06-12/25/06	3.40E-09		7.50E-09	4.00E-09	4.97E-09

Grand Mean of All Samples 6.84E-10

Appendix B to 10CFR20 gives the Effluent limit for C-14 as 3.00E-09 this is equal to the 50 mrem limit for the general public. The 10 mrem constraint would be met if the limit is reduced to 20% of this value, or

6.00E-10

Then the uncorrected dose is the grand mean divided by the reduced limit times 10 mrem or 1.14E+01

The occupancy factor for this industrial park 50/168 or 2.98E-01

There fore the dose to the general Public from C-14 is the reduced limit dose muiltiplied by the occupancy Factor, Or

3.39E+00 mrem in a year

The total for both nuclides is then 5.41E+00 mrem in a year.

2005 INTAKE AIR

Tritium

Date Range	SouthEast	South	North	NorthWest	Mean
1/5/05-1/19/05	3.20E-09	1.90E-09	9.60E-10	5.10E-10	1.64E-09
1/19/05-2/1/05	9.20E-10	2.20E-09	1.40E-09	1.30E-09	1.46E-09
2/1/05-2/14/05	1.10E-09	1.90E-09	1.60E-10	2.40E-13	7.90E-10
2/14/05-2/28/05	1.60E-13	2.70E-09	1.90E-13	4.30E-10	7.83E-10
2/28/05-3/14/05	1.20E-10	1.90E-09	2.50E-13	4.20E-10	6.10E-10
3/14/05-3/31/05	1.50E-13	9.70E-10	2.20E-13	1.60E-13	2.43E-10
3/31/05-4/11/05	2.80E-12	3.10E-12	3.00E-12	2.00E-12	2.73E-12
4/11/05-4/25/05	8.00E-10	4.80E-09	3.20E-09	1.20E-08	5.20E-09
4/25/05-5/9/05	1.80E-09	4.40E-09	1.50E-09	4.40E-09	3.03E-09
5/9/05-5/24/05	9.20E-09	6.00E-09	1.80E-09	9.50E-09	6.63E-09
5/24/05-6/6/05	1.30E-08	1.90E-08	5.70E-10	3.20E-08	1.61E-08
6/6/05-6/20/05	3.60E-09	4.80E-09	1.90E-10	6.10E-11	2.16E-09
6/20/05-7/5/05	1.40E-09	4.30E-09	2.90E-09	2.70E-12	2.15E-09
7/5/05-7/17/05	2.70E-09	2.80E-12	1.80E-09	3.70E-12	1.13E-09
7/17/05-8/1/05	5.50E-09	6.40E-09	3.30E-09	1.80E-09	4.25E-09
8/1/05-8/15/05	3.70E-09	7.90E-09	7.10E-09	1.40E-08	8.18E-09
8/15/05-8/29/05	9.90E-13	1.80E-09	3.50E-10	4.10E-10	6.40E-10
8/29/05-9/19/05	1.00E-09	7.00E-10	4.10E-10	2.00E-12	5.28E-10
9/1905-10/3/05					
10/3/05-10/17/05	8.00E-09	3.40E-08	7.00E-09	2.70E-08	1.90E-08
10/17/05-10/31/05	7.20E-10	7.20E-10	1.20E-09	6.60E-13	6.60E-10
10/31/05-11/16/05	3.80E-09	4.30E-09	8.30E-09	2.70E-09	4.78E-09
11/16/05-11/30/05	1.10E-12	3.10E-12	1.70E-12	8.60E-10	2.16E-10
11/30/05-12/12/05	1.90E-12	2.50E-12	2.00E-12	1.10E-12	1.88E-12
12/12/05-12/31/05	9.80E-09	1.70E-09	1.80E-09	1.30E-09	3.65E-09

Grand Mean of All Samples 3.49E-09

Appendix B to 10CFR20 gives the Effluent limit for Tritium as 1.00E-07 this is equal to the 50 mrem limit for the general public. The 10 mrem constraint would be met if the limit is reduced to 20% of this value, or 2.00E-08

Then the uncorrected dose is the grand mean divided by the reduced limit times 10 mrem or 1.75E+00

The occupancy factor for this industrial park 50/168 or 2.98E-01

There fore the dose to the general Public from Tritium is the reduced limit dose muiltiplied by the occupancy Factor, Or

5.20E-01 mrem in a year

Carbon-14

Date Range	SouthEast	South	North	NorthWest	Mean
1/5/05-1/19/05	1.60E-10	2.10E-12	1.40E-11	1.10E-11	4.68E-11
1/19/05-2/1/05	1.90E-12	1.30E-12	1.80E-12	2.90E-12	1.98E-12
2/1/05-2/14/05	5.30E-11	3.40E-11	4.30E-12	1.80E-11	2.73E-11
2/14/05-2/28/05	1.60E-13	2.30E-13	1.90E-13	3.40E-13	2.30E-13
2/28/05-3/14/05	1.70E-11	3.40E-11	2.80E-11	9.10E-11	4.25E-11
3/14/05-3/31/05	7.40E-12	5.70E-11	1.40E-11	3.30E-11	2.79E-11
3/31/05-4/11/05	2.80E-13	3.10E-13	3.00E-13	2.00E-13	2.73E-13
4/11/05-4/25/05	9.70E-11	2.00E-11	3.50E-11	7.20E-11	5.60E-11
4/25/05-5/9/05	2.60E-11	3.10E-11	3.90E-11	7.70E-11	4.33E-11
5/9/05-5/24/05	2.00E-10	5.60E-11	9.30E-11	6.30E-11	1.03E-10
5/24/05-6/6/05	7.60E-11	1.60E-11	3.60E-13	8.20E-11	4.36E-11
6/6/05-6/20/05	1.00E-11	2.20E-11	1.80E-10	1.60E-10	9.30E-11
6/20/05-7/5/05	2.70E-13	5.50E-11	6.40E-10	9.70E-11	1.98E-10
7/5/05-7/17/05	1.40E-11	4.10E-11	1.90E-10	1.40E-10	9.63E-11
7/17/05-8/1/05	4.70E-11	4.70E-10	1.30E-10	1.10E-09	4.37E-10
8/1/05-8/15/05	1.00E-10	9.90E-11	1.10E-10	2.50E-10	1.40E-10
8/15/05-8/29/05	1.60E-10	1.20E-10	1.30E-11	2.00E-10	1.23E-10
8/29/05-9/19/05	4.50E-11	2.30E-11	1.00E-11	1.40E-10	5.45E-11
9/1905-10/3/05					
10/3/05-10/17/05	2.80E-10	9.40E-11	1.14E-10	7.90E-11	1.42E-10
10/17/05-10/31/05	1.10E-10	1.30E-10	7.80E-11	8.80E-11	1.02E-10
10/31/05-11/16/05	6.20E-11	8.20E-11	2.10E-10	1.50E-10	1.26E-10
11/16/05-11/30/05	1.10E-13	3.10E-13	1.70E-13	2.70E-13	2.15E-13
11/30/05-12/12/05	5.80E-10	8.40E-10	2.90E-10	1.80E-10	4.73E-10
12/12/05-12/31/05	7.30E-11	6.60E-11	9.40E-11	5.50E-11	7.20E-11

Grand Mean of All Samples 1.02E-10

Appendix B to 10CFR20 gives the Effluent limit for C-14 as 3.00E-09 this is equal to the 50 mrem limit for the general public. The 10 mrem constraint would be met if the limit is reduced to 20% of this value, or 6.00E-10

Then the uncorrected dose is the grand mean divided by the reduced limit times 10 mrem or 1.70E+00

The occupancy factor for this industrial park 50/168 or 2.98E-01

There fore the dose to the general Public from C-14 is the reduced limit dose muiltiplied by the occupancy Factor, Or

5.06E-01 mrem in a year

The total for both nuclides is then 1.03E+00 mrem in a year.

Attachment 2

17 February 2011

U.S.Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Reference: Docket No 030-20567
License No: 24-21362-01

Subject: Report of Exceeding Constraint in 10CFR20.1101(d)

Gentlemen,

This report is submitted in accordance with 10CFR20.2203(b)

American Radiolabeled Chemical, Inc (ARC) has been measuring the airborne concentrations at the intakes to our Building 400, the closest building where members of the public are found. There are four individual intakes for the four zones of the building. As these zones are not mixed, the zones are treated separately.

Due to many one time circumstances, the final calculations for the proceeding year were not completed until February 16th of 2011.

During the calendar year 2010 the dose in a year to the exposed members of the public were determined to be:

55.9 mrem in a year for Zone 1
37.8 mrem in a year for Zone 2
10.0 mrem in a year for Zone 3
7.9 mrem in a year for Zone 4

The dose limits for the general public found in 10CFR20.1301(a)(1) were not exceeded.

The cause of the increase was increased production of labeled chemicals for medical research. This resulted in a large increase in the use of, and consequently the release of, Tritium.

Corrective steps taken:

Reduction in the amount of Tritium used in each reaction;
Increased use of cold traps for Tritiated water
Increased use of charcoal traps for Tritium gas.

Corrective steps planned:

1. Submission of a license amendment request to place charcoal filters on the exhaust of the Tritium process hoods.

2. Calculation of the public dose monthly *vice* annually.

3. Submission of an amendment request to permit the use of the COMPLY code on a monthly basis for screening purposes.

Actions to prevent recurrence:

ARC feels that the steps taken and planned will prevent the total annual dose from exceeding 10 mrem in a year.

Determination of the dose on a monthly basis will enable us to make any additional changes required prior to the year ending.

Unofficial use of COMPLY with January's data shows a projected annual dose within the constraint.

Thank you for your attention in this matter.

Sincerely,

Surendra K. Gupta, PhD
President
American Radiolabeled Chemicals

Attachment 3

10 January 2012

U.S.Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Reference: Docket No 030-20567
License No: 24-21362-01

Subject: Report of Exceeding Constraint in 10CFR20.1101(d)

Gentlemen,

This report is submitted in accordance with 10CFR20.2203(b)

American Radiolabeled Chemical, Inc (ARC) has been measuring the airborne concentrations at the intakes to our Building 400, the closest building where members of the public are found. There are four individual intakes for the four zones of the building. As these zones are not mixed, the zones are treated separately.

During the calendar year 2011, while significant improvement was made, the dose in a year to the exposed members of the public was determined to be above the constraint for one zone.

Zone	**2011 results**	**2010 results (prior year**
1.	17.3 mrem in a year	55.9 mrem in a year
2.	8.2 mrem in a year	37.8 mrem in a year
3.	7.1 mrem in a year	10.0 mrem in a year
4.	6.9 mrem in a year	7.9 mrem in a year

The dose limits for the general public found in 10CFR20.1301(a)(1) were not exceeded.

Corrective steps taken:

Reduction in the amount of Tritium used in each reaction;
Increased use of cold traps for Tritiated water

Corrective steps planned:

1. Requested and received a license amendment request to increase the effective stack height to increase dilution and dispersion of effluent. This will eliminate any "wake effect" from Building 300. The modifications have been bid, and will start in February.

2. Calculation of the public dose monthly *vice* annually.

3. Requested and received a license amendment to permit the use of the COMPLY code on a monthly basis for screening purposes.

Actions to prevent recurrence:

ARC feels that the steps taken and planned will prevent the total annual dose from exceeding 10 mrem in a year.

Determination of the dose on a monthly basis will enable us to make any additional changes required prior to the year ending.

Unofficial use of COMPLY with January's data shows a projected annual dose within the constraint.

Thank you for your attention in this matter.

Sincerely,

Surendra K. Gupta, PhD
President
American Radiolabeled Chemicals

Attachment 4

Licensee Improvements

A total of $102,000 has been spent on capital improvements relating to Radiation Protection. $ 58,000 for increasing effective stack height on building 300; $40,000 for new air effluent sampling; $ 4,000 for a flow calibrator for the air sampling equipment.

1. Increase in Building 300 Effective stack Height has lowered dose to public from 15 mrem in a year to 1.3 mrem in a year. Effective stack height was increased by adding a nozzle and wind band to the top of the existing stack and increasing the blower from 5 horsepower to 25 horsepower.

   COMPLY calculations are done weekly to allow for trending and to spot any adverse changes.

   Building 100, which showed the greatest variability in C-14 gaseous effluent, has new air sampling rigs which sample separately for Tritium, Carbon dioxide, and volatile organic carbon compounds.

   Building 300 has new effluent air sampling rigs which sample separately for Tritium and Carbon dioxide.

   Processing of liquid waste backlog has reduced non-aqueous Rad waste to that generated in a week. That is, zero in storage.

2. Continued reduction in aqueous rad waste has the activity discharged to the sanitary sewer to be lowered for the third year in a row.

3. Trending of all survey results shows a significant decrease in the number of points above the action level, and almost complete elimination of points above the investigation level.

4. Clearing of decay in storage items has lowered the total number of items in storage. Decontamination of the shielded containers has allowed these items to be re-used.

   A "decay in storage" inventory is now part of the weekly summary report.

5. As an ALARA measure, Hood flows are now subject to correction at 150 LFPM instead of the license required 100 LFPM

6. Radiation Safety Committee meetings, required by license to be quarterly, are held whenever possible at least monthly.

7. Surveys of lab workers vehicles; street shoes; Outer clothing; and full body frisks are performed by Radiation Safety personnel at least monthly

8. Safety topics are distributed monthly to maintain a safety conscious workplace.

9. Entrances to RAM areas are checked every day to ensure they are locked or guarded.

10. The security system vendor performs a complete test of all sensors every quarter and a written report is on file.

Attachment 5

AMERICAN RADIOLABELED CHEMICALS, INC
STANDARD OPERATING PROCEDURE – SOP-43 DRAFT

Supersedes: new
Reviewed by RSC:
Approved by NRC:
SUBJECT: Evacuation of Laboratories Due to Exhaust Failure

OBJECTIVE: This SOP outlines actions to be taken in the event of Exhaust blower failure.

This SOP will go into effect at the time license renewal is approved by Region III.

RESPONSIBILITY: Radiation Safety Officer or designee

PROCEDURE:

1.0 Immediate actions.

1.1 All personal shall evacuate the laboratory in question. Each chemist, before leaving, will place any operation in a safe condition.

1.2 The RSO or designee will, as far as practical, determine the cause

1.3 If the cause is not due to loss of utility power then direct the make-up air system for the laboratory in question to be shut down.

2.0 Duration of Evacuation

2.1 The laboratory without exhaust flow will remain out of service until flow is restored.

2.2 Entry into the laboratory for safety reasons, or to protect the public, or to prevent serious financial loss will be permitted by the RSO or designee on a case by case basis.

3.0 Return to operation

3.1 Start the exhaust blower.

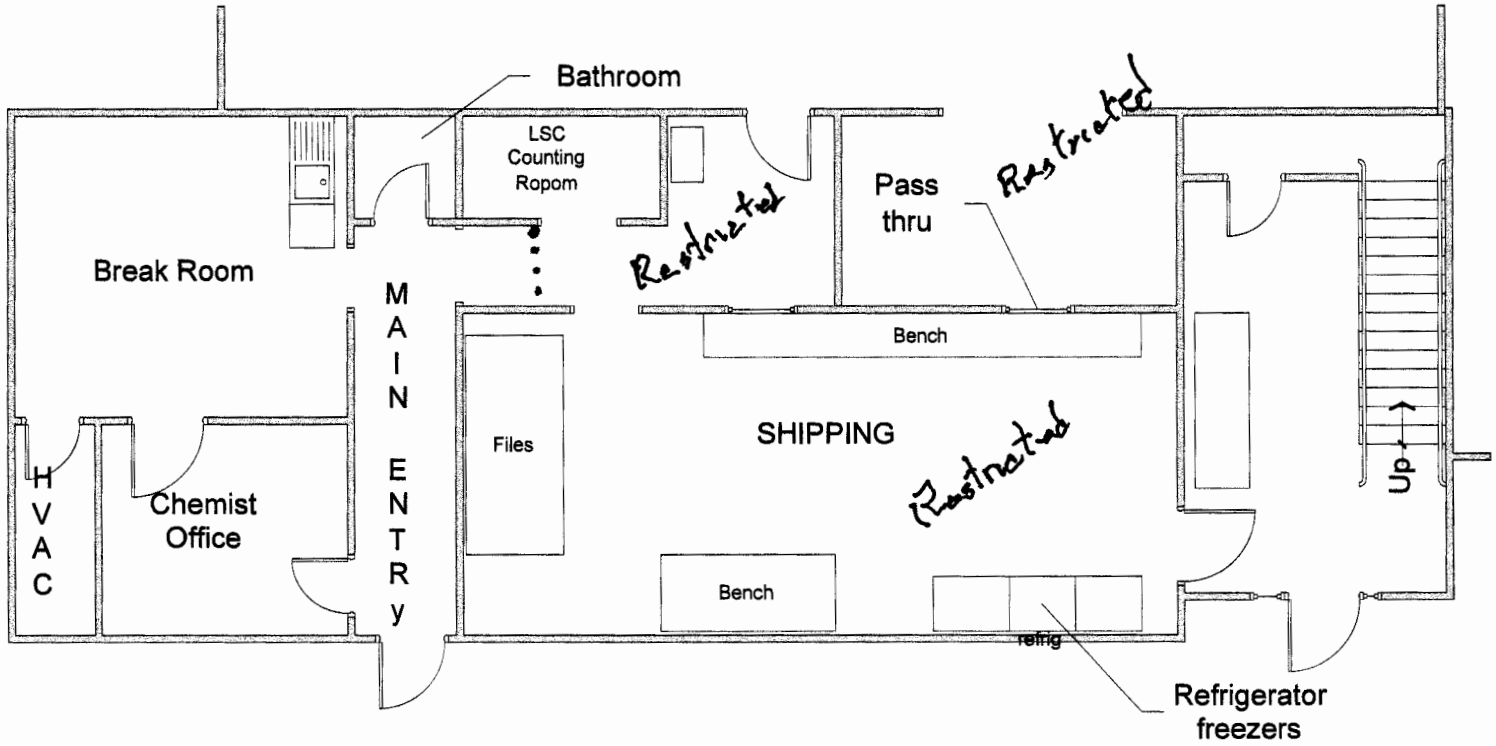
3.2 After the exhaust blower has been operating for 15 to 20 minutes, start the make up air system.

3.3 After the make-up air system has been operating for 15 to 20 minutes, entry will be permitted.

3.4 The RSO or designee will measure the individual hood face velocity and determine if all hoods are within limits. 100 lfpm mandatory and 150 lfpm preferred.

Supersedes: new
Reviewed by RSC:
Approved by NRC:
SUBJECT: Evacuation of Laboratories Due to Exhaust Failure

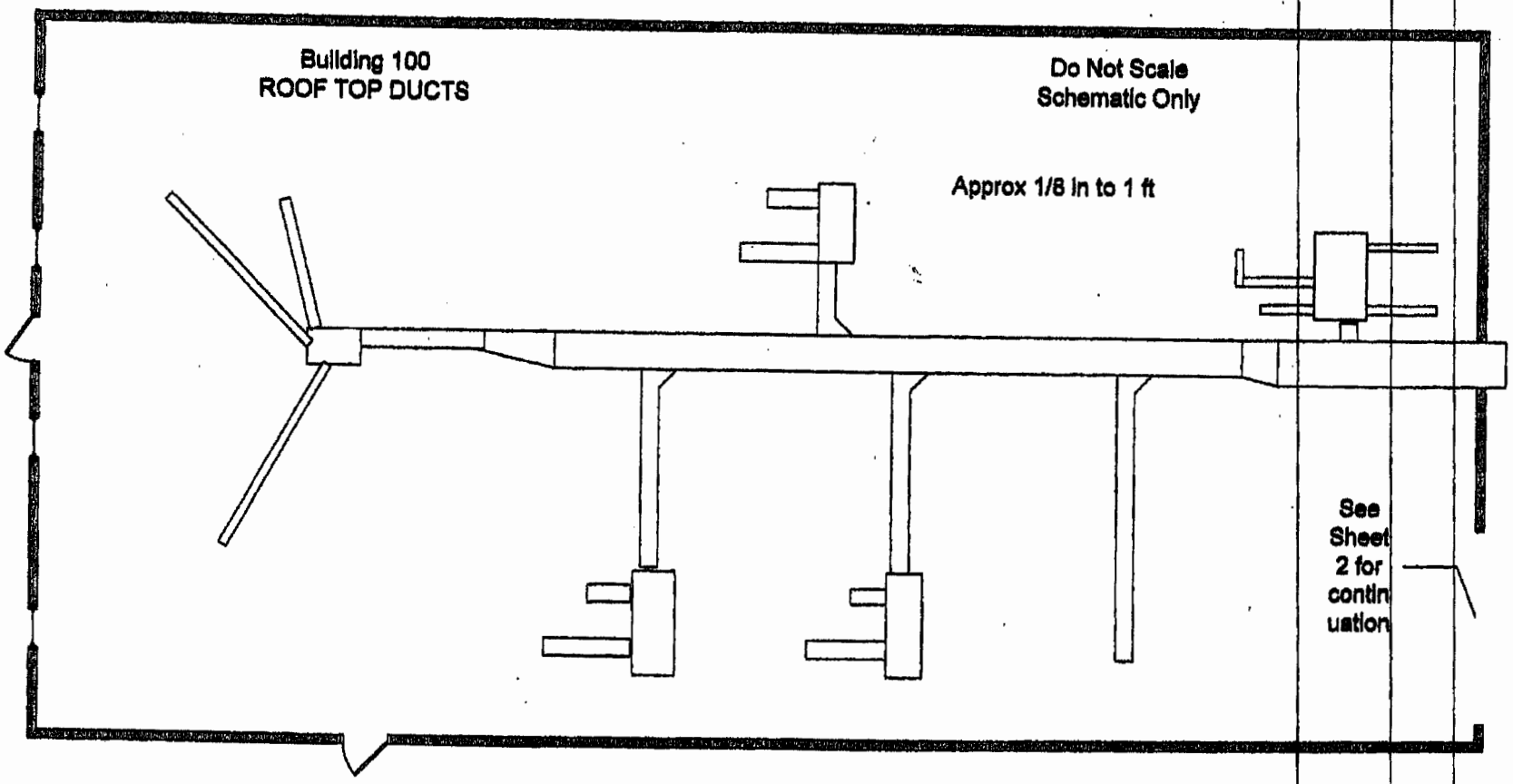
Attachment 6

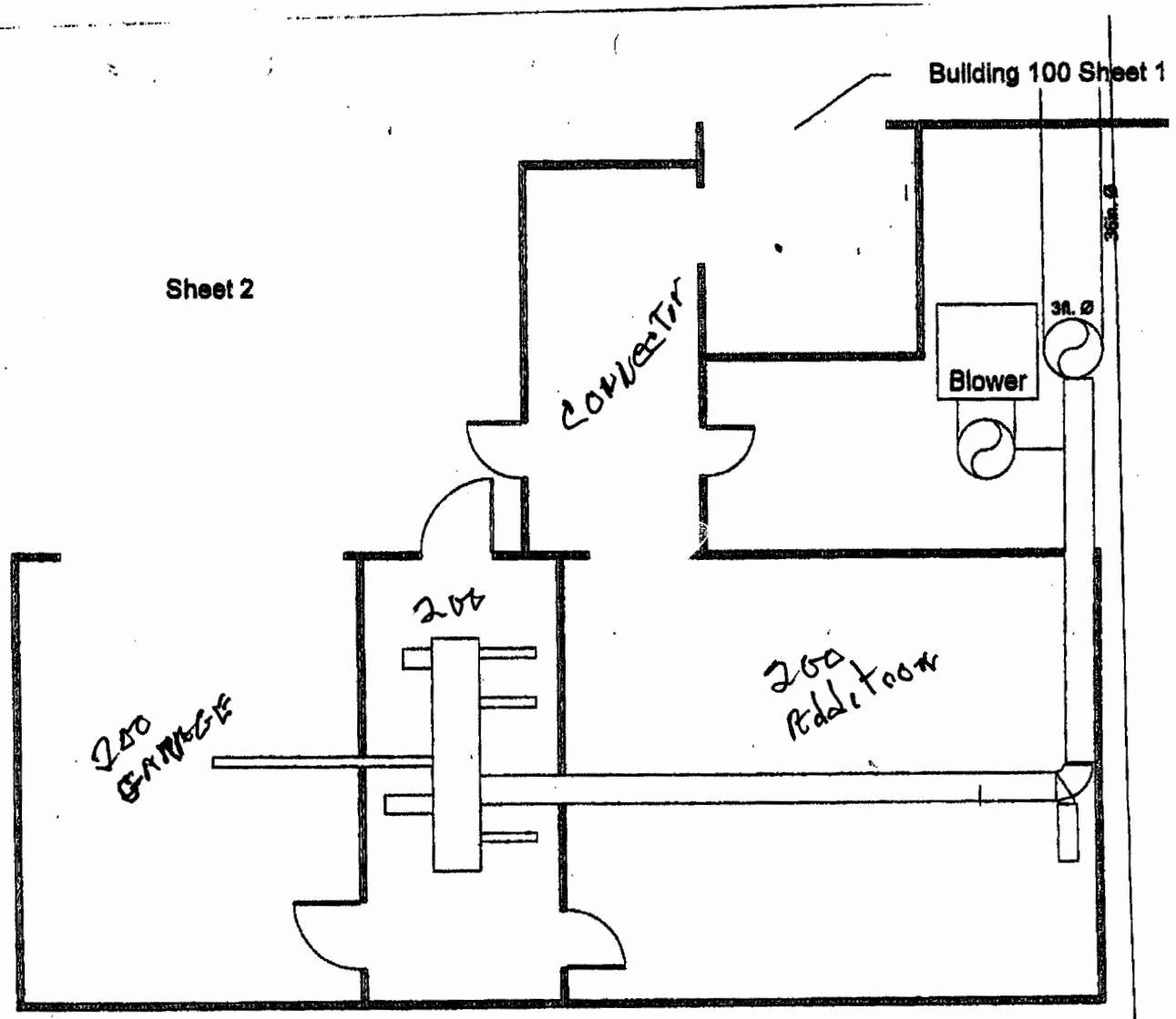


Building 300 Controlled
areas and Shipping Area

Do Not Scale Approx.
1/8 in to 1 foot

Attachment 7

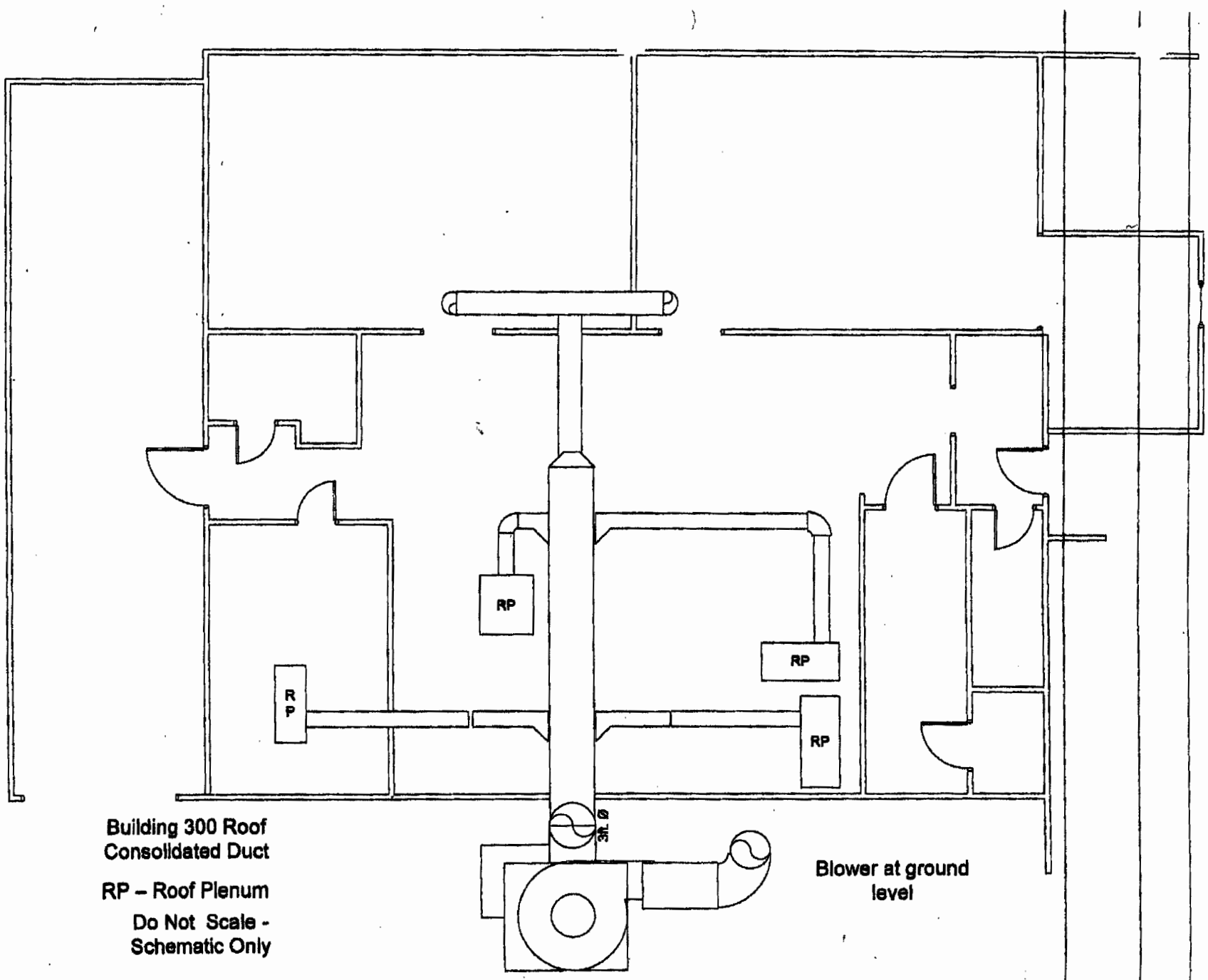

Building 100
ROOF TOP DUCTS
Do Not Scale
Schematic Only
Approx 1/8 in to 1 ft
See
Sheet
2 for
contin
uation



Building 100 Roof Ducts
Schematic Only

Do Not Scale
Approx. 1/8 in to 1 foot

Attachment 8



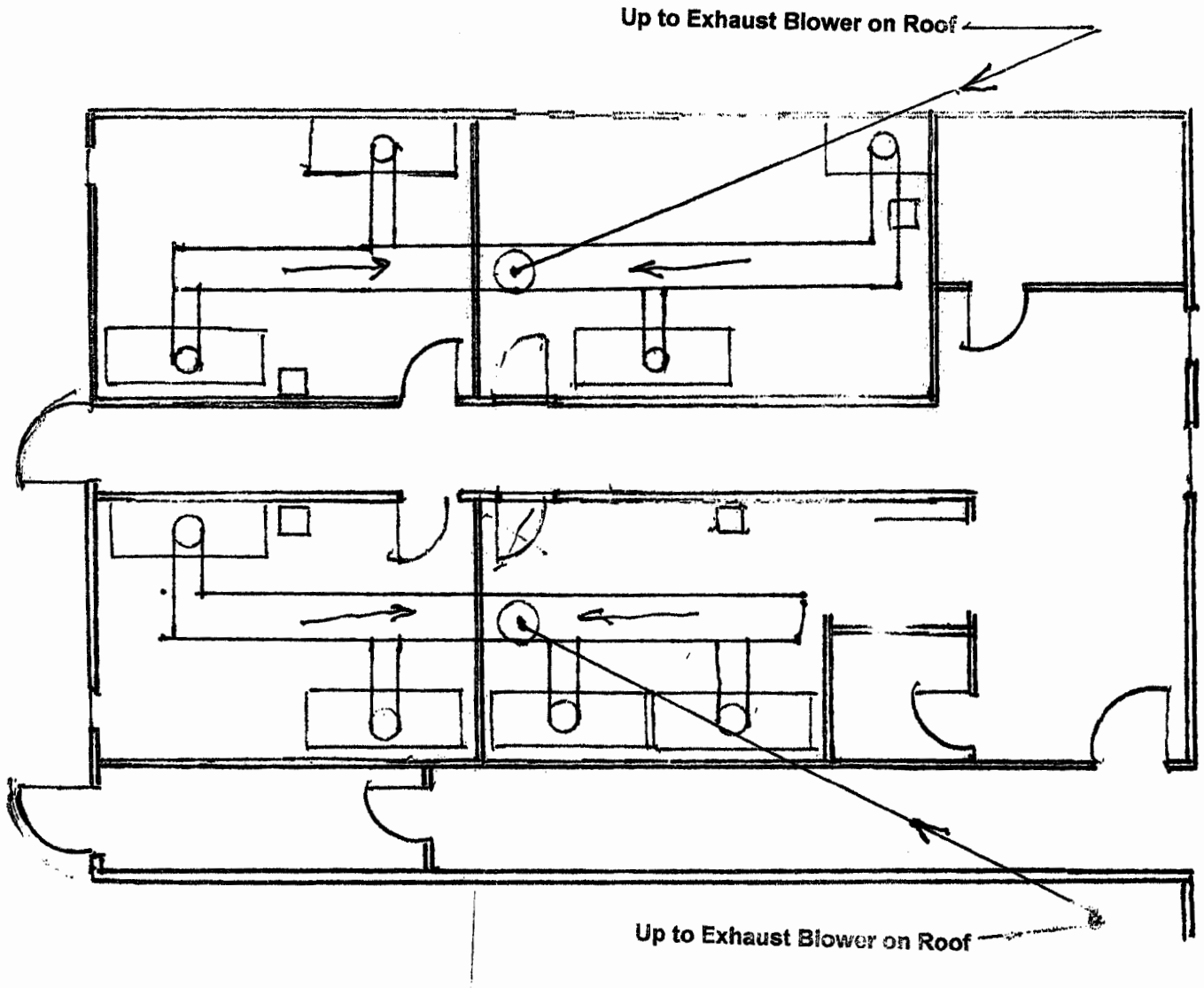
Building 300 Roof
Consolidated Duct

RP – Roof Plenum

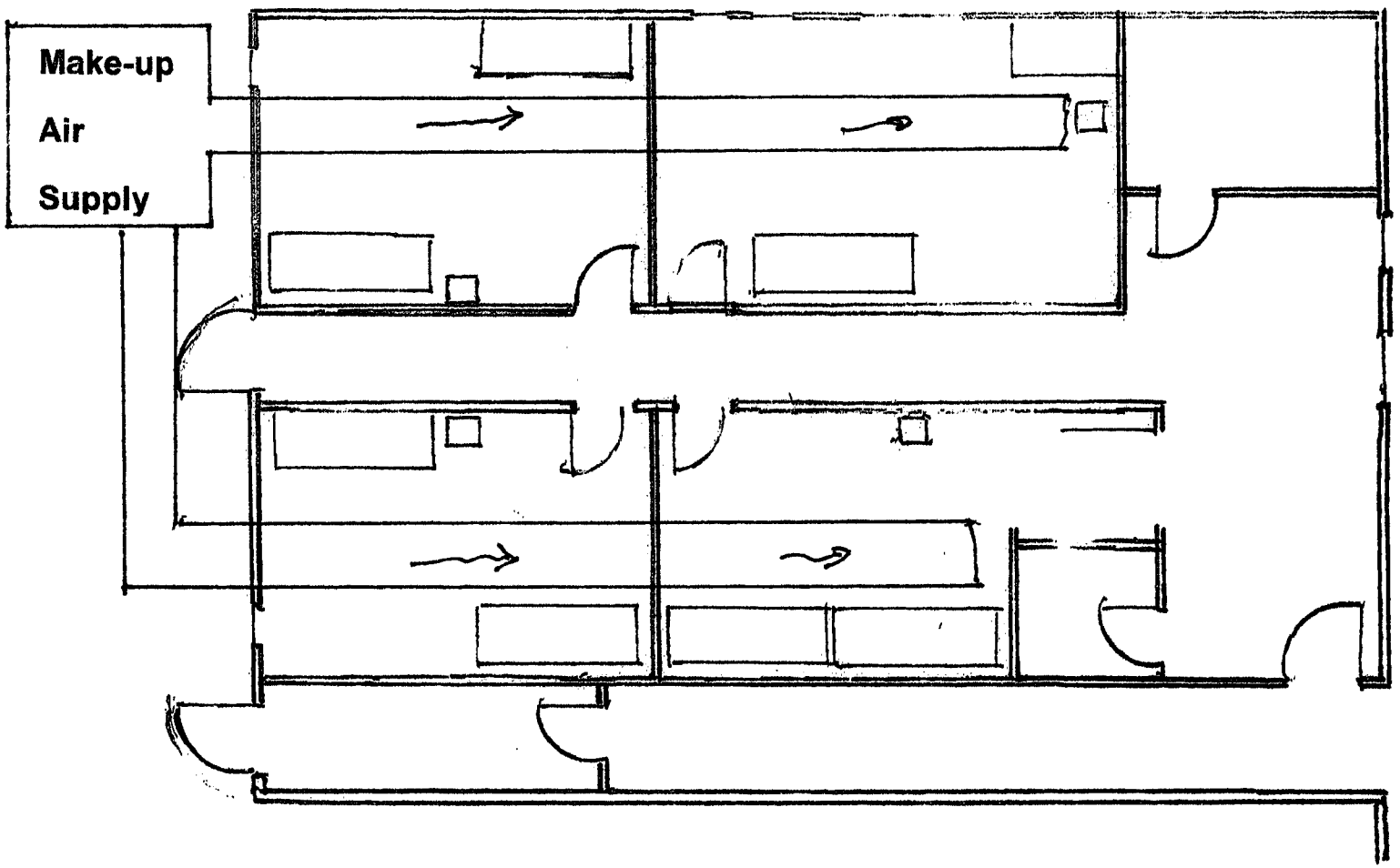
Do Not Scale -
Schematic Only

Blower at ground
level

Attachment 9



300 Annex Exhaust


Make-up
Air
Supply

Attachment 10

Radiation Protection Program Audit

I. Introduction

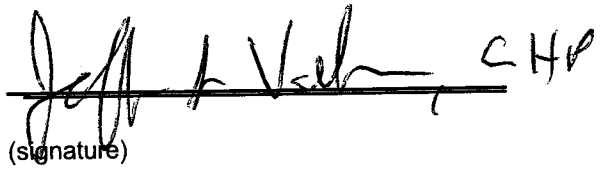
This report documents the performance of the annual radiation protection program review required by the ARC Radiation Protection Program. The audit consists of a review of the program's content and implementation, evaluating the effectiveness in compliance with regulatory requirements and keeping radiation exposure to workers and the general public As low As Reasonably Achievable (ALARA). Records of the annual audits must be made available for inspection by NRC region 4.

licensee Name: American Radiolabeled Chemicals, Inc.

license number: 24-21362-01 Date of Audit: December 1, 2011

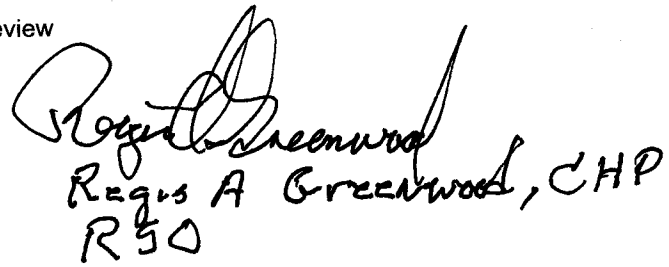
Auditor: Jeffrey S. Vollmer, CHP

(name, title)



(signature)

Management Review



II. Audit History

A. last audit conducted on: 12/1/2011
B. Any deficiencies noted?..... Yes
C. Were corrective actions taken? ..... yes
D. Brief description of prior deficiencies. Corrective actions taken
   1. licensee lacked a formal corrective action program connected to the root cause analysis. A formal root cause program was created and took effect. Reviewing records showed evidence of formal root cause evaluations occurring.
   2. There was no evidence of disciplinary action being taken on the part of management. Additionally , ARC does not have a formal disciplinary policy or procedure.

An ARC policy on consequence for failure to comply with company policies and procedures was approved and took effect on January 1st 2011.

3. Records indicate repeated cases of contaminated personal work stations (e.g desk, phone), contamination in lunch room, contamination in personal vehicles and elsewhere. Interviews with personnel indicate that some individuals are not as conscientious as they should be about the spread of contamination. There was no evidence of disciplinary action being taken on the part of management. Additionally, ARC does not have a formal disciplinary policy or procedures.

   - Records reviewed during the current inspection did not indicate repeated case of contaminated work stations and contamination in the lunch room or personal vehicles and elsewhere. Interviews with personnel still indicate that some individuals are not as conscientious as they should be about the spread of contamination. ARC has added a formal disciplinary policy that went into effect January 1. 2011.

4.No evidence of written job descriptions specifying individual duties and responsibilities for the RSO and assistant RSO.

- Duties and responsibilities for the RSO and assistant RSO can be found in the Radiation Protection Program document; however separate written job descriptions have not been prepared.

III. Organization and Scope of Program

A.Organizational responsibilities for RPP are well defined and understood? Yes

B.Staffing and resources are sufficient to accomplish assigned tasks? Yes

The RSO is planning on retiring very soon and a plan for replacement should be made. This plan should include necessary training and mentoring for the replacement to help maintain the significant strides the organization has made in Radiation Protection.

C. Appropriate responsibilities are assigned to management level personnel? Yes

But documented only in the Radiation Protection Program

O. Responsibilities and authorities of the radiation staff are clearly defined and sufficient to control work to protect employees? Yes

Specification of individual duties and responsibilities were found in the RPP and no separate written job descriptions.

E. Management, Supervisors and technicians understand their authority, responsibilities and accountabilities? Yes

F. The RSO has direct access to Corporate management and sufficient authority to perform his/her duties. Yes

G. Auditable reports of inspections, audits, and resulting corrective actions are maintained? Yes

With the exception that no auditable report of the 2007 audit by the RSO was available. H. Procedures approved by facility management are in place to implement the RPP and reviewed periodically and updated as needed? Ye

I. Radiation Protection problems are evaluated and documented and corrective actions are taken to correct root causes? Yes

J. Radiation Protection personnel are actively encouraged to pursue continuous improvement to the RPP and its implementation? Yes

IV. Member of Public (MOP) Dose Umits

A. Has a MOP dose compliance study been developed, submitted & approved by the NRC? Yes

B. Have licensed activities changed during the year to increase likelihood of public dose limits being exceeded. No

V. Training Program

W.instructions to workers per [10CFR 19.12] Yes

X. Training program implemented as required [I/C}? Yes

Y. Training records maintained [L/C}? Yes

D. Evaluation of individuals' understanding of procedures and requirements based on interviews, observation of selected workers was performed? Yes

1. Each area has an up to date copy of the licensee's safe use and emergency procedures? Yes

2. Adequate understanding of:

Current safe use procedures? Yes

Emergency Procedures? Yes

E. 10 CFR 20 workers cognizant of requirements for:

1. Radiation Safety Program [20.110l]? Yes
2. Annual dose limits [20.1301, 20.1302]? Yes
3. NRC forms 4 and 5? Yes
4. 10% monitoring threshold? Yes
5. Procedures for opening packages [20.1906]? Yes

F. Upon hiring, female workers provided instructions regarding radiation risk to embryo/fetus and procedure for declared pregnancies, and documentation of receipt of instructions maintained on file? Yes

G. Female workers declaring pregnancy document their declaration, are provided instructions regarding monitoring and limiting the dose to the embryo/fetus, and receipt of instructions documented? Yes

H. Field observations of chemists demonstrate use of safe work practices & compliance with regulatory requirements? Yes

VI. Personnel Monitoring (PM)

A. Personal Monitoring is conducted for internal exposure only (Urine Bioassay)

1. Has a request for an exemption from monitoring been submitted and approved by NRC? Annual prospective determination of need for Monitoring shows no need for external monitoring but does show need for internal monitoring. These reviews are on file and have been reviewed by NRC inspectors
2. Have licensed activities changed during the year to increase workers radiation exposures (ie expanded work load or increase activity use)? No

Remarks: Using less activity than previous year.

VII. Internal Radiation Exposure Control

A. Are procedures in place and adequate for properly determining internal doses from licensed activities Yes

B. Occupational Exposures within limits? Yes

C. Do dosimetry records and investigation indicate that worker doses are being kept ALARA. Yes

VIII. Posting and Labeling

A. Following documented posted at facilities:

1. Emergency Procedures Yes

2. „ Notice to Employees" Yes

3. Any notice of violations, proposed imposition of administrative penalties and agency issued orders and response to the cited violations? Yes

B. Above documents posted in conspicuous locations (s) to permit workers to observe them on way to/from work? Yes

C. Radiation Signs:

1. "Caution (or Danger), Radioactive Material" signs posted? Yes

2. "Caution (or Danger Radition Area" signs N/A

IX. Radiation Survey Instruments

A. If a specific survey meter is not possessed are specific plans in place to have one available when needed Yes

B. Are an adequate number of instruments available when for backup when primary are unavailable? Yes

C. Instruments are properly tested and calibrated periodically and adequate records are maintained? Yes

D. Numbers and types of instruments are adequate to meet the needs of the radiation surveillance program? Yes

E. Adequate system for instrument calibration recall exists as demonstrated by current calibration stickers on instruments? Yes

F. Calibration and repair facilities adequate for calibration and maintenance and are periodically quality checked? Yes

G. Adequate check sources are available for operability testing prior to use? Yes

Remarks: Source and operability of instruments used for release could be improved by creating a standard source and a source check response sheet and documenting the results of daily inspections of this. The standard from ANSI N323-1978

To assure proper operation of the instrument between calibrations, the instrument shall be tested with the check source during operation and prior to each intermittent use. Reference readings shall be obtained on each instrument when exposed to a check source in a constant and reproducible manner at the time of, or promptly after, primary calibration. If at any time the instrument response to the~ check source differs from the reference reading by more than ± 20 percent, the instrument shall be returned to the calibration facility for calibration or for maintenance, repair, and recalibration, as required. Reference readings should be obtained for one point on each scale or decade normally used. The check source should accompany the instrument if it is specific to that instrument

X. Environmental Monitoring

A. Adequate surveys are conducted to demonstrate that dose to the public does not exceed NRC limits [20.1301 (a)(l), 20.1302(a)(2), 20.1302(b}? Yes

B. All potential releases of RAM to the environment are monitored? Yes

C. Auditable records are kept to show RAM release quantities Yes

Remarks: Added collection drums to monitor potential pathway. Exceeded an EPA constraint but have not exceeded NRC limit of 10m rem/yr.

XI. Security

A. Facilities as described in license documents? Ye

B. Access to restricted area/licensed material in accordance with 20.1801? Yes s

C.Extra precautions used to deter theft (e.g. concealing material/devices from view in high crime areas?

Yes

XII. Operating and Emergency (O&E) Procedures

A. Any revisions to O&E procedures made that have not been reviewed and approved by the NRC? Yes

B. O&E procedures list correct phone numbers for RSO & NRC? Ye s

C. Access to the facility is pre-planned and pre-arranged for emergency personnel and equipment during emergencies? Yes

XIII. Transportation

A. Only DOT-7 A or other authorized packages used to transport RAM? Yes

B. Packages used to ship products properly marked & labeled per 49 CFR Part 172, Subparts 0 & E? Yes

C. Shipping containers properly locked, blocked & braced prior to transport? Yes

D. Prior to shipment containers inspected to ensure proper packaging, unimpaired physical condition of container & closure devices? Yes

E. Properly completed bill of lading & emergency response information provided for each shipment? Yes

Remarks: ARC also follows lATA requirements for international shipments. Up to date transportation regulations are available in a searchable computer. Dangerous goods checklist used: all DG requirements are being met. ARC has not experienced external contamination on a package since 2003.

XIV. ALARA Program

A Management & RSO emphasize to workers importance of maintaining doses ALARA? Yes

B. Management has made all reasonable efforts to minimize RAM releases to the environment from operations? Yes

C. Good work practices used by workers to minimize the spread of contamination? Yes

Remarks: Improvements could be made in contamination control through the use of a hand and foot monitor at exit points or a Personnel Contamination monitor.

XV. Sealed Source Leak Tests

Not applicable

XVI Radioactive Material (RAM) Inventory

A. Receipt & transfer/disposal records maintained Yes

B. Inventories of stored RAM specify locations, quantities, and characteristics and are current and periodically audited? Yes

C. Procedures are in place to adequately control, label, handle, ship and receive RAM?

Yes

Remarks: One person dedicated to updating inventory and an audit was in process during the inspection.

XV... Record Keeping. Notifications & Reports

A. All required documents maintained on file at permanent facility for duration specified by the license Yes

B. Did any incidents/ emergencies occur since last review Yes

C. If yes to B, was the response appropriate? (Le., operator followed emergency procedures, required notifications/ reports timely filed, cause of incident investigated, corrective actions taken & documented? Yes

XVIII. Independent Audits/Inspections

A. Any independent audits/inspections conducted since last internal audit? Yes

B. Summary of deficiencies identified and corrective actions taken:

XIX.Program Deficiencies

No Program deficiencies were noted.

XX. Other Recommendations for Improvement

1. Cross train personnel to be prepared to fill in for individuals where the present manpower is "one deep".
2. Consider the use of a hand and foot monitor or PCM at release points to improve contamination control.
3. Source and operability of instruments used for release could be improved by creating a standard source and a source check response sheet and documenting the results of daily inspections of this. The standard from ANSI N323-1978: To assure proper operation of the instrument between calibrations, the instrument shall be tested with the check source during operation and prior to each intermittent use. Reference readings shall be obtained on each instrument when exposed to a check source in a constant and reproducible manner at the time of, or promptly

after, primary calibration. If at any time the instrument response to the check source differs from the reference reading by more than ± 20 percent, the instrument shall be returned to the calibration facility for calibration or for maintenance, repair, and recalibration, as required. Reference readings should be obtained for one point on each scale or decade normally used. The check source should accompany the instrument if it is specific to that instrument

4. Create staffing and training plan for RP personnel to ensure the program maintains its high standards when replacing departing RP staff members.
5. The following program improvement was noted during the audit a separate job description outside the RPP still needs to be created for the RSO and assistant RSO.

Attachment 11

Health Physics Summary
Friday, 19 July 2013

This report covers the period from 7/12/13 to 7/18/13 inclusive.

Friday Surveys 7/12/13 Note: this survey is taken on the last scheduled work day of a given week, It is referred to as the "Friday Survey" for convenience.

Inside

One area in Building 100 was 1.7 x AL.

Bldg 100 stack was below AL

One area in Bldg 200 was 3.1 x AL.

One area in Bldg 300 was 2.0 x AL.

The Bldg 300 stack was below AL

Outside

These areas are surveyed using both wipes and direct survey

On 12 July, 44 areas in the controlled and restricted (non-contaminated) zones of the laboratory buildings were surveyed.

No area in Building 100 was above AL by wipe, none by direct scan.

No area in Building 300 was above AL by wipe, none by direct scan.

No area in the Annex was above AL by wipe, none by scan

Monday Surveys: Note: this survey is taken on the first scheduled work day of a given week, It is referred to as the "Monday Survey" for convenience

Inside

The restricted contaminated areas are surveyed for removable/spreadable contamination by wipe survey

Unrestricted Areas (Bldg 400) wipes

The **goal** for these areas is 100 total dpm above background for wipe samples and 100 cpm above background for direct survey. The action level is 2 x background. Twenty to twenty five areas are surveyed each week. One area was 1.09 x AL by wipe.

Liquid Waste Discharge

2010	**Total**	**H-3 4.71 Ci (94.3%)**	**C-14 0.845 Ci (84.5%)**
2011	**Total**	**H-3 4.59 Ci (92.0 %)**	**C-14 0.759 Ci (76.0 %)**
2012	**Total**	**H-3 3.91 Ci (78.2 %)**	**C-14 0.477 Ci (47.7 %)**

July (to 7/18)	**H-3**	**C-14**	**% of monthly**
	0.152 Ci	**0.015 Ci**	**8**

2013 (to 7/18) **2.045 Ci H-3 (40.9 % of annual limit)**
0.271 Ci C-14 (27.1% of annual limit)

Liquid waste in Storage waiting processing

Date 7/18/13 Tritium 0.0 Ci C-14 0.0 Ci

Stack Releases

July (as of 7/16)

Building 100/200	0.013 Ci C-14	5.126 Ci H-3
Building 300	0.026 Ci C-14	8.603 Ci H-3

Year to Date (as of 7/16/13)

Building 100/200	18.545 Ci C-14	79.034 Ci H-3
Building 300	25.802 Ci C-14	706.310 Ci H-3.

Seconds since 12/26/12 as of 7/16/13) - 17,193,600

2. Revisions to SOPs 10, 29, and 41 continue to be reviewed by the Radiation Safety Committee before submission to Region III.

Regis A Greenwood, CHP, FHPS
Director, Regulatory Affairs
Radiation Safety Officer

Reviewed by:
Surendra K. Gupta, PhD
President

Cc: Members, RSC
RSC File

Attachment 12

Radiation Protection Program
Entry Examination

Name(Print)_____ Signature_____

1. ARC Employees receive what kind of exposure to radiation?

   a. Dose to living tissue from radioactive material inside the body.
   b. Dose from internal electromagnetic radiation.
   c. Dose to living tissue from radioactive material outside the body.
   d. Dose from external electromagnetic radiation.

2. ARC Employees are exposed to what kind of radiation in the course of their work?

   a. X-rays
   b. Gamma rays
   c Beta Particles
   d. Alpha particles.

3. How could radioactive material enter your body?

   a. By breathing it in.
   b. From hand contamination transferred to food or drink.
   c. Through Cuts or breaks in the skin.
   d. All of the above.

4 Most tritium is eliminated from the body as tritiated water. By what pathway is most of this tritiated water eliminated from the body?

   a. As water in urine
   b. As water in sweat.
   c. As water vapor in exhalation.
   d. As water in feces.

5. How is most of the carbon-14 eliminated from the body?

   a. As carbon compounds in urine
   b. As carbon compounds in sweat
   c. As carbon dioxide in exhalation
   d. As carbon compounds in feces.

6. What method does ARC use to determine dose to radiation workers?

   a. Calculation from survey data.
   b. Urine bioassay
   c. Feces bioassay
   d. Radiation sensitive badges.

7. Which individuals are required to participate in the bioassay program?

   a. All individuals on the ARC site; whether ARC employees or not.
   b. All ARC employees.
   c. All ARC employees entering laboratory areas.
   d. All ARC employees handling unfinished forms of radioactive material.

8. When leaving a laboratory area, what is the requirement for washing your hands?

   a. Wash your hands if a survey detects contamination on them.
   b. Wash your hands if you did not wear gloves in the laboratory.
   c. Wash your hands every time you leave the laboratory.
   d. Washing of hands is only necessary when a Class 1 worker tells you to wash.

9. What do you do <u>first,</u> if you spill radioactive material?

   a. Stop the spread of the spill.
   b. Notify the RSO.
   c. Attempt to clean up the spill.
   d. Restrict access to the spill.

10. What do you do <u>second,</u> if you spill radioactive material?

   e. Stop the spread of the spill.
   f. Notify the RSO.
   g. Attempt to clean up the spill.
   h. Restrict access to the spill.

11. When may a Class 2 radiation worker process radioactive material?

   a. Only when a Class 1 radiation worker is present on the ARC site.
   b. Only when the Class 2 worker's supervisor is present.
   c. Only when a Class 1 worker is watching the Class 2 worker.
   d. Only during regular working hours.

12. Liquid radioactive waste is discharged

    a. Only by Class 1 workers through special sinks.
    b. Only by the RSO through special sinks.
    c. Only after assay to determine the amount of each nuclide, and checking against discharge limits.
    d. Only on weekends after all cleaning is completed.

13. The NRC limit on dose is 5 rem (or 5000 millirem) Deep Dose Equivalent. During what period of time may this be received?

    a. During one calendar year.
    b. During any one calendar quarter.
    c. During any one month
    d. During any consecutive seven days

14. ARC Inc has a guideline limiting employee's dose to 1250 millirem. During what period of time may this be received?

    a. During one calendar year.
    b. During any one calendar quarter.
    c. During any one month
    d. During any consecutive seven days

15. What are the principal isotopes of concern at ARC?

    a. Iodine 131 and tritium
    b. Iodine 131 and carbon -14
    c. Phosphorus 33 and tritium.
    d. Tritium and Carbon-14.

Training provided by: _____ Date: _____

Basics of Radiation and Radiation Safety

Name:_____ Date:_____

1. True False Gamma rays should be shielded by a piece of paper.
2. True False A GM meter is used to tell what kind of radiation is present.
3. True False Bioassay is used to check for internal radiation
4. True False You can receive internal dose by breathing in material
5. True False Alpha radiation can pass through lead

6. What is a possible effect on cells from radiation:
   a) Nothing happens to the cell
   b) The cell dies
   c) The cell become mutated
   d) All of the above

7. Radiation is:
   a) Radioactive material where it is not supposed to be
   b) Energy
   c) 100% safe for any use
   d) Only found inside your body

8. The following is a type of high energy radiation emission:
   a) Beta
   b) Alpha
   c) Photosynthesis
   d) Gamma

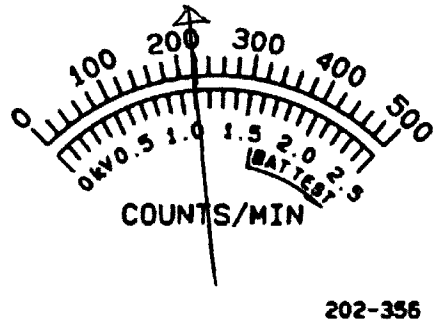
9. How can radioactive material enter your body:
   a) Inhalation
   b) Absorption
   c) Ingestion
   d) All of the above

10. When removing your PPE what should be the last piece you take off:
    a) Shoe covers
    b) Lab coat
    c) Inner (Clean) gloves
    d) Sleeve covers

Pass:_____ Graded by:_____

Name:_____ Date:_____

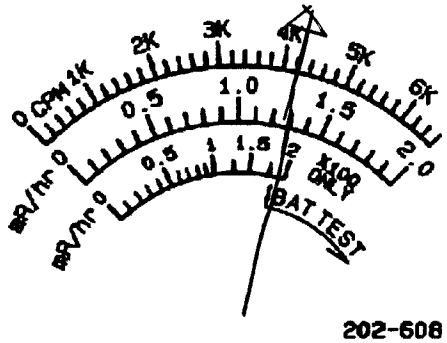
1. What does the following meter face read on the X1 scale??



202-356

a) 210 counts per minute
b) 220 counts per minute
c) 22 counts per minute
d) 220 mR/hr

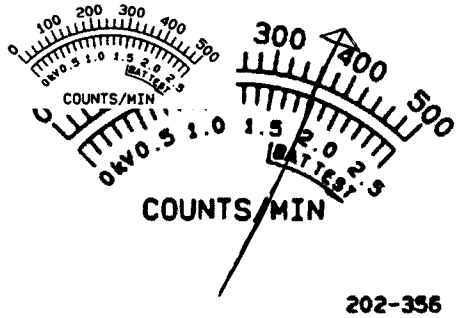
2. What does the following meter face read on the X0.1 scale?



202-608

a) 40200 counts per minute
b) 0.5 mR/hr
c) 4200 counts per minute
d) 420 counts per minute

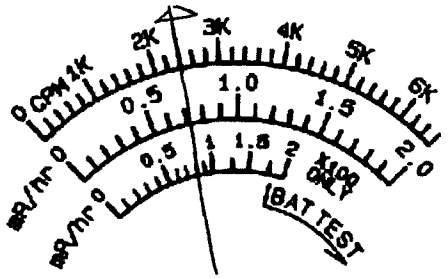
3. What does the following meter face read on the X10 scale?



202-356

a) 360 counts per minute
b) 3200 counts per minute
c) 32 counts per minute
d) 3600 counts per minute

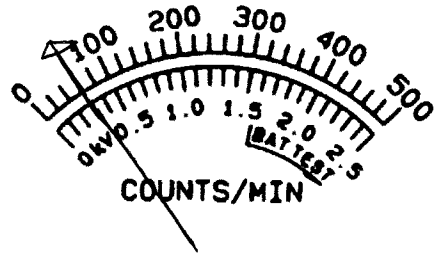
4. What does the following meter face read on the X100 scale?



202-608

a) 24000 counts per minute
b) 420000 counts per minute
c) 240000 counts per minute
d) 2.4 mR/hr

5. What does the following meter face read on the X1 scale



202-356

a) 60 counts per minute
b) 600 counts per minute
c) 60 counts per second
d) Battery Test Passed

Pass:_____

Graded by:_____

Training given by:_____

Personal Protective Equipment
Quiz

1) List a type of activity in your facility that requires personal protective equipment.

_____

2) True or false?
Contacts will protect your eyes from the danger of Chemical.

3) When you are working in the lab, which of the following is required?
   a. Safety Glasses
   b. Contacts
   c. Sunglasses

4) What is the proper way to clean your lab gloves?
   a. Abrasive soaps
   b. Cloth towels
   c. You should not reuse your gloves

5) True or false?
You will always be able to see or smell hazardous particles in the air, before they become a risk to you.

6) When are you required to change lab coat?
   a. Annually
   b. Weekly
   c. Daily

7) Where in your facility is the personal protective equipment stored?

_____

8) True or false?
There are chemicals on site that may cause burns, blindness, or even death.

9) True or false?
It is ok step on the "clean" side of the change area with your yellow shoe covers.

10) When examining your personal protective equipment, what is an example of damaged equipment you should be looking for?

_____

Name: _____

Date: _____

Graded by: _____

Pass: _____

Date: _____

Attachment 13

ANNUAL REVIEW OF SOP's

SOP-01 Waste Compaction

Currently States

3.2.6 "Before compacting, spread a plastic sheet or plastic-backed bench- paper on the floor in front of the compactor and tape in place."

3.2.11 "After compacting, remove the plastic sheet or bench-paper from the floor and place it in a compactor bag."

3.2.12 "After compacting, remove the additional PCE and place it in the compactor bag."

3.2.13 "Survey the floor area and clean as may be required. Action level is 50,000 dpm H-3 and 10,000 dpm C-14. Inform the RSO if Action Level is exceeded."

Action: Delete All

Justification: This SOP was written based on the idea that the area around the compactor enclosure was to remain uncontaminated. Building 200 is contaminated throughout so laying plastic down to prevent the spread of contamination, wearing additional PCE, and surveying the floor after use are unnecessary.

3.2.15 "Mark the container with the next sequential number and the date the container is closed."

3.2.16 "Place a temporary RAM label on the container. Fill in the label with the date and <10 mCi ^{14}C and <10 mCi ^{3}H."

3.2.17 "Inform the RSO of the box number (the date the box was sealed) and the weight."

Action: Add "After weighing, load the container inside the Sea Land and" and delete "and the date the container is closed" from 3.2.15; Delete 3.2.16; and add "and the contents of the container" to 3.2.17

Justification: Several containers are simultaneously filled over a period of weeks, marking them with numbers before they are full and ready to load in the Sea Land, may cause confusion in numbering with maintenance staff. At the time this SOP was written, ARC used 55-gallon metal drums as individual containers of radioactive waste, because they are individual containers, they each needed to be labeled with this information. Currently ARC uses a Sea Land shipping container as the means for disposal and cardboard boxes for convenience. The Sea Land is the container and is labeled. The date the cardboard container is closed is irrelevant and RAM labels are unnecessary. Loading staff also reports the general contents of the container to the RSO.

SOP-06 Package Receipt

Currently States

2.1 "Put on gloves to prevent hand contamination."

Action: Delete 2.1

Justification: The shipment has left the shipper's facility, has been handled by employees of the shipping company, and been laid to rest on the floor of the main office until wipes can be done on the outside of the package. At no time in transit are gloves required to handle the box, ARC feels that gloves are unnecessary to handle the outer package.

SOP-08 Radioactive Waste Processing

Currently States

1.3.2.5 "Before compacting, spread a plastic sheet or plastic backed bench paper on the floor in front of the compactor and tape in place

1.3.2.9 "After compacting, remove the plastic sheet or bench paper from the floor and place it in a compactor bag

1.3.2.10 "Survey the floor area according to the weekly schedule

Action: Delete All

Justification: At the time this SOP was written, the compactor enclosure was in an uncontaminated place. It is now inside of Building 200 in a contaminated area, and these steps are no longer necessary. The part requiring that the floor area be surveyed according to the weekly schedule, is redundant and unnecessary.

1.3.2.12 "Mark the container with the next sequential number, the date the container is closed, and the weight of the container."

1.3.2.13 "Place a temporary RAM label on the container. Fill in the label with the date and <10 mCi ^{14}C and <10 mCi ^{3}H."

Action: Add to 1.3.2.12 "After weighing, load the container inside the Sea Land and" and delete ", the date the container is closed, and the weight of the container"; delete 1.3.2.13

Justification: Several containers are simultaneously filled over a period of weeks, marking them with numbers before they are full and ready to load in the Sea Land, may cause confusion in numbering with maintenance staff. At the time this SOP was written, ARC used 55-gallon metal drums as individual containers of radioactive waste, because they are individual containers, they each needed to be labeled with this information. Currently ARC uses a Sea Land shipping container as the means for disposal and cardboard boxes for convenience. The Sea Land is the container and is labeled. The date the cardboard container is closed is irrelevant and RAM labels are unnecessary.

4.1.6 "A personal contamination survey is required after an individual performs liquid waste evaporation operations and before they exit Building 200."

Action: Delete 4.1.6

Justification: Evaporation takes place in Building 200 and in order to access it, one must go through the Building 100 change area. Exiting the change area requires all persons to do a personal contamination survey. This is a redundant statement because you are already required to survey yourself whether handling evaporating liquids or not.

4.2.3 "Laboratory Technician

Whenever transporting a liquid waste container system (LWCS) between buildings, a disposable glove must be worn on the hand used to carry the LWCS. Keep the other hand ungloved for opening doors, etc. Do not allow the transfer container to come in contact with surfaces outside of restricted areas since the LWCS could be externally contaminated."

4.2.3.1 Whenever transporting a LWCS to building 200, exit buildings 100 or 300 through the respective change area.

4.2.3.2 Place the LWCS on the transfer cart in building 200.

4.2.3.3 Pour the liquid waste into an open pan containing absorbent sponges or paper. Fill the liquid to a depth of 1 inch or less.

4.2.3.5

4.2.3.6 Return an empty LWCS to the buildings 100 or 300 through its change area.

Action: Delete 4.2.3 and replace with, "Store the liquid waste container system (LWCS) in the HP work area, do not bring it into the lab. This will prevent external contamination so that the container will only contaminated internally."; delete from 4.2.3.1 "100 or" and "respective change area" and add "most direct route possible; delete from 4.2.3.2 "on the transfer cart" and add "outside of (building 200) and set the liquid waste bottle inside the door"; delete from 4.2.3.3 "Fill the liquid to a depth of 1 inch or less" and add "or transfer it to an empty liquid waste bottle for temporary storage"; add section 4.2.3.5 to state, "Return the empty liquid waste bottle to the originating hood. Use the LWCS for Building 300, using the most direct route possible. Reusing the empty liquid waste bottles will reduce radioactive waste. Because different chemists create different types of waste, always return the bottles to their originating hoods." Delete from 4.2.3.6 "buildings 100 or 300 through its change area" and add "HP work area"

Justification: 4.2.3 Formerly the LWCS was stored in a contaminated area, currently it is stored in an uncontaminated restricted area so there is no external contamination on the transport container. 4.2.3.1 Buildings 100 and 200 are connected so when transporting liquid waste from 100 to 200, there is no need to exit. 4.2.3.2 The LWCS never enters the contaminated area and therefore does not need to be placed on the transfer cart which will be contaminated. 4.2.3.3 On occasion there are no evaporation trays open, so we have empty temporary containers for the liquid to wait in until a tray has evaporated all of its liquid. The depth of liquid does not affect the evaporation rate of the liquid and is unnecessary. 4.2.3.5 This section was added so that emptied liquid waste containers are

returned to their source hood. In the past a brand new uncontaminated liquid waste container would replace the old one in the hood. By reusing the same containers in the hoods, we greatly reduce the amount of waste created. 4.2.3.6 Empty LWCS are returned HP work areas so they will remain uncontaminated externally.

SOP-16 Radioactive Contamination Control Program

Currently States

1.3.2.2 "Any area, no matter where located, where the following limits are exceeded:
Total – 5000 dpm/100cm^2 average, not to exceed 15,000 for a single point"

Action: Delete ", not to exceed 15,000 for a single point"

Justification: The sentence states that contamination areas includes, "Any area, no matter where located, where the following limits are exceeded" but then later it says "not to exceed 15,000 for a single point" This statement was cut and pasted from the definition for a Controlled Area. The "not to exceed" part is applicable to the controlled area, but is unnecessary when defining areas which do exceed 15,000 for a single point.

SOP-18 Liquid Waste Evaporation

Currently States

1.6 "A personal contamination survey is required after an individual performs liquid waste evaporation operations and before he exits building 200.

Action: Delete All

Justification: This was written when Buildings 100 and 200 were separate. They are now connected through a door, so all who enter Building 200 to perform evaporation, must exit through the Building 100 change area. One is already required to do a personal contamination survey when exiting the change area, therefore this statement is redundant.

2.3 Laboratory Technician

Whenever transporting a liquid waste container system (LWCS) between buildings, a disposable glove must be worn on the hand used to carry the LWCS. Keep the other hand ungloved for opening doors, etc. Do not allow the transfer container to come in contact with surfaces outside of restricted areas since the LWCS could be externally contaminated.

2.3.1 Whenever transporting a LWCS to building 200, exit buildings 100 or 300 through the respective change area.

2.3.2 Place the LWCS on the transfer cart in building 200.

2.3.3 Pour the liquid waste into an open pan containing absorbent sponges or paper. Fill the liquid to a depth of 1 inch or less.

2.3.5

2.3.6 Return an empty LWCS to buildings 100 or 300 through its change area.

Action: From 2.3 delete and replace with "Store the liquid waste container system (LWCS) in the HP work area, do not bring it into the lab. This will prevent external contamination so that the container will only contaminated internally." From 2.3.1 delete "100 or" and "respective change area" and add "most direct route possible" From 2.3.2 delete "on the transfer cart in" and add "outside of (building 200) and set the liquid waste bottle inside the door" From 2.3.3 add ", or transfer it to an empty liquid waste bottle for temporary storage" and delete "fill the liquid to a depth of 1 inch or less" Add a section called 2.3.5 stating "Return the empty liquid waste bottle to the originating hood. Use the LWCS for Building 300, using the most direct route possible. Reusing the empty liquid waste bottles will reduce radioactive waste. Because different chemists create different types of waste, always return the bottles to their originating hoods." From 2.3.6 delete "building 100 or 300 through its change area" and add "the HP work area".

Justification: This was done to reflect the changes recommended in SOP-08 Radioactive Waste Processing. The justification is stated above.

SOP-21 Training and Dose Estimates for Non-Laboratory Personnel

Currently States

2.4.1 "Contractors that are repairing an instrument or performing building maintenance that is short term and under direct supervision by the RSO, assistant RSO, or Health Physics Technician does not require above training. Instead of the above training the person providing the direct supervision will also provide guidance to the contractor such as but not limited to locations of RAM, exiting survey, and donning and doffing PPE.

Action: Delete "assistant RSO, or Health Physics Technician" and replace with "or someone whose experience with contractors is deemed sufficient by the RSO,"

Justification: These are job titles and they may change in the future or if someone new is hired and they hold the job title, but may not be qualified to give a facility tour to contractors. Therefore someone whose experience with touring contractors is deemed sufficient by the RSO, may perform this duty.

SOP-30 Release of Material

Currently States

2.1 "Scan the equipment with a GM survey meter and outline (with grease pencil or "magic marker") any areas where activity exceeding two times background is detected."

Action: Delete "outline (with grease pencil or "magic marker)" and replace with "note"

Justification: Some items, like gas cylinders and dry ice boxes, are returned to vendors. Permanently marking an item for contamination when the contamination is readily cleanable is unnecessary and will ruin said items.

3.2 "Less than 5000 dpm average over the surface of the object, with no single reading greater than 15,000 dpm by direct scan with a survey meter."

Action: Delete "average" and ", with no single reading greater than 15,000 dpm"

Justification: An average scan over an area will have human error involved, by just saying 5000 dpm we eliminate any chance for human error when calculating the average scan over the surface.

SOP-32 Segregation of Dry Active Waste

Currently States

5.3 "If the item appears to be readily cleanable, then decon and re-wipe until the areas are below the release level, which is 1000 dpm/100 cm2 for the sum of tritium and carbon-14, or less than 500 cpm using the wide setting of the scintillation counter. AND, the item is less than 150 cpm direct survey.

Action: delete "cpm using the wide setting of the scintillation counter. AND, the item is less than 150 cpm direct survey" and add to read "carbon-14 and less than 5,000 dpm direct scan. See SOP-30 "Release of Material" for further reference.

Justification: SOP-30 Release of Material, Section 3 Release Levels, gives specific direct scan and wipe survey release limits. This section in SOP-32 seems to be in conflict with those specific limits. This change is to reflect SOP-30 and define one and only one release limit.

SOP-33 Use of Protective Clothing and Equipment (PCE)

Currently States

2.1.1 "These areas include the eating area in each lab building, but do not include any posted buffer zones within the lab building."

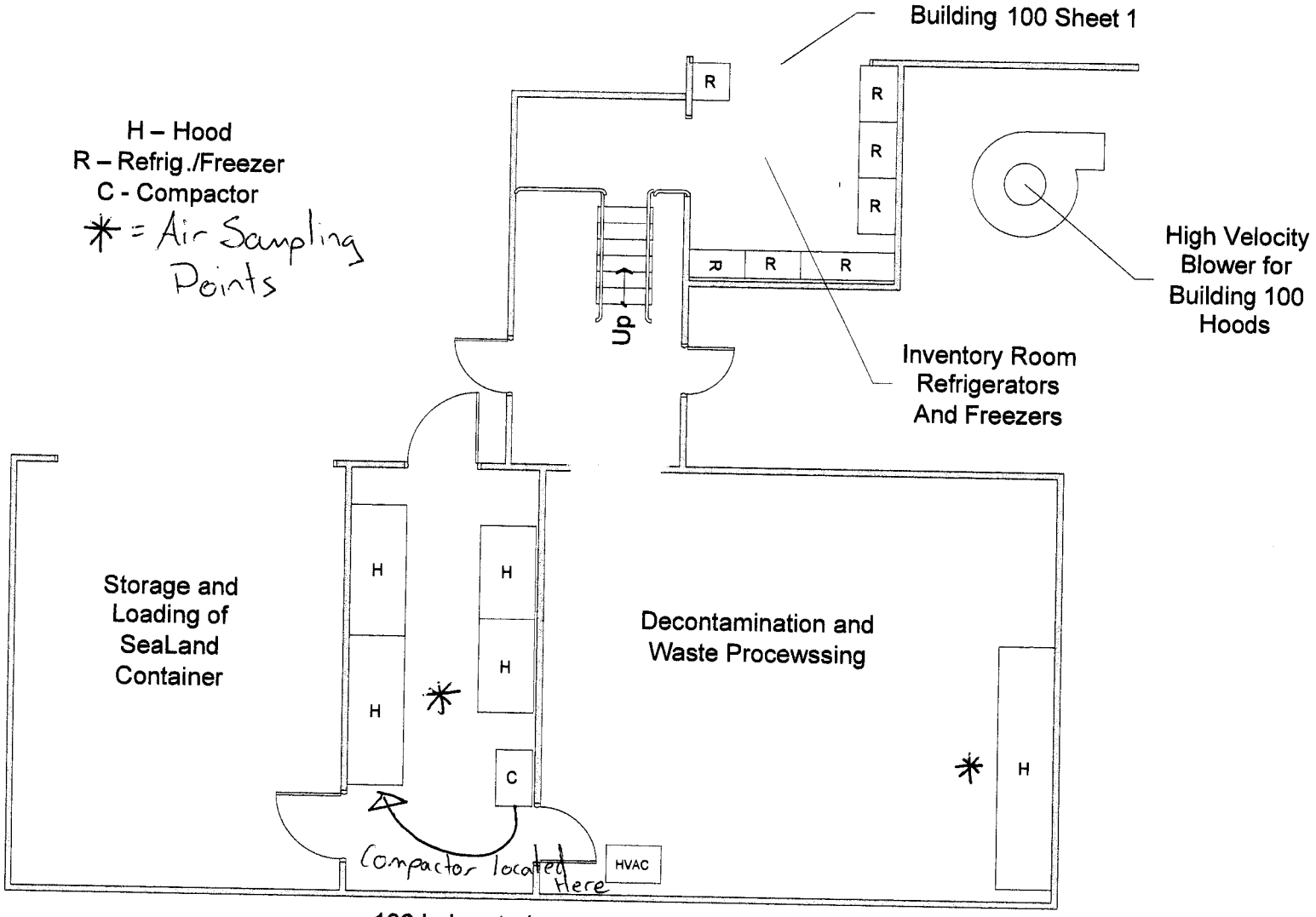
2.1.2 "All areas outside the laboratory buildings unless temporary posted otherwise"

2.3.3 "Buffer Zones (BZ) Areas such as, but not limited to, change areas, the shipping area, the building 300 garage or other areas designated by the RSO.

Action: Delete 2.1.1 and 2.1.2 and add a paragraph stating" Unrestricted Areas are thos that are not controlled or restricted in any manner by ARC. Example: Building 400, Building 400 parking areas, Building 400 Landscape areas, ARC Drive, and all off site areas." Add a section, "2.2 Controlled areas; Any Area, outside of restricted areas and within the site boundaries, access to which can be limited for any reason. Offices and lunchrooms in the laboratory buildings, and areas of the property between and around the laboratory buildings are examples of controlled areas." Add 2.3.2.2 "Any area, no matter where located, where the following limits are exceeded: Total – 5000 dpm/100 cm^2 average, Removable – 1000 dpm/100 cm^2" Remove 2.3.3 and replace with "Non-contaminated Restricted areas; Areas such as, but not limited to, change areas, the shipping area, or other areas designated by the RSO."

Justification: SOP-16 Contamination Control Program Section 1.0 Requirement; gives specific definitions for unrestricted, controlled, restricted contaminated and restricted uncontaminated areas of ARC property. However the definitions of these areas differ in SOP-33. This change will reflect the definitions in SOP-16 for uniformity.

Attachment 14



100 Laboratories - Sheet 2

Do Not Scale
Approx. 1/8 in to 1 foot

2 AUG 2013 09:07

USER PROGRAM REVIEW

User: 3 ID: BIOASSAY
Count time: 5.00 DL DPM
Repeats: 1 H# Liquid
Replicates: 1
Cycle Reps: 1
Low Reject: 0 Blanks

Isotope:	3H	14C	NONE
2 sig:	0.00	0.00	
Bkgsub:	0.00	0.00	
Factor:	0.00058	0.13800	
Units:	PERCNT	DPM	
Printer:	Std	RS-232:	Off

ACTIVE KEYS

MainC	HelpC	Select		Reset
PrevC	Print	Cancel		

REVIEW / EDIT

Id: BIOASSAY

Comments: PERCENT OF WEEK GUIDE

Counting Time: 5.00 min

Isotope 1: 3H

Isotope 2: 14C

Isotope 3: NONE

Edit Other Parameters

Enter program identification:

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ORIGIN ID:ZSVA (314) 991-4545
OFFICE
AMERICAN RADIOLABELED CHEMICALS
101 ARC DRIVE

ST. LOUIS, MO 63146
UNITED STATES US

SHIP DATE: 02AUG13
ACTWGT: 1.0 LB MAN
CAD: 0747982/CAFE2703

BILL SENDER

TO ATTN: KEVIN NULL
U.S. NUCLEAR REGULATORY COMMISSION
2443 WARRENVILLE ROAD, SUITE 210
REGION III
LISLE IL 605324351

REF: REPLY TO RFAI

DEPT: LICENSE NO 24-21362--01

518C1/AA84/6FB3

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Part # 156148-434 RITZ 04/13

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