PWGC
Strategic Environmental Engineering Solutions

Brookhaven National Laboratory
National Synchrotron Light Source (NSLS)

Surface Metals Characterization Report

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PREPARED FOR:

BROOKHAVEN
NATIONAL LABORATORY

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VERSION HISTORY LOG

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0	First Issue	December 12, 2014
1	• Revised section 5.1.5 with additional HVAC sample locations; • Revised section 6.1 with additional HVAC sample results and revised Liberty Mutual analytical reports; • Revised table 6.1 with additional HVAC sample results and revised Liberty Mutual analytical reports; • Revised Figure 3 and Figure 4 with additional HVAC sample locations.	January 15, 2014

BROOKHAVEN NATIONAL LABORATORY
NATIONAL SYNCHROTRON LIGHT SOURCE
METALS CHARACTERIZATION REPORT

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List of Acronyms

BNL	Brookhaven National Laboratory
D&D	Decontamination and Decommissioning
ESD	Environmental Services Division
ESH	Environment, Safety and Health
ft^2	Square feet
HVAC	Heating, Ventilating and Air Conditioning
JTA	Job Training Assessment
Linac	Linear Accelerator
LOQ	Limit of Quantification
MER	Mechanical Equipment Room
NSLS	National Synchrotron Light Source
Pb	Lead
PPE	Personal Protective Equipment
PS	Photon Sciences
PWGC	P.W. Grosser Consulting, Inc.
QA	Quality Assurance
QC	Quality Control
RF	Radio Frequency
RL	Reporting Limit
SAD	Safety Assessment Document
ug	Microgram
VUV	Vacuum Ultraviolet

1.0 PURPOSE

P.W. Grosser Consulting, Inc. (PWGC) has prepared the following Surface Metals Characterization Report to detail the findings of the surface metals characterization at the National Synchrotron Light Source (NSLS). This scope of work was based on the *Statement of Work for the Non-Radiological Characterization Planning and Implementation for NSLS Transition-Hazard Removal Project*. The metals survey was conducted in order to support the characterization of the NSLS facility; specifically, the objective was to survey the facility for surface metal contamination to determine:

- Hazards to personnel and impacts to planned demolition and removal activities;
- Impacts to the packaging, transportation and disposition of removed materials, equipment and waste;
- Impacts to re-purposing the NSLS facility; and
- Impacts and/or threats to the environment.

This metals survey is part of a comprehensive non-radiological characterization of the NSLS facility. An evaluation of the results of this metals survey, as well as the characterization of other non-radiological hazards (e.g., stored energy, laboratory chemicals, nanomaterials, etc.) will be documented in the general facility characterization report.

2.0 SITE DESCRIPTION AND HISTORY

According to LS-NSLS-0012, *NSLS Safety Assessment Document (SAD)*, the NSLS was a large user facility dedicated to the production and utilization of synchrotron radiation. It supported the development of electron-based radiation sources and new applications of this radiation in the physical and biological sciences. Ground was broken in 1979 for construction and first beam was delivered in 1982. The NSLS ended operations on September 30th, 2014. Building 725, which houses the NSLS, is located in the eastern region of the BNL site.

According to LS-NSLS-0012, *NSLS Safety Assessment Document (SAD),* the current configuration of Building 725, which has two stories, is the result of a series of upgrades over the years. The first floor (123,644 sq. ft.) consists largely of the experimental floor and support equipment, and is constructed below grade. This includes the linac, booster synchrotron, VUV ring, X-Ray ring, beamlines, operational control and power systems, laboratories, offices, machine shops, storage and setup areas, stockroom and delivery areas, and a library. The stockroom and VUV floor are serviced by a total of three 4,000 lb. capacity overhead bridge & trolley cranes, and the booster ring is serviced by a 2,000 lb. capacity jib crane. The second floor (38,512 sq. ft.) consists largely of office space and conference rooms, as well as machine shops. Both floors have a number of mechanical equipment rooms. The layout of both floors of Building 725 is illustrated in **Figure 1** and **Figure 2**.

Similar construction has been used in each upgrade. The floor is poured concrete. Exterior walls are insulated metal panels. The roof is an insulated metal deck, originally a Factory Mutual Class I built-up tar roof system.

Exposed metal frames support the structure, except in the perimeter. The perimeter of the facility has a two-story office mezzanine constructed of poured concrete on metal deck.

According to previous lead investigations summarized in *Summary Report of Evaluation of Lead Contamination in NSLS, National Synchrotron Light Source, Upton, New York* (Photon Sciences, August 24, 2012), uncoated lead was widely used for radiation shielding at the NSLS facility. Lead shielding configuration changes resulted in movement of lead bricks throughout many areas of the first floor, as well as lead machining in some of the laboratories and Tech Areas. In addition, lead soldering was performed in laboratories and Tech Areas on both the first and second floors of Building 725.

According to interviews with previous NSLS staff, beryllium was used in accelerator and beamline components, and beryllium windows were mistakenly broken on the first floor. Other metals (e.g., cadmium, manganese, etc.) were cut and soldered in laboratories and Tech Spaces, as well as used in other applications to support research activities.

Additional descriptions of the facility, including building utility systems, accelerator systems, and radiation protection systems are documented in LS-NSLS-0012, *NSLS Safety Assessment Document (SAD)*.

3.0 PREVIOUS INVESTIGATIONS

Measureable surface lead contamination has been previously detected at the NSLS facility during surveys performed by PS ESH Staff to assess hazards for occupational workers, as documented in the *Summary Report of Evaluation of Lead Contamination in NSLS, National Synchrotron Light Source, Upton, New York* (Photon Sciences, August 24, 2012). Areas where lead contamination was detected include the Experimental Floor, Tech Areas and Laboratories on the first floor of Building 725, with highest concentrations detected in the Machine Shop (Room 1-124) and on the more inaccessible areas of the beamline aisle floors (i.e., under the beam tubes). Lead was detected at concentrations as high as 2,000 ug/ft^2 in wipe samples collected from these areas. Locations of elevated surface lead contamination appear to be associated with past activities, such as lead soldering, shielding configuration changes and routine movement of lead bricks associated with plug door movements.

Cadmium and manganese were detected on Building 725 first floor surfaces at concentrations greater than the equipment release standards provided in Table 3 of BNL-IH75190, *Surface Wipe Sampling Procedure*. These results are documented in an analytical report provided by Liberty Mutual Industrial Hygiene Laboratory, dated October 9th, 2012. According to the report, the associated wipe samples were collected on September 20, 2012.

Additional lead surveys are being performed by PS ESH Staff to support ongoing equipment removal and stabilization activities at the NSLS facility, which were initiated after operations ended on September 30th, 2014. These surveys are being performed mainly on equipment that is being removed from the first floor experimental

areas and laboratories. The results of these surveys are being assessed as they are made available. To date, lead wipe survey results performed on equipment being removed have ranged from below detection limits to as high as 551.7 ug/ft^2.

There is no current knowledge of previous metal surveys performed on the second floor of Building 725.

4.0 CONTAMINANTS OF CONCERN

Lead was identified as the primary metal contaminant of concern based upon knowledge of historical operations, as well as the August 2012 *Summary Report of Evaluation of Lead Contamination in NSLS, National Synchrotron Light Source*. Additional metal contaminants of concern (**Table 4.1**) were derived from the list of metals evaluated in the analytical report provided by Liberty Mutual Industrial Hygiene Laboratory, dated October 9th, 2012, as well as from knowledge of historical and ongoing activities.

Table 4.1

Additional Metal Contaminants of Concern

Aluminum	Calcium	Magnesium	Thallium
Antimony	Chromium	Manganese	Tin
Arsenic	Cobalt	Mercury	Titanium
Beryllium	Copper	Nickel	Vanadium
Cadmium	Iron	Selenium	Zinc

5.0 PROJECT SCOPE AND FIELD PROCEDURES

Wipe samples were collected to characterize the extent of lead contamination, as well as additional metals of concern, on representative surfaces throughout the NSLS facility. Wipe sample collection was performed by a field engineer who was previously trained in the required sampling protocol: HP-IHP-51200, *IH Lab Equipment and Sample Processing* and HP-IHP-75190, *Surface Wipe Testing*. Samples were collected in accordance with BNL-IH5190 *Surface Wipe Sampling Procedure* and based upon direction provided by BNL Safety & Health Services Division Industrial Hygiene (IH) personnel. Wipe samples were delivered by the field engineer to BNL IH personnel under BNL-IH51300 *Chain or Custody* procedures for packaging and shipment to their contracted analytical laboratory. Both Liberty Mutual IH Laboratory (Liberty) and EMSL Analytical (EMSL) performed wipe sample analysis for this characterization effort.

5.1 Sample Locations

For the purpose of this characterization survey, the NSLS facility was divided into the following five area groups, which are illustrated in **Figure 1** and **Figure 2**:

- Accelerator systems;

- First floor rooms (offices, labs, tech space, mechanical equipment rooms (MERs), lounges, hallways, bathrooms, and storage areas);
- The experimental floor (general area);
- Second floor; and
- Heating ventilation and air-conditioning (HVAC) ductwork.

The frequency, distribution, and location of wipe samples were planned based upon information collected during interviews and facility walkthroughs with PS staff and subject matter experts, as well as the review of facility drawings and reports. This information includes historical operations throughout the facility, HVAC system design, and the likelihood of surfaces to remain undisturbed (i.e., dusty surfaces, such as bookshelves, tops of experimental hutches, etc.). Specific criteria considered when choosing wipe sample locations in each of the five area groups are discussed in the following subsections. Actual sample locations were subject to field observations and professional judgment of the field engineer and are illustrated in **Figure 3** (1st floor) and **Figure 4** (2nd floor).

5.1.1 *Accelerator Systems*

Accelerator Systems that previously operated at the NSLS facility include the Gun area, Klystron Gallery, Linac enclosure, Booster Ring enclosure, VUV Ring area and the X-Ray Ring tunnel. Lead shielding configurations are currently still in place in these areas. Wipe samples were collected from:

- Areas where dust is not frequently disturbed (e.g., elevated surfaces, top of equipment, floors beneath equipment, etc.);
- Floors and/or ledges adjacent to lead shielding configurations; and
- HVAC return vents, where easily accessible.

Wipe sample locations were chosen based on spatial coverage and historical operations (i.e., movement of uncoated lead). Accelerator systems were surveyed via wipe sample collection at a minimum frequency of five samples in each accelerator system area. The sample frequency for the accelerator systems and the associated analytes are summarized in **Table 5.1** Sample locations are illustrated on **Figure 3** and photographs of sample locations are available in the *NSLS Surface Metals Characterization Sampling Photo Log* (PWGC, November 2014).

Table 5.1

Summary of Accelerator Systems Wipe Sample Locations

Area	Sample Location Description	No. of Samples for Lead Only	No. of Samples for Lead and Table 4.1 Metals[1]	No. of Samples for Mercury	Total
Gun/Linac/Booster/Klystron Gallery	Top of equipment rack, file cabinet, and concrete block near shielding	5	1	1	**7**
VUV Ring	Top of VUV ring equipment and racks	5	1	1	**7**
X-Ray Ring	Top of x-ray ring equipment, magnets, wall ledge, and floor.	7	1	1	**9**
QA Blank Samples		0	2	2	**4**
Total		**17**	**5**	**5**	**27**

Note: 1- Sampling for Table 4.1 Metals requires the collection of two wipe samples: one Whatman 42 for mercury and one GhostWipe™ for the remaining metals. Therefore, mercury samples are counted in a separate column.

5.1.2 *First Floor Rooms (Offices, Labs, Tech Spaces, MERs, Lounges, Hallways, Bathrooms and Storage Areas)*

The first floor rooms, which are primarily located along the outer perimeter of the Experimental Floor, supported an assortment of activities. These rooms include offices, labs, tech spaces, storage areas, mechanical equipment rooms (MERs), conference rooms, and bathrooms. Corridors (i.e., hallways) outside of the Experimental Floor were also included in this group. The first floor rooms are presently in a state of flux as NSLS users and BNL staff prepare equipment, material, and supplies for disposition or removal during stabilization activities.

Wipe sample locations were chosen based on spatial coverage, however they were primarily based on knowledge of historic operations that took place in these rooms. For example, wipe sample locations were biased to rooms where lead cutting, soldering and staging took place, as well as rooms with fume hoods. These rooms include labs, tech spaces and the Lead Laydown Area (Area 3 – 1-123). For comparison, wipe sample locations were also chosen in areas assumed to be "clean" (i.e., isolated from lead operations and laboratory activities). These assumed "clean" areas included the Building 725 Lobby and a first floor bathroom. First floor rooms were surveyed via wipe sample collection at a minimum frequency of one out of every five rooms.

Specifically, wipe samples were collected from:

- Areas where dust is not frequently disturbed (e.g., tops of bookcases, cabinets, and vending machines);
- Work benches in labs and Tech Spaces;
- Inside fume hoods in labs;
- Surfaces where metal shavings were observed;
- HVAC return vents and;
- Overhead crane located in LEGS (1-168); and
- Floors.

The sample locations and frequency for the first floor rooms and hallways, as well as the associated analytes, are summarized in **Table 5.2**. Sample locations are illustrated on **Figure 3** and photographs of sample locations are available in the *NSLS Surface Metals Characterization Sampling Photo Log* (PWGC, November 2014).

Table 5.2
Summary of First Floor Rooms Wipe Sample Locations

Area	Sample Location Description	No. of Samples for Lead Only	No. of Samples for Lead and Table 4.1 Metals[1]	No. of Samples for Mercury	Total
Lobby (1-192)	Top of Vending Machines	2	0	0	**2**
Control Room (1-181)	Top of bookshelf, wall ledge	2	0	0	**2**
Tech Shop (1-171)	Top of cabinet, workbench	2	0	0	**2**
LEGS (1-168)	HVAC return vent, wall ledge, overhead crane	3	0	0	**3**
Confirmed Pb Solder Station (1-167)	Top of cabinet, workbenches	3	0	0	**3**
User Shop (1-124A)	Floor-adjacent to lathe, top of workbench	2	0	0	**2**
1-163	Storage rack, top of workbench	2	0	0	**2**

Area	Sample Location Description	No. of Samples for Lead Only	No. of Samples for Lead and Table 4.1 Metals[1]	No. of Samples for Mercury	Total
Men's Bathroom (1-156)	Ceiling diffuser, top of radiator	2	0	0	**2**
1-154	Top of workbench, bookshelf	2	0	0	**2**
West Roll-up Door Area (1-151A)	Floor-adjacent to roll-up door, top of equipment	2	0	0	**2**
Area 1 User Storage (1-151)	Top of storage rack, corner of floor	2	0	0	**2**
Lab (1-146)	Top of workbench, top of haz. storage cabinet	2	0	0	**2**
SU Lab 1 (1-123A)	Floor beneath band saw, top of equipment cart, top of workbench	3	0	0	**3**
Area 3 (1-123)	Adjacent to floor drain, top of haz. storage cabinet, middle area floor	2	1	1	**4**
Stock Room (1-116)	Top of vacuum parts rack, entryway floor	2	0	0	**2**
1-110C	Top of bookshelf, floor-in front of cabinet	2	0	0	**2**

Area	Sample Location Description	No. of Samples for Lead Only	No. of Samples for Lead and Table 4.1 Metals[1]	No. of Samples for Mercury	Total
1-107	Floor entryway, top of cabinet, top of workbench	3	0	0	**3**
1-103	Floor-middle area, top of cabinet	2	0	0	**2**
MERs	Top of equipment, floor, top of cabinet, top of workbench	6	0	0	**6**
Hallway Floors	Along wall, corner, user experimental area	5	0	0	**5**
QA Blank Samples		4	2	2	**8**
QA Duplicate Samples		0	1	1	**2**
Total		**55**	**4**	**4**	**63**

Note: 1- Sampling for Table 4.1 Metals requires the collection of two wipes: one Whatman 42 for mercury and one GhostWipe™ for the remaining metals. Therefore, mercury samples are counted in a separate column.

5.1.3 *Experimental Floor (General Area)*

Wipe sample locations were limited in the Experimental Floor (General Area) due to equipment disposition and stabilization activities that are currently ongoing throughout that area. Samples were biased to elevated surfaces (e.g., ledges, shelves, cabinets, etc.) since the floor surface conditions are in a state of flux. Additionally, wipe samples were collected from surfaces along the elevated walkways above both the X-Ray ring and the VUV Ring, as well as on the tops of experimental hutches.

The sample frequency for areas throughout the Experimental Floor (General Area) and the associated analytes are summarized in **Table 5.3**.

Table 5.3

Summary of Experimental Floor (General Area) Wipe Sample Locations

Area	Sample Location Description	No. of Samples for Lead Only	No. of Samples for Lead and Table 4.1 Metals[1]	No. of Samples for Mercury	Total
X-Ray Ring Experimental Floor	Top of equipment, top of doorway, user floor area	3	1	1	**5**
X-Ray Ring Elevated Walkway	Top of X6B hutch	1	0	0	**1**
VUV Ring Experimental Floor	Top of wall ledge	1	0	0	**1**
VUV Ring Elevated Walkway	Metal surface off elevated catwalk	1	0	0	**1**
Electrical Shop (1-204)	Floor along wall, top of cabinet	2	0	0	**2**
Power Supply Test Area (1-205)	Top of workbench, equipment shelf	2	0	0	**2**
Booster Quad Area (1-201)	Floor-behind electrical equipment, top of electrical j-box	1	1	1	**3**
RF Equipment Room (1-200)	Top of equipment, floor beneath rack	4	0	0	**4**
QA Blank Samples		1	0	0	**1**
Total		**16**	**2**	**2**	**20**

Note: 1- Sampling for Table 4.1 Metals requires the collection of two wipes: one Whatman 42 for mercury and one GhostWipe™ for the remaining metals. Therefore, mercury samples are counted in a separate column.

5.1.4 *Second Floor/RF Penthouse*

With the exception of second floor workshops (Rooms 190A through 190E) and tech spaces (Rooms 124B, 124C, 124D, 124E and 124G), there is no current knowledge of metals contamination on the second floor of Building 725; however, it has been noted that portions of the second floor exchange airflow with the first floor through the building's HVAC system. This area is referred to as "A/C 6" on **Figure 4**. The majority of the second floor consists of office space, hallways and conference rooms. In addition, there are two MERs (Room 175 and Room 209), second floor workshops (Rooms 190A through 190E), tech spaces (Rooms 124B, 124C, 124D, 124E and 124G), and bathrooms (Rooms 105, 107, 171 and 173). Additionally, the RF Penthouse is accessible from the second floor roof exit.

Wipe sample locations were biased to the hallways and offices in the A/C 6 area, MERs, workshops and the tech space. Samples were taken at a lower frequency in office areas and hallways that do not directly exchange air with the first floor (e.g., A/C 3 and A/C 10 as shown on **Figure 3**). Specifically, second floor rooms were surveyed via wipe sample collection at a minimum frequency of one out of every ten offices in the A/C 3 and A/C 10 areas, and at a minimum frequency of one out of every five rooms in the A/C 6 area. Wipe samples were collected from the following locations within offices, rooms and hallways:

- Areas where dust is not frequently disturbed (e.g., tops of bookcases);
- Work benches in workshops and tech space
- HVAC diffusers in the A/C 6 area; and
- Floors

The sample frequency for areas throughout the second floor of Building 725 and the associated analytes are summarized in **Table 5.4**. Sample locations are illustrated on **Figure 4** and photographs of sample locations are available in the *NSLS Surface Metals Characterization Sampling Photo Log* (PWGC, November 2014).

Table 5.4

Summary of Second Floor/RF Penthouse Wipe Sample Locations

Area	Sample Location Description	No. of Samples for Lead Only	No. of Samples for Lead and Table 4.1 Metals[1]	No. of Samples for Mercury	Total
A/C 3 Rooms	Ceiling diffusers, floors-along walls, representative surfaces	6	1	1	**8**

Area	Sample Location Description	No. of Samples for Lead Only	No. of Samples for Lead and Table 4.1 Metals[1]	No. of Samples for Mercury	Total
A/C 3 Hallways	Ceiling diffusers, floors	2	0	0	**2**
A/C 6 Rooms	Ceiling diffusers, floors-along walls, representative surfaces	56	1	1	**58**
A/C 6 Hallways	Ceiling diffusers, floors	8	0	0	**8**
A/C 8 Rooms	Ceiling diffusers, floors, representative surfaces	4	1	1	**6**
Covered Walkway (2-192A)	Floor-center of hallway	1	0	0	**1**
MER No. 4 (2-175)	Top of AC equipment	0	1	1	**2**
MER No. 6 (2-209)	Top of AC equipment	0	1	1	**2**
Tech Area (2-124B through 2-124E)	Top of workbenches, floor adjacent to fume hood	4	1	1	**6**
Workshop (2-190A through 2-190E)	Top of workbenches, top of cabinet, counter top	4	1	1	**6**
RF Penthouse on Roof (122)	Top of electrical equipment box	1	0	0	**1**

Area	Sample Location Description	No. of Samples for Lead Only	No. of Samples for Lead and Table 4.1 Metals[1]	No. of Samples for Mercury	Total
QA Blank Samples		7	3	1	**11**
Total		**93**	**10**	**8**	**111**

Note: 1- Sampling for Table 4.1 Metals requires the collection of two wipes: one Whatman 42 for mercury and one GhostWipe™ for the remaining metals. Therefore, mercury samples are counted in a separate column.

5.1.5 *HVAC Ductwork*

Multiple facility walkthroughs with the HVAC engineer assigned to NSLS were performed to assist in choosing the associated wipe sample locations. As briefly discussed in Section 5.1.4, the Building 725 HVAC system is divided into "A/C" sections. As illustrated on **Figure 3** and **Figure 4**, there are 16 A/C sections throughout the building including the Leibert Package unit located in the RF equipment room (1-200). No ductwork services the Leibert Package and therefore no samples were collected from this A/C section. Wipe sample locations were initially biased to A/C sections that handle air where lead shielding configuration changes were likely common, areas where excess lead bricks were staged and moved/removed, where lead cutting was performed, and where air is exchanged with the second floor. These A/C sections included the following:

- A/C-1 – West half experimental area and X-Ray Ring tunnel;
- A/C-2 – East half experimental area and X-Ray Ring tunnel;
- A/C-4 – VUV Ring: high bay area;
- A/C-5 – Linac, Booster ring, and lobby;
- A/C-6 – 1st floor offices north side and second floor lobby northeast offices past north elevator, and;
- A/C-7 – 1st floor: MER 4 south to lobby. Includes Lead Laydown Area (Area 3 – 1-123).

Based upon the initial HVAC system characterization results, it was decided that characterization of the remaining HVAC systems was necessary. Many contaminants of concern were not detected in the initial HVAC characterization; therefore, a subset of eight analytes (**Table 5.5**) was selected.

Table 5.5

Remaining HVAC Metal Contaminants of Concern

Beryllium	Cadmium	Chromium	Lead
Manganese	Cobalt	Silver	Zinc

Silver, which was not originally identified as a contaminant of concern, was added based upon a subsequent review of notes from a facility walkthrough (McQueen, VUV Beamlines Walkthrough, October 9, 2014) and a facility characterization survey response that was completed as part of the NSLS Transition and Hazard Removal

Project (Nintzel, Facility Characterization Survey, December 9, 2014). Both of these sources indicated the historic use of silver solder in the facility.

The remaining A/C sections included the following:

- A/C-3 – 2nd floor offices north west of lobby;
- A/C-8 – 2nd floor north offices west of north elevator;
- A/C-9 – LEGs or gamma ray facility (1-168)
- A/C-10 – RF Penthouse;
- A/C-11 – Machine shop outside MER 2;
- A/C-12 – Technicians area south of breeze way;
- A/C-14 – Library;
- A/C-16 – Structural biology north of LEGs (by MER 8);
- A/C-17 – Structural biology east of LEGs (by MER 7).

Within these A/C sections, wipe sample locations were chosen at accessible points of air return and diffuser ductwork. The sample locations for the Building 725 ductwork and the associated analytes are summarized in **Table 5.5**. Sample locations are illustrated on **Figure 4** and photographs of sample locations are available in the *NSLS Surface Metals Characterization Sampling Photo Log* (PWGC, January 2015).

Table 5.6
Summary of HVAC Ductwork Sample Locations

Duct Wipe Sample Location	Sample Location Description	No. of Samples for Lead Only	No. of Samples for Lead and Table 4.1 Metals[1]	No. of Samples for Mercury	No. of Samples Table 5.5 Metals	Total
A/C 1 (1-201)	Inside hatch on overhead return duct downstream of RF Area	1	0	0	0	**1**
A/C 2 (1-207)	Inside hatch on overhead return duct inside MER-2	1	0	0	0	**1**

Duct Wipe Sample Location	Sample Location Description	No. of Samples for Lead Only	No. of Samples for Lead and Table 4.1 Metals[1]	No. of Samples for Mercury	No. of Samples Table 5.5 Metals	Total
A/C 5 (1-115)	Inside hatch on return duct inside MER 3	1	0	0	0	**1**
A/C 4	Inside hatch on overhead return duct near Hutch X-25	1	0	0	0	**1**
A/C 7 (1-123)	Diffuser hatch located in lead laydown area	1	0	0	0	**1**
A/C 7 (1-123)	Inside hatch on return located inside MER-4	1	0	0	0	**1**
A/C 6 (1-121)	Inside return hatch located in MER-4	0	1	1	0	**2**
A/C 3 (1-115)	Inside hatch on return duct located in MER-3	0	0	0	1	**1**
A/C 8 (2-209)	Inside hatch on return duct located in MER-6	0	0	0	1	**1**
A/C 9 (1-168)	Inside hatch on return duct located in LEGs mezzanine	0	0	0	1	**1**

Duct Wipe Sample Location	Sample Location Description	No. of Samples for Lead Only	No. of Samples for Lead and Table 4.1 Metals[1]	No. of Samples for Mercury	No. of Samples Table 5.5 Metals	Total
A/C 10 (2-122)	Inside return panel of AH10A located in RF Penthouse	0	0	0	1	**1**
A/C 11 (Roof)	Inside hatch on return duct	0	0	0	1	**1**
A/C 12 (Roof)	Inside hatch on return duct	0	0	0	1	**1**
A/C 14 (1-110D)	Inside hatch on return duct	0	0	0	1	**1**
A/C 16	Inside hatch on return duct located in MER-8	0	0	0	1	**1**
A/C 17 (1-172A)	Inside hatch on return duct located in MER-7	0	0	0	1	**1**
QA Blank Samples		0	1	1	2	**4**
Total		**6**	**2**	**2**	**11**	**21**

Note: 1- Sampling for Table 4.1 Metals requires the collection of two wipes: one Whatman 42 for mercury and one GhostWipe™ for the remaining metals. Therefore, mercury samples are counted in a separate column.

5.2 Sample Summary

The total number of collected wipe samples is presented in **Table 5.6**. This table also includes a summary of Quality Assurance (QA)/Quality Control (QC) samples, which are further discussed in Section 5.3.

Table 5.7

Summary of Collected Wipe Samples

Area/QC Sample Type	No. of Samples for Lead Only	No. of Samples for Lead and Table 4.1 Metals[1]	No. of Samples for Mercury	No. of Samples Table 5.5 Metals	Total
Accelerator Systems	**17**	**5**	**5**	**0**	**27**
Representative Surface	16	3	3	0	22
Floor	1	0	0	0	1
QA Blank	0	2	2	0	4
First Floor Rooms	**55**	**4**	**4**	**0**	**63**
HVAC Diffuser	1	0	0	0	1
HVAC Return	1	0	0	0	1
Representative Surface	35	0	0	0	35
Floor	14	1	1	0	16
QA Blank	4	2	2	0	8
QA Duplicate	0	1	1	0	2
Experimental Floor (General Area)	**16**	**2**	**2**	**0**	**20**
Representative Surface	12	1	1	0	14
Floor	3	1	1	0	5
QA Blank	1	0	0	0	1
Second Floor/RF Penthouse	**93**	**10**	**8**	**0**	**111**
HVAC Diffuser	27	0	0	0	27
Representative Surface	30	6	7	0	43
Floor	29	1	0	0	30
QA Blank	7	3	1	0	11
HVAC Ductwork	**6**	**2**	**2**	**11**	**21**
HVAC Diffuser	1	0	0	0	1
HVAC Return	5	1	1	9	16
QA Blank	0	1	1	2	4
Total	**187**	**23**	**21**	**11**	**242**

5.3 Quality Assurance/Quality Control

Proper QA and QC procedures were followed in the field and at the laboratory to ensure that reliable data was obtained. While performing field sampling, care was taken to prevent the cross-contamination of non-dedicated sampling equipment that could compromise sample integrity. QA/QC samples were collected in accordance with BNL-IH75190, *Surface Wipe Sampling Procedure* and/or based upon direction from BNL IH personnel.

Overall, QA blank samples were collected at a frequency of approximately one per 8 samples, while QA duplicate samples were collected at a rate of approximately one per 100 samples. The distribution and total number of QA/QC samples is presented in **Table 5.7**.

Table 5.8

Summary of QA/QC Samples

Sample Group Area	No. of Blank Sample for Lead Only	No. of Blank Samples for Lead and Table 4.1 Metals[1]	No. of Blank Samples for Mercury	No. of Samples Table 5.5 Metals	No. of Duplicate Samples for Lead and Table 4.1 Metals	No. of Duplicate Samples for Mercury	Total
Accelerator Systems	0	2	2	0	0	0	**4**
1st Floor Rooms	4	2	2	0	1	1	**10**
Experimental Floor	1	0	0	0	0	0	**1**
2nd Floor Rooms	7	3	1	0	0	0	**11**
HVAC Systems	0	1	1	2	0	0	**4**
Total	**12**	**8**	**6**	**2**	**1**	**1**	**30**

5.4 Laboratory Analysis

Wipe samples were submitted by BNL Safety & Health Services Division IH personnel to both Liberty and EMSL for analysis. Analytical results are fully documented in the following analytical reports:

- Liberty Mutual Industrial Hygiene Laboratory Analytical Reports: 1410204 dated October 29, 2014, 1410205 dated October 30, 2014, and 1410206 dated October 30, 2014.
- EMSL Analytical, Inc. Laboratory Reports: 011406203 dated November 19, 2014, 011406226 dated November 20, 204 and 011407014 dated January 8, 2015.

5.5 Sample Identification

Each sample was identified by a set of information relating individual sample characteristics in accordance with BNL-IH75190, *Surface Wipe Sampling Procedure*. Required information consists of building number, date (MMDDYY), analyte symbol (e.g., M for metals) and sample number. An example of appropriate sample identification is as follows:

- **725-101514-M-001**

5.6 Chain-of-Custody, Sample Packaging and Shipment

Samples and associated field sampling forms were delivered to BNL Safety & Health Services Division IH personnel under BNL-IH51300 *Chain or Custody* procedures for packaging and shipment. BNL IH personnel completed the necessary laboratory chain-of-custody forms, packaged, and shipped samples to the analytical laboratories for the requested analysis. Samples were packaged and shipped in a manner that maintained sample preservation requirements during transport, ensured that sample holding time could be achieved, and prevented samples from being tampered with.

Samples were shipped using the commercial carrier FedEx. Commercial carriers are not required to sign the chain-of-custody as long as it is enclosed in the shipping container and evidence tape (custody seal) remains in place on the shipping container. Chain of custody documentation is available in the NSLS Surface Metals Characterization Chain-of-Custody Records, January 2015.

5.7 Field Equipment Calibration

The use of field equipment that would require calibration was not utilized for this project.

5.8 Equipment Decontamination

Non-dedicated sampling equipment, such as reusable templates and scissors, were thoroughly cleaned using GhostWipes™ prior to and between sampling locations. Gloves were changed out between samples by pulling them off inside-out and discarding them appropriately before handling the next wipe.

5.9 Management of Investigation Derived Waste

In accordance with Attachment 9.5 of IH75190, *Surface Wipe Sampling Procedure*, personal protective equipment (PPE) and paper templates generated during wipe sampling operations were disposed of as non-hazardous waste (i.e., normal trash). The wipe samples themselves will be consumed in the analysis at the end of the test by the offsite analytical laboratories.

5.10 Documentation

5.10.1 *Field Documentation*

The Surface Contamination Sampling Form (Attachment 9.3 of BNL – IH75109, *Surface Wipe Sampling Procedure*) was used to document wipe sample information (e.g., location, identification, analyte, etc.). In addition, a dedicated site logbook was used to document daily field activities. Permanent black or blue ink was used to record information on the form and in the logbook. Errors in field documentation were lined through, initialed, dated, and corrected. The logbook contains waterproof pages that are consecutively numbered, and are permanently bound with a hard cover. Upon completion of daily activities, unused portions of pages were lined-through and initialed. All entries in the field logbook were recorded and dated by the field engineer. Copies of the Surface Contamination Sampling Form and the daily log entries are included available in the NSLS Surface Metals Characterization Sampling Forms and Daily Log (PWGC, January 2015).

In addition, field personnel photographed each wipe sample location and maintain an associated photo log so that the sample locations may be revisited. The photo log and photographs are documented in the *NSLS Surface Metals Characterization Sampling Photo Log* (PWGC, January 2015).

5.10.2 *Records Management*

Liberty and EMSL analytical laboratories provided analytical data reports, which will be maintained by BNL in accordance with BNL SBMS Subject Area, *Records Management*.

6.0 RESULTS

Wipe sample results were compared to both the Housekeeping and Equipment Release criteria in Table 3 of BNL IH75190, *Surface Wipe Sampling Procedure* to determine impacts to future decontamination and decommissioning (D&D) activities, to aid in decision-making relative to re-purposing the facility, and to assess any potential threats to the environment.

6.1 Metals Results Summary

Surface metal wipe sampling conducted at the NSLS facility identified lead above the BNL IH75190 Surface Wipe Criteria for Lead Operational Areas (250 µg/ft^2) on the 1st floor periphery, experimental floor, and accelerator enclosures; with levels as high as high as 7,900 µg/ft^2, 8,800 µg/ft^2 and 40,000 µg/ft^2, respectively. Lead was detected above the BNL IH75190 Surface Wipe Criteria for non-Lead Operational Areas (40 µg/ft^2) in the offices and rooms of the second floor and RF penthouse, with a maximum of 1,600 µg/ft^2 in the workshop located in room 2-190A. In addition, quantifiable levels of lead were detected on ductwork surfaces in each of the 15 remaining A/C sections, with a maximum of 1,200 µg/ft^2 found inside the return hatch of A/C 1.

Lead results associated with the metals wipe survey are summarized below in Table 6.2. Complete results are provided in the Surface Metals Characterization Report (**Attachment B**).

Table 6.2

Lead Results Summary

Area	Lead Results
Accelerator Systems	20 of 20 samples with quantifiable levels 180 µg/ft^2 to 8,700 µg/ft^2 lead range (typical) 40,000 µg/ft^2 maximum
1st Floor Rooms	52 of 52 samples with quantifiable levels 110 µg/ft^2 to 1,500 µg/ft^2 lead range (typical) 7,900 µg/ft^2 lead maximum
Experimental Floor (General Area)	17 of 17 with quantifiable levels 110 µg/ft^2 to 750 µg/ft^2 lead range (typical) 8,800 µg/ft^2 lead maximum
2nd Floor/RF Penthouse	88 of 93 samples with quantifiable levels 1.1 µg/ft^2 to 110 µg/ft^2 lead range (typical) 1,600 µg/ft^2 lead maximum
HVAC Ductwork	16 of 16 samples with quantifiable levels 59 µg/ft^2 to 920 µg/ft^2 lead range (typical) 1,200 µg/ft^2 lead maximum

Surface metal wipe sampling conducted at the NSLS facility identified several other metals above their corresponding BNL IH75190, *Surface Wipe Criteria for Metals* in various locations within the facility, as described below:

- Cadmium was identified in each of the five sample group areas (i.e., accelerator systems, first floor rooms, experimental floor, second floor rooms/RF Penthouse and the HVAC ductwork). It should be noted that, in general, where lead was detected and samples were analyzed for additional metals of concern, cadmium was also detected.
- Manganese was identified in the experimental floor sample group area;
- Silver was identified in the HVAC ductwork sample group area;
- Cobalt was identified in the 2-190 workshop located in the second floor rooms sample group area; and
- Mercury was detected above its respective analytical laboratory reporting limit in each of the sample group areas.

Analytical results for metals are provided in their entirety, with results above their respective BNL IH75190 Surface Wipe Criteria highlighted, at the end of this report in Table 6.1 Sample locations, as well as analytical results above their respective BNL IH75190 Surface Wipe Criteria, are also illustrated in **Figure 3** and **Figure 4.** Sample location photographs are available in the *NSLS Surface Metals Characterization Sampling Photo Log* (PWGC, January 2015).

6.2 QA/QC Results Summary

Samples 001 through sample 106 were analyzed by Liberty Mutual Industrial Hygiene Laboratory. Liberty Mutual Industrial Hygiene Laboratory analytical report 1410204 indicated that QA blank samples 021 and 022 did not meet the quality control criteria for lead and therefore samples 001 through 020 were not blank corrected. Samples 023 through sample 106 (analytical reports 1410205 and 1410206) did meet quality control criteria and samples were blank corrected. QA blank sample results from analytical reports 1410205 and 1410206 were not found above their respective limit of quantification (LOQ).

Beryllium, cadmium, cobalt, chromium, manganese, antimony, molybdenum, nickel, and vanadium were detected in some samples analyzed by Liberty, which were only submitted for lead analysis. A request was submitted to Liberty on December 9, 2014 to revise the original analytical reports with the additional analytes. The revised reports are included as reference material to this report.
It should also be noted that samples 048, 049, and 050 were voided prior to analysis and samples 242, 243, 244 were held and not analyzed. The sample number sequence was not changed.

Samples 107 through 248 were analyzed by EMSL Analytical, Inc. EMSL analytical reports 011406203 and 011406226 indicated that aluminum, arsenic, calcium, copper, magnesium, tin, and zinc were detected in laboratory method blanks above their respective reporting limit (RL). EMSL analytical report 011407014 indicated that beryllium was outside the method control limits and zinc was detected in the method blank above the reporting limit. Results for these analytes, therefore, may be biased high. Generally, QA blank analytical results did not exceed their RL; however, analytes that did were not found at appreciably high levels. The analytical results for the two QA duplicate samples collected (233 and 234) were found to be comparable to their respective wipe samples (208 and 209). Obtaining repeatability of QA duplicate wipe sample results is problematic due to the fact that duplicate wipe samples cannot be collected from the same wipe surface, and are instead collected on surfaces adjacent to the original wipe sample location.

7.0 HEALTH AND SAFETY

Project personnel adhered to the facility requirements presented in Email correspondence from Lori Stiegler to Photon Sciences Personnel, dated October 16, 2014: *725 Facility Update*. The field engineer who performed wipe sample collection also followed the PPE requirements specified in IH75190, *Surface Wipe Sampling Procedure*. Additionally, the field engineer completed the Job Training Assessment (JTA) designated for wipe sample collection: HP-75C, *Surface Wipes Sampler for Toxic Metals*.

8.0 REFRENCES

LS-NSLS-0012, *NSLS Safety Assessment Document (SAD)*.

BNL Photon Sciences Division, *Summary Report of the Evaluation of Lead Contamination in NSLS, National Synchrotron Light Source, Upton, New York*, August 24, 2012

Brookhaven National Laboratory Safety & Health Services Division – Industrial Hygiene Group, Standard Operating Procedure: IH75190, *Surface Wipe Sampling Procedure*, Rev 18, March 3, 2014

Brookhaven National Laboratory Safety & Health Services Division – Industrial Hygiene Group, Standard Operating Procedure: BNL-IH51300 *Chain or Custody*.

BNL SBMS Subject Area, *Records Management*

Liberty Mutual Industrial Hygiene Laboratory Analytical Report, Sample Set: 1209253, October 9th, 2012

Liberty Mutual Industrial Hygiene Laboratory Analytical Report 1410204, October 29, 2014

Liberty Mutual Industrial Hygiene Laboratory Analytical Report 1410205, October 30, 2014

Liberty Mutual Industrial Hygiene Laboratory Analytical Report 1410206, October 30, 2014

EMSL Analytical, Inc. Laboratory Report 011406203, November 19, 2014

EMSL Analytical, Inc. Laboratory Report 011406226, November 20, 2014

Statement of Work for the Non-Radiological Characterization Planning and Implementation for NSLS Transition-Hazard Removal Project

JTA: HP-75C, *Surface Wipes Sampler for Toxic Metals*

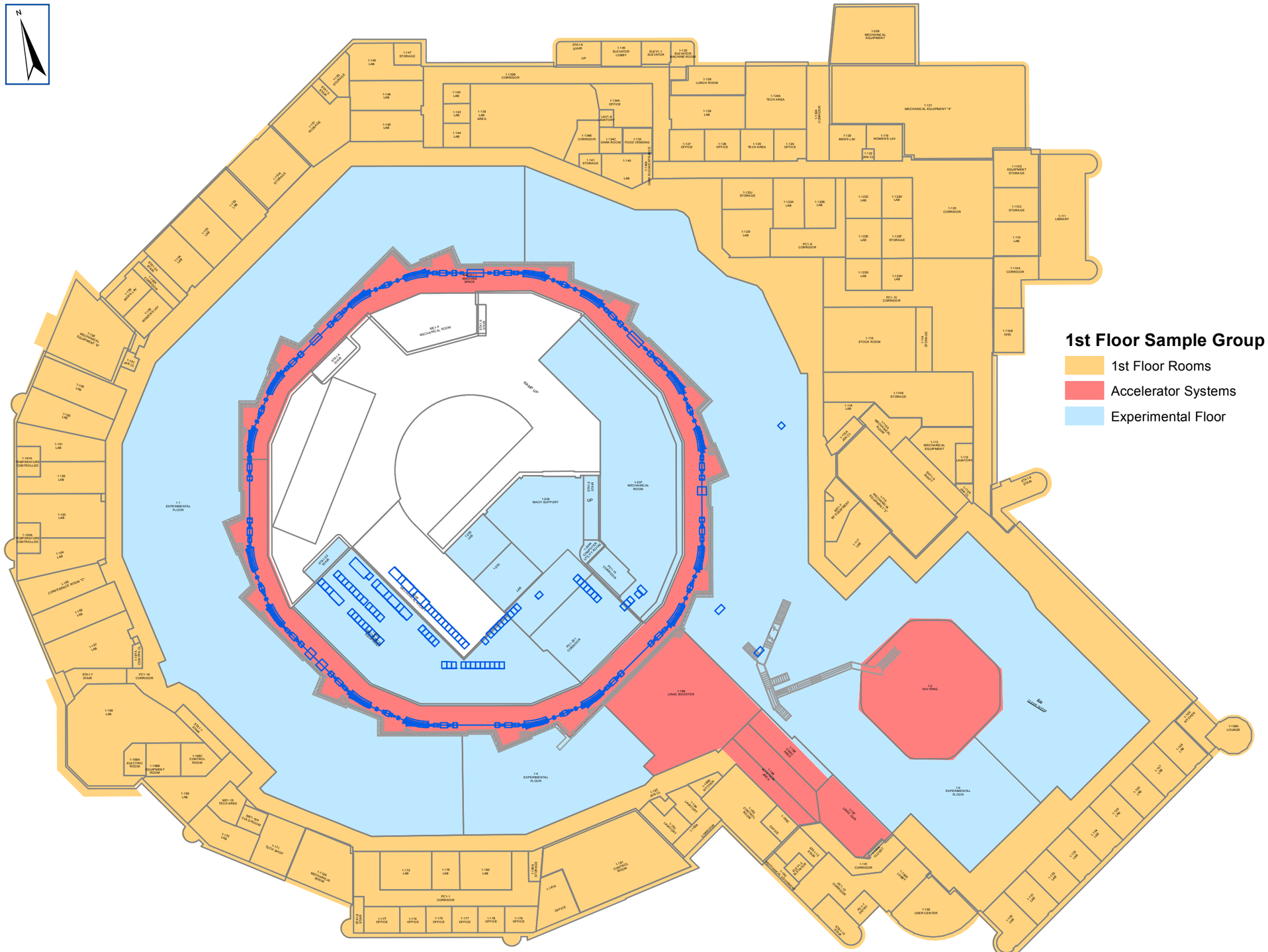
NSLS Surface Metals Characterization Sampling Photo Log, PWGC, November 2014

NSLS Surface Metals Characterization Chain-of-Custody Records, November 2014

NSLS Surface Metals Characterization Sampling Forms and Daily Log, PWGC, November 2014

NSLS Transition and Hazard Removal Project, Facility Characterization Survey, Nintzel, December 9, 2014

FIGURES



1st Floor Sample Group Areas

🟧 1st Floor Rooms

🟥 Accelerator Systems

🟦 Experimental Floor

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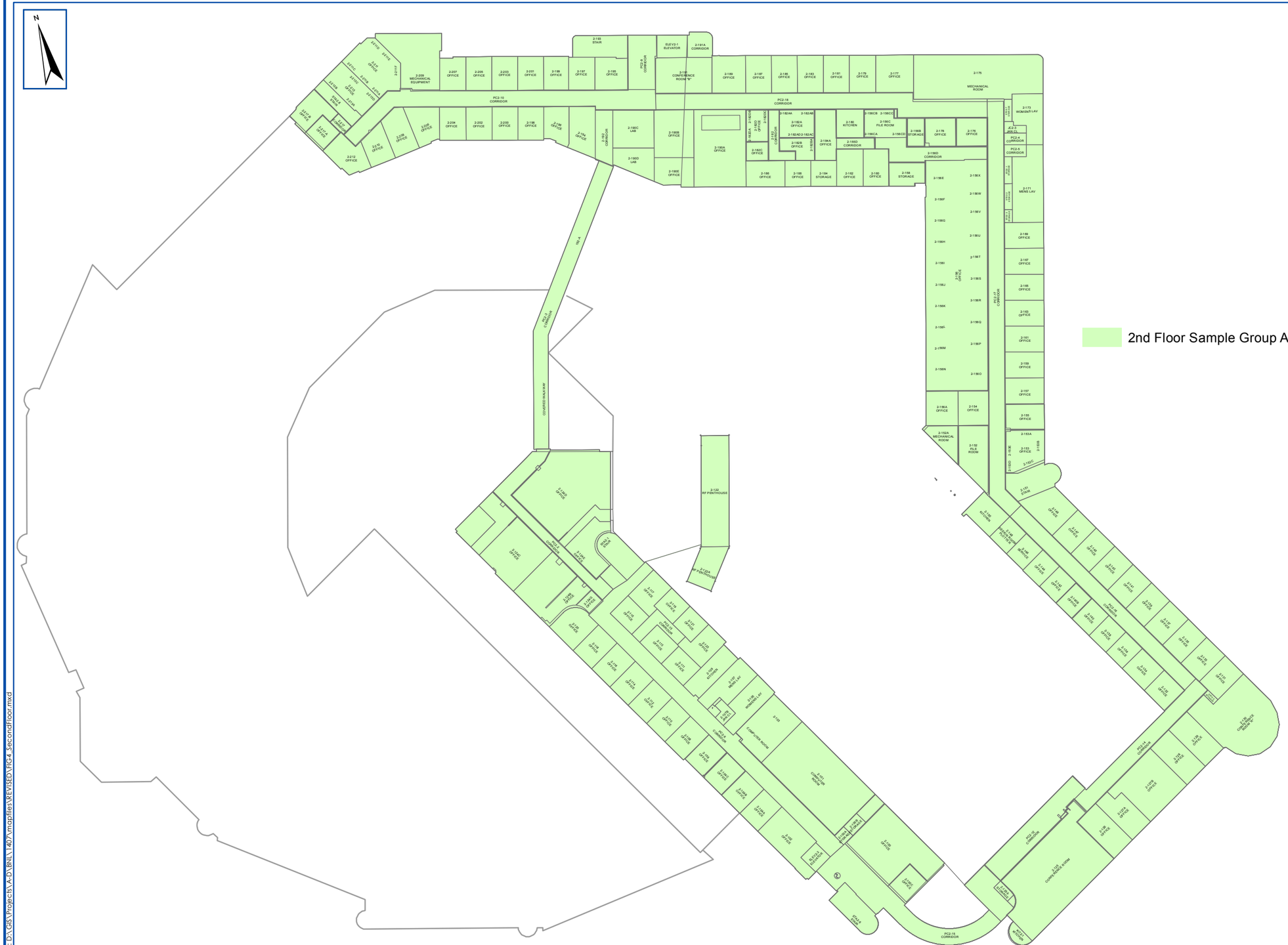
NSLS TRANSITION AND HAZARD REMOVAL

BLDG 725
FIRST FLOOR
SAMPLE GROUP AREAS

FIGURE NO:
1

SHEET:

Document Path: D:\GIS\Projects\A-D\BNL\1407\mapfiles\REVISED\FIG1_FirstFloor.mxd



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NSLS TRANSITION AND HAZARD REMOVAL

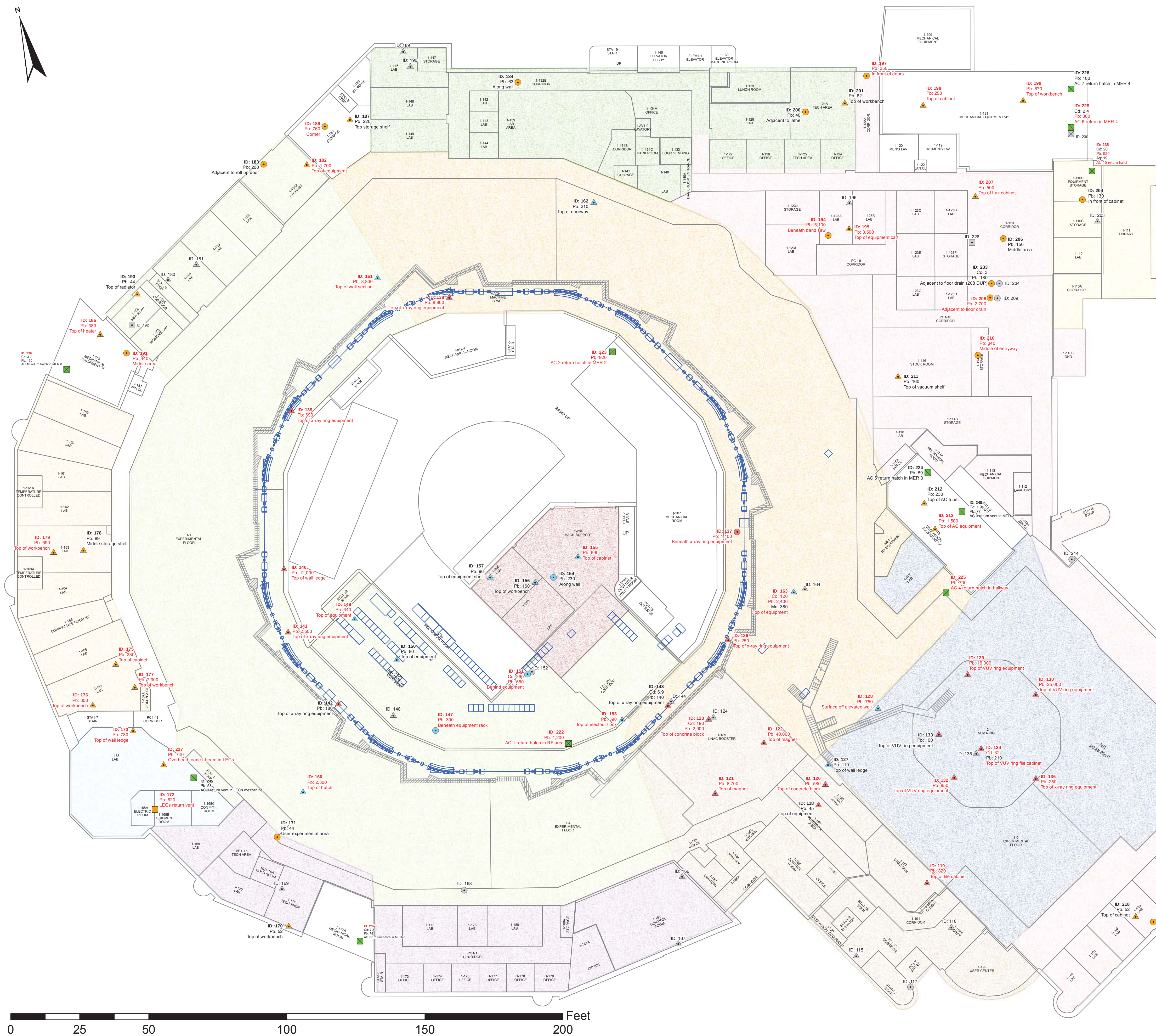
BLDG 725
SECOND FLOOR
SAMPLE GROUP AREAS

FIGURE NO:

2

SHEET:

Document Path: D:\GIS\Projects\AD\BNL\1407\mapfiles\REVISED\VIC4_SecondFloor.mxd



Samples Exceeding BNL Surface Wipe Criteria For Metals

Sample Group, location

- 1st Floor Rooms, Floor
- 1st Floor Rooms, Representative
- 1st Floor Rooms, Return
- Accelerator Systems, Floor
- Accelerator Systems, Representative
- Experimental Floor, Floor
- Experimental Floor, Representative
- HVAC System, Return

Sample results are reported in µg/sq ft

Black text denotes:
Metals results that exceed their respective Equipment Release Criteria.
OR
Lead results that exceed the non-Pb Operational Areas Equipment Release and Housekeeping Critera.

Red text denotes:
Metals results that exceed their respective House Keeping Criteria.
OR
Lead results that exceed the Pb Oerational Areas Equipment and Housekeeping Criteria.

BNL S&H Division - IH Group IH75190, Table 3 BNL Surface Wipe Criteria for Metals.

Samples Not Exceeding BNL Surface Wipe Criteria For Metals

- Diffuser
- Dup
- Floor
- Representative
- Return

1st Floor A/C Areas

- AC 1 - West Half Experimental Area & X-Ray Tunnel
- AC 2 - East Half Experimental Area & X-Ray Tunnel
- AC 4 - VUV Ring: High Bay Area
- AC 5 - LINAC Ring (Booster Ring) & Lobby
- AC 6 - 1st Floor Offices North Side & 2nd Floor Lobby North East Offices Past North Elevator
- AC 7 - 1st Floor MER 4 .... South to Lobby
- AC 9 - Legs or Gamma Ray Facility
- AC 11 - Machine Shop Outside MER 2
- AC 14 - Library
- AC 16 - Structural Biology North of Legs (By MER 8)
- AC 17 - Structural Biology East of Legs (By MER &)

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CLIENT

BROOKHAVEN NATIONAL LABORATORY PHOTON SCIENCE DIVISION

PROJECT

NSLS TRANSITION AND HAZARD REMOVAL SURFACE METALS CHARACTERIZATION

SHEET TITLE

FIRST FLOOR WIPE SAMPLE LOCATIONS AND ANALYICAL RESULTS THAT EXCEED BNL SURFACE METALS CRITERIA

JOB NO.:	BNL1407
DATE:	1/14/2015
DESIGNED BY:	BB
DRAWN BY:	BB
APPROVED BY:	MM
SCALE:	AS SHOWN

SHEET NO.:

FIGURE NO.: 3

Samples Exceeding
BNL Surface Wipe Criteria For Metals
Sample Group, location

- 🟥 2nd Floor, Diffuser
- ● 2nd Floor, Floor
- ▲ 2nd Floor, Representative
- ☒ HVAC System, Return

Sample results are reported in µg/sq ft

Black text denotes:
Metals results that exceed their respective Equipment Release Criteria.
OR
Lead results that exceed the non-Pb Operational Areas Equipment Release and Housekeeping Critera.

Red text denotes:
Metals results that exceed their respective House Keeping Criteria.
OR
Lead results that exceed the Pb Oerational Areas Equipment and Housekeeping Criteria.

BNL S&H Division - IH Group IH75190, Table 3 BNL Surface Wipe Criteria for Metals.

Samples Not Exceeding
BNL Surface Wipe Criteria For Metals

- ■ Diffuser
- ● Floor
- ▲ Representative
- ☒ Return

2nd Floor A/C Areas

- 🟩 AC 10 - Penthouse (Roof)
- 🟥 AC 12 - Technician's Area, South Breeze Way
- ⬜ AC 3 - Offices North West of Lobby
- 🟨 AC 6 - 1st Floor Offices North Side & 2nd Floor Lobby North East Offices Past North Elevator
- 🟦 AC 8 - 2nd Floor North Offices West of North Elevator

Document Path: Z:\GIS\Projects\A-D\BNL\1407\mapfiles\REVISED\FIG4_SecondFloorSampleLocations_24x36.mxd

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BROOKHAVEN NATIONAL LABORATORY
PHOTON SCIENCE DIVISION

PROJECT

NSLS TRANSITION AND HAZARD REMOVAL
SURFACE METALS CHARACTERIZATION

SHEET TITLE

SECOND FLOOR WIPE SAMPLE LOCATIONS
AND ANALYTICAL RESULTS THAT
EXCEED BNL SURFACE METALS CRITERIA

JOB NO.:	BNL1407
DATE:	1/14/2015
DESIGNED BY:	BB
DRAWN BY:	BB
APPROVED BY:	MM
SCALE:	AS SHOWN

SHEET NO.:

FIGURE NO.: 4

TABLES

Table 6.1

Brookhaven National Laboratory - Photon Science Division		Sample Group Area:	Accelerator Systems																											
	Sample Identification	Building Number:	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725
		Sample Date (mmddyy):	102414	102414	102414	102414	102414	102414	102414	102414	102414	102414	102414	102414	102414	102414	102414	102414	102414	102414	102414	102414	102414	102414	102414	102414	102414	102414	102414	102414
		Requested Analyte(s):	Pb	Pb	Pb	Pb	Pb	Pb	20 Metals	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	20 Metals	Pb	20 Metals	Pb	Pb	Hg	Hg	Hg	20 Metals	20 Metals	Hg	Hg
		Sample ID:	122	130	129	140	138	121	123	141	137	132	119	139	131	120	136	134	142	143	133	118	124	135	144	145	125	126	146	
NSLS Transition and Hazard Removal - Surface Metals Characterization	Sample Loation Description	Room Number:	1-189	VUV Ring	VUV Ring	1-222	1-224	1-189	1-189	1-222	1-226	VUV Ring	1-187	1-223	VUV Ring	1-188	1-227	VUV Ring	1-222	1-22B	VUV Ring	1-186	1-189	VUV Ring	1-22B					
		Room Designation:	Booster Ring	VUV Ring	VUV Ring	X-Ray Tunnel	X-Ray Tunnel	Booster Ring	Booster Ring	X-Ray Tunnel	X-Ray Tunnel	VUV Ring	LINAC	X-Ray Tunnel	VUV Ring	LINAC	X-Ray Tunnel	VUV Ring	X-Ray Tunnel	X-Ray Tunnel	VUV Ring	Klystron Area	Booster Ring	VUV Ring	X-Ray Tunnel	BLANK	BLANK	BLANK	BLANK	
Analytical Results		Collection Location:	Top of magnet	Top of VUV ring equipment	Top of VUV ring equipment	Top of wall ledge	Top of x-ray ring equipment	Top of magnet	Top of concrete block	Top of x-ray ring equipment	Beneath x-ray ring equipment	Top of VUV ring equipment	Top of file cabinet	Top of x-ray ring equipment	Top of VUV ring equipment	Top of concrete block	Top of x-ray ring equipment	Top of VUV ring file cabinet	Top of x-ray ring equipment	Top of x-ray ring equipment	Top of VUV ring equipment	Top of equipment	Top of concrete block	Top of VUV ring file cabinet	Top of x-ray ring equipment					
		AC Area:	AC 5	AC 4	AC 4	AC 1	AC 2	AC 5	AC 5	AC 1	AC 2	AC 4	AC 5	AC 1	AC 4	AC 5	AC 2	AC 4	AC 1	AC 2	AC 4	AC 5	AC 5	AC 4	AC 2					

Table 3 (BNL Surface Wipe Criteria For Metals)[1]																														
Analyte	Housekeeping	Equipment Release																												
	All	All																												
Aluminum	NS	NS							4,000									1,200		650						4.6	2.2		
Antimony	NS	NS							8.1									13		25						<0.50	<0.50		
Arsenic	NS	NS							1.6									0.96		0.74						0.09	0.05		
Beryillium	28	Be Operational Areas - 28 / Public and non-Be operations areas - 1.9							0.12									<0.050		<0.050						<0.050	<0.050		
Cadmium	27.9	1.9							190									32		6.9						0.17	<0.0054		
Calcium	NS	NS							41,000									1,900		1,800						86	45		
Chromium	6,968	464							30									12		4.5						<1.0	<1.0		
Cobalt	278.7	18.6							1.6									1.3		1.4						<0.50	<0.50		
Copper	NS	NS							710									450		380						2.4	0.94		
Iron	NS	NS							4,000									4,700		1,000						717	<5.0		
Lead	Pb operational areas - 250 / non-Pb operational areas - 40	Pb operational areas - 250 / non-Pb operational areas - 40	40,000	25,000	16,000	12,000	8,800	8,700	2,900	2,500	1,100	850	820	690	590	580	250	210	180	140	100	45				0.74	0.39		
Magnesium	NS	NS							2,400									520		280						81	74		
Manganese	2,786	184							82									32		13						<0.50	<0.50		
Molybdenum	NS	NS																												
Mercury	NS	NS																					0.05	0.09	0.24			<0.020	<0.020	
Nickel	13,935	929							22									19		5.5						<0.50	<0.50		
Selenium	NS	NS							1.3									1.2		0.78						<0.050	<0.050		
Silver	139	9.3																												
Tellurium	NS	NS																												
Thallium	NS	NS							0.06									<0.050		<0.050						<0.050	<0.050		
Tin	NS	NS							130									42		12						1.2	1.1		
Titanium	NS	NS							23									15		22						<0.50	<0.50		
Vanadium	NS	NS							9.1									2.5		1.6						<0.50	<0.50		
Zinc	NS	NS							2,200									2,200		350						41	34		

Notes:

All sample results are reported in µg/ft2.

NS - No Standard

Blank cells denote the analyte was not analyzed for.

< - Non detect (no detectable result above the respective Limit of Quantification/Reporting Limit)

Yellow highlight denotes sample above its respective equipment release standard.

Red highlight denotes sample above its respective housekeeping standard

[1] Brookhaven National Laboratory Safety & Health Services Division Industrial Hygiene Group - IH-75190 Surface Wipe Sample Procure, March 4th, 2014

Brookhaven National Laboratory - Photon Science Division		Sample Group Area:	Experimental Floor																			First Floor Rooms						
	Sample Identification	Building Number:	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725
		Sample Date (mmddyy):	102414	102414	102714	102714	102714	102714	102714	102714	102714	102714	102714	102714	102714	102714	102714	102714	102714	102814	102714	102814	102914	102914	102914	102814	102914	102814
		Requested Analyte(s):	Pb	Pb	Pb	Pb	Pb	Pb	20 Metals	Hg	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	20 Metals	Hg	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb
		Sample ID:	127	128	147	148	149	150	151	152	153	154	155	156	157	160	161	162	163	164	168	165	177	194	195	208	182	213	173
NSLS Transition and Hazard Removal - Surface Metals Characterization	Sample Loation Description	Room Number:	VUV Floor	VUV Floor	1-200	1-200	1-200	1-200	1-201	1-201	1-201	1-204	1-204	1-205	1-205	X6B	X15	X18A	X27A	X27A	X2A		1-167	1-123A	1-123A	1-123	1-151A	1-115	1-168
		Room Designation:	Experimental Floor	Experimental Floor	RF Equipment Room	RF Equipment Room	RF Equipment Room	RF Equipment Room	Booster Quad Area	Booster Quad Area	Booster Quad Area	Electrical Shop	Electrical Shop	Power Supply Test Area	Power Supply Test Area	Experimental Floor	Experimental Floor	Experimental Floor	Experimental Floor	Experimental Floor	Experimental Floor	BLANK	Lab	Lab	Lab	Pb Laydown Area	West Rollup Door	MER 3	LEGs
Analytical Results		Collection Location:	Top of wall ledge	Surface off elevated walk	Floor beneath equipment rack	Top of equipment	Top of equipment	Top of equipment	Floor behind equipment	Floor behind equipment	Top of electric J-box	Floor along wall	Top of cabinet	Top of workbench	Top of equipment shelf	Top of hutch	Top of wall section	Top of doorway	Top of equipment	Top of equipment	Floor user experimental area		Top of workbench	Floor under band saw	Top of equipment cart	Floor near floor drain	Top of equipment	Top of AC equipment	Top of wall ledge
		AC Area:	AC 4	AC 4	AC 1	AC 1	AC 1	AC 1	AC 1	AC 1	AC 1	AC 2	AC 2	AC 2	AC 2	AC 1	AC 1	AC 2	AC 2	AC 2	AC 1		AC 7	AC 7	AC 7	AC 7	AC 1		AC 9
Table 3 (BNL Surface Wipe Criteria For Metals)[1]																													
Analyte	Housekeeping	Equipment Release																											
	All	All																											
Aluminum	NS	NS		32,000				7,700																					
Antimony	NS	NS		28				1.8																					
Arsenic	NS	NS		14				0.44																					
Beryillium	28	Be Operational Areas - 28 / Public and non-Be operations areas - 1.9		0.26				0.15																					
Cadmium	27.9	1.9		120				260																					
Calcium	NS	NS		21,000				4,900																					
Chromium	6,968	464		120				25																					
Cobalt	278.7	18.6		17				2.6																					
Copper	NS	NS		1,400				2,200																					
Iron	NS	NS		39,000				24,000																					
Lead	Pb operational areas - 250 / non-Pb operational areas - 40	Pb operational areas - 250 / non-Pb operational areas - 40	8,800	2,400	2,300	750	690	660	390	340	300	230	210	160	110	96	80	32	27			0.23	7,900	5,100	3,500	2,700	1,700	1,500	780
Magnesium	NS	NS		6,300				1,400																					
Manganese	2,786	184		380				140																					
Molybdenum	NS	NS																											
Mercury	NS	NS																		0.11	0.3								
Nickel	13,935	929		120				28																					
Selenium	NS	NS		15				1.4																					
Silver	139	9.3																											
Tellurium	NS	NS																											
Thallium	NS	NS		0.19				<0.050																					
Tin	NS	NS		36				1,200																					
Titanium	NS	NS		220				38																					
Vanadium	NS	NS		80				4.2																					
Zinc	NS	NS		26,000				3,100																					

Notes:

All sample results are reported in µg/ft2.

NS - No Standard

Blank cells denote the analyte was not analyzed for.

< - Non detect (no detectable result above the respective Limit of Quantification/Reporting Limit)

Yellow highlight denotes sample above its respective equipment release standard.

Red highlight denotes sample above its respective housekeeping standard

[1] Brookhaven National Laboratory Safety & Health Services Division Industrial Hygiene Group - IH-75190 Surface Wipe Sample Procure, March 4th, 2014

Table 6.1

Brookhaven National Laboratory - Photon Science Division		Sample Group Area:	First Floor Rooms																										
	Sample Identification	Building Number:	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725
		Sample Date (mmddyy):	102914	102914	103014	102814	102914	102814	102914	102914	102914	102914	102914	102814	102814	102914	102914	102914	102814	102914	102914	102914	102914	102914	102914	102814	102814	102914	102814
		Requested Analyte(s):	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb
		Sample ID:	217	188	227	179	199	172	207	191	186	197	210	175	176	198	212	187	183	211	206	204	215	216	178	184	201	219	170
NSLS Transition and Hazard Removal - Surface Metals Characterization	Sample Loation Description	Room Number:	1-107	1-151	1-168	1-163	1-121	1-168	1-123	1-158	1-158	AC 7 Hall	1-116	1-167	1-167	1-121	1-115	1-151	1-151A	1-116	1-123	1-110C	1-107	1-107	1-163	AC 6 Hall	1-124A	1-103	1-171
		Room Designation:	Lab	User Storage	LEGs	Lab	MER 4	LEGs	Pb Laydown Area	MER 8	MER 8	Corridor	Stock Room	Lab	Lab	MER 4	MER 3	User Storage	West Rollup Door	Stock Room	Pb Laydown Area	Storage	Lab	Lab	Lab	Corridor	Tech Shop	Lab	Tech Shop
Analytical Results		Collection Location:	Floor entryway	Corner of floor	Overhead crane I-beam in LEGs	Top of workbench	Top of workbench	LEGs return vent	Top of haz cabinet	Floor middle area	Top of heater	Floor near doors	Floor middle entryway	Top of cabinet	Top of workbench	Top of cabinet	Top of AC 5 unit	Top storage shelf	Floor near roll-up	Top of vacuum shelf	Floor middle area	Floor near cabinet	Top of cabinet	Top of workbench	Middle storage shelf	Floor along wall	Top of workbench	Floor middle area	Top of workbench
		AC Area:	AC 7		AC 9	AC 7		AC 9	AC 7			AC 7	AC 7	AC 7	AC 7				AC 1	AC 7	AC 7	AC 14	AC 7	AC 7	AC 7	AC 6	AC 6	AC 7	AC 17

Table 3 (BNL Surface Wipe Criteria For Metals)[1]																													
Analyte	Housekeeping	Equipment Release																											
	All	All																											
Aluminum	NS	NS																											
Antimony	NS	NS																											
Arsenic	NS	NS																											
Beryillium	28	Be Operational Areas - 28	Public and non-Be operations areas - 1.9																										
Cadmium	27.9	1.9																											
Calcium	NS	NS																											
Chromium	6,968	464																											
Cobalt	278.7	18.6																											
Copper	NS	NS																											
Iron	NS	NS																											
Lead	Pb operational areas - 250	non-Pb operational areas - 40	Pb operational areas - 250	non-Pb operational areas - 40	770	760	740	690	670	620	500	440	380	350	340	330	300	250	230	220	200	160	150	130	110	110	89	63	62	56	52
Magnesium	NS	NS																											
Manganese	2,786	184																											
Molybdenum	NS	NS																											
Mercury	NS	NS																											
Nickel	13,935	929																											
Selenium	NS	NS																											
Silver	139	9.3																											
Tellurium	NS	NS																											
Thallium	NS	NS																											
Tin	NS	NS																											
Titanium	NS	NS																											
Vanadium	NS	NS																											
Zinc	NS	NS																											

Notes:

All sample results are reported in µg/ft2.

NS - No Standard

Blank cells denote the analyte was not analyzed for.

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Yellow highlight denotes sample above its respective equipment release standard.

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[1] Brookhaven National Laboratory Safety & Health Services Division Industrial Hygiene Group - IH-75190 Surface Wipe Sample Procure, March 4th, 2014

Brookhaven National Laboratory - Photon Science Division

NSLS Transition and Hazard Removal - Surface Metals Characterization

Analytical Results

		Sample Group Area:	**First Floor Rooms**																												
	Sample Identification	Building Number:	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725
		Sample Date (mmddyy):	102914	102814	102914	102914	102914	102814	102414	102914	Pb	102814	102914	102814	102414	102914	102914	102414	102814	102914	102814	102914	102714	102714	102814	102814	102914	102914	102914	102914	102914	102914
		Requested Analyte(s):	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Hg	20 Metals	Hg	Pb	Pb	Pb	Pb	Pb	20 Metals	Hg
		Sample ID:	218	171	193	200	190	167	115	214	166	196	181	117	192	203	116	169	189	180	209	158	159	174	185	202	205	220	221		
	Sample Loation Description	Room Number:	1-103	AC 2 Hall	1-156	1-124A	1-146	1-181	1-192	STA1-8	1-181	1-123A	1-154	STA1-23	1-156	1-110C	1-192	1-171	1-146	1-154	1-123										
		Room Designation:	Lab	Corridor	Lavatory	Tech Shop	Lab	Control Room	Corridor	Stairs	Control Room	Lab	Lab	Stairs	Lavatory	Storage	Lobby	Tech Shop	Lab	Lab	Pb Laydown Area	BLANK	BLANK	BLANK	BLANK	BLANK	BLANK	BLANK	BLANK	
		Collection Location:	Top of cabinet	User area floor	Top of radiator	Floor under lathe	Top of haz cabinet	Top of wall ledge	Top of vending machine	Stair landing floor	Top of bookshelf	Top of workbench	Top of bookshelf	Corner of floor	Ceiling diffuser	Top bookshelf	Top of vending machine	Top of cabinet	Top of workbench	Top of workbench	Floor near floor drain										
		AC Area:	AC 7	AC 17	AC 1	AC 6	AC 6	AC 17	AC 5	AC 7	AC 17	AC 7	AC 1	AC 5	AC 1	AC 14	AC 5	AC 17	AC 6	AC 1	AC 7										

Table 3 (BNL Surface Wipe Criteria For Metals)[1]																															
Analyte	Housekeeping	Equipment Release																													
	All	All																													
Aluminum	NS	NS																				4.6						3.6	
Antimony	NS	NS																				<0.50						<0.50	
Arsenic	NS	NS																				0.1						0.075	
Beryillium	28	Be Operational Areas - 28 / Public and non-Be operations areas - 1.9																				<0.050						<0.050	
Cadmium	27.9	1.9																				0.15						0.34	
Calcium	NS	NS																				100						64	
Chromium	6,968	464																				<1.0						<1.0	
Cobalt	278.7	18.6																				<0.50						<0.50	
Copper	NS	NS																				2.3						2	
Iron	NS	NS																				9.3						9.2	
Lead	Pb operational areas - 250 / non-Pb operational areas - 40	Pb operational areas - 250 / non-Pb operational areas - 40	52	44	44	40	38	33	27	23	21	20	19	16	15	14	13	13	9.3	3.4		0.34		0.21	0.19	0.19	0.19	0.22	
Magnesium	NS	NS																				77						68	
Manganese	2,786	184																				<0.50						<0.50	
Molybdenum	NS	NS																													
Mercury	NS	NS																			0.33		<0.020						<0.020	
Nickel	13,935	929																				<0.50						<0.50	
Selenium	NS	NS																				<0.050						<0.050	
Silver	139	9.3																													
Tellurium	NS	NS																													
Thallium	NS	NS																				<0.050						<0.050	
Tin	NS	NS																				1.4						1.3	
Titanium	NS	NS																				<0.50						<0.50	
Vanadium	NS	NS																				<0.50						<0.50	
Zinc	NS	NS																				43						35	

Notes:

All sample results are reported in µg/ft2.

NS - No Standard

Blank cells denote the analyte was not analyzed for.

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[1] Brookhaven National Laboratory Safety & Health Services Division Industrial Hygiene Group - IH-75190 Surface Wipe Sample Procure, March 4th, 2014

Table 6.1

Brookhaven National Laboratory - Photon Science Division		Sample Group Area:	First Floor Rooms		Second Floor Rooms																							
	Sample Identification	Building Number:	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725
		Sample Date (mmddyy):	103014	103014	102014	102014	102014	102014	102014	102014	102014	102014	102014	102014	102014	101614	102014	102014	102214	101614	101614	101614	102014	101614	101714	101614	101614	102014	101614	101614
		Requested Analyte(s):	20 Metals	Hg	Pb	Pb	Pb	20 Metals	Pb	Pb	20 Metals	20 Metals	Pb	Pb	Pb	Pb	Pb	Pb	Hg	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb
		Sample ID:	233	234	080	091	077	086	083	090	076	092	079	078	016	066	087	110	017	018	015	106	001	059	020	007	098	019	013
NSLS Transition and Hazard Removal - Surface Metals Characterization	Sample Loation Description	Room Number:			2-190A	2-124C1	2-190C	2-209	2-201	2-124D	2-190B	2-124C2	2-190E	2-190D	2-152	2-182A	2-210	2-124C	2-152	2-156	2-152	2-122	2-125	2-189	2-156	2-140B	2-109	2-156	AC6 Hall
		Room Designation:	DUPLICATE (208)	DUPLICATE (208)	190 Workshop	125 Workshop	190 Workshop	MER 6	Office	124 Workshop	190 Workshop	126 Workshop	190 Workshop	190 Workshop	File Room	Office	Office	124 Workshop	File Room	Design Room	File Room	RF Penthouse	Conference Room	Office	Design Room	Office	Kitchen	Design Room	Corridor
Analytical Results		Collection Location:			Top of workbench	Top of workbench	Top of workbench	Top of AC unit	Ceiling diffuser	Top of workbench	Top of workbench	Top of workbench	Top of workbench	Floor in front of fume hood	Floor behind door	Ceiling diffuser	Ceiling diffuser	Top of file cabinet	Top of file cabinet	Ceiling diffuser	Ceiling diffuser	Top of transformer	Ceiling diffuser	Floor beneath desk	Top shelf of desk	Ceiling diffuser	Ceiling diffuser	Floor adj. to radiator	Ceiling diffuser
		AC Area:			AC 6	AC 12	AC 6		AC 8	AC 12	AC 6	AC 12	AC 6	AC 6	AC 6	AC 6	AC 8	AC 12	AC 6	AC 6	AC 6	AC 10	AC 6	AC 6	AC 6	AC 6	AC 3	AC 6	AC 6

Table 3 (BNL Surface Wipe Criteria For Metals)[1]																												
Analyte	Housekeeping	Equipment Release																										
	All	All																										
Aluminum	NS	NS	550					470			1400	290																
Antimony	NS	NS	0.84		2.9	21		<2.0		2.9	<2.0	4.7	2.8			2.6												
Arsenic	NS	NS	1.2					<5.0			<5.0	<5.0																
Beryillium	28	Be Operational Areas - 28 / Public and non-Be operations areas - 1.9	<0.050		0.94		0.074	<0.035			0.037	0.48							0.092									
Cadmium	27.9	1.9	3		7	2.7	2.8	8.2	1.1		5.7	6.3	0.56	2.3	1.5	2.4	1.2		4.3	1.6	4.5	15	0.77		0.91	0.91	9.6		0.86
Calcium	NS	NS	3500					2700			730	370																
Chromium	6,968	464	4.9		43	3	8.8	12	4.8		8.8	2.1		28	8.3	8	7.7		6	5.9	5.3	3.9	3.7	2.5	3.6	2.4	3.7		
Cobalt	278.7	18.6	0.89		200	0.3	10	0.5	0.93	0.23	8.7	0.27	3.6	6.4	1.8	4.8	0.38		0.99	0.96	0.99	0.35	0.47	1.2	0.39	0.57	0.35		0.21
Copper	NS	NS	44					220			540	390																
Iron	NS	NS	1200					14,000			1,800	430																
Lead	Pb operational areas - 250 / non-Pb operational areas - 40	Pb operational areas - 250 / non-Pb operational areas - 40	180		1,600	730	630	420	380	380	320	290	240	230	110	100	89		83	78	65	59	48	45	44	42	42	38	36
Magnesium	NS	NS	1500					570			230	<160																
Manganese	2,786	184	15		120	3.7	17	61	32		27	4	1.7	37	23	26	37		66	33	26	16	11	6.6	6.3	18	13	2.9	21
Molybdenum	NS	NS			320	0.81	130		12				1.2	180	1.5	2	3.5		5.2	250	4.8	1.7	1.8	0.8	0.99	7.2	1.2	1.6	47
Mercury	NS	NS		0.12														0.06											
Nickel	13,935	929	5.4		720	8.1	27	3.8	6.4	160	11	5	3.8	280	10	11	2.2		5.6	11	8.6	6.3	3.9	12	2.8	4.6	2.7	2.9	1.7
Selenium	NS	NS	0.68					<9.8			<9.8	<9.8																	
Silver	139	9.3																											
Tellurium	NS	NS						3.6			3.2	<1.1																	
Thallium	NS	NS	<0.050					<4.1			<4.1	<4.1																	
Tin	NS	NS	2.4					19			27	1,800																	
Titanium	NS	NS	9.7					21			9.5	2.2																	
Vanadium	NS	NS	1		5.3		1	3.3	5.5		1.3	<0.20		2.4	1.9	5.5	8.7		2.4	9.2	6.2	0.7	1.9	0.48	0.59	4.6	3.9	0.25	2
Zinc	NS	NS	500					1,400			460	140																	

Notes:

All sample results are reported in µg/ft2.

NS - No Standard

Blank cells denote the analyte was not analyzed for.

< - Non detect (no detectable result above the respective Limit of Quantification/Reporting Limit)

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Red highlight denotes sample above its respective housekeeping standard

[1] Brookhaven National Laboratory Safety & Health Services Division Industrial Hygiene Group - IH-75190 Surface Wipe Sample Procure, March 4th, 2014

Brookhaven National Laboratory - Photon Science Division		Sample Group Area:	Second Floor Rooms																										
	Sample Identification	Building Number:	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725
		Sample Date (mmddyy):	102014	101714	101714	101614	101714	102014	101614	101614	101614	101614	101614	101714	101614	102014	102014	101614	101614	101714	101614	102014	101614	101714	101714	101714	101714	101714	101614
		Requested Analyte(s):	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb
		Sample ID:	073	037	035	006	036	096	008	014	010	011	062	012	103	068	004	005	054	003	064	009	045	067	030	055	026	058	002
NSLS Transition and Hazard Removal - Surface Metals Characterization	Sample Loation Description	Room Number:	2-195	2-156B	2-156B	2-131	2-156B	2-116	2-140B	AC6 Hall	2-149	2-149	AC6 Hall	2-149	AC3 Hall	2-182A	2-131	2-131	AC6 Hall	2-125	2-188	2-140B	2-177	2-182A	AC6 Hall	2-183	2-169	2-189	2-125
		Room Designation:	Office	Storage	Storage	Office	Storage	Office	Office	Corridor	Office	Office	Corridor	Office	Corridor	Office	Office	Office	Corridor	Conference Room	Corridor	Office	Office	Office	Corridor	Office	Office	Office	Conference Room
Analytical Results		Collection Location:	Ceiling diffuser	Top of bookshelf	Ceiling diffuser	Top of radiator	Corner of floor	Ceiling diffuser	Floor behind desk	Floor along wall	Ceiling diffuser	Floor behind door	Floor along wall	Top of bookshelf	Stair landing floor	Top of bookshelf	Ceiling diffuser	Floor entryway	Floor corner	Top of radiator	Floor adj. to radiator	Top shelf of desk	Ceiling diffuser	Floor along wall	Ceiling diffuser	Ceiling diffuser	Ceiling diffuser	Ceiling diffuser	Floor entryway
		AC Area:	AC 6	AC 6	AC 6	AC 6	AC 6	AC 3	AC 6	AC 6	AC 6	AC 6	AC 6	AC 6	AC 3	AC 6	AC 6	AC 6	AC 6	AC 6	AC 6	AC 6	AC 6	AC 6	AC 6	AC 6	AC 6	AC 6	AC 6

Table 3 (BNL Surface Wipe Criteria For Metals)[1]																													
Analyte	Housekeeping	Equipment Release																											
	All	All																											
Aluminum	NS	NS																											
Antimony	NS	NS		6.5				2.7																	3				15
Arsenic	NS	NS																											
Beryillium	28	Be Operational Areas - 28	Public and non-Be operations areas - 1.9																										
Cadmium	27.9	1.9	1.9	2.3	0.4	0.35	1.2	4.7		0.36	0.54		0.43		0.8	1.2				0.4	5.9		0.86	1.2	2.1	0.61	0.87	0.56	
Calcium	NS	NS																											
Chromium	6,968	464	7.8	12	5.5	4.2	14	6	2.5		2.2	4.2	2.1		5.1	4.8			2.5	2.4	3.6	2.4	3.9	3.6	3.8	3.1	3.5	2.8	
Cobalt	278.7	18.6	3.1	4	0.34	0.58	1.9	0.51		0.27	0.3		1.7		0.68	1.3			0.43	2.5	0.94		1.1	0.94	0.79	1.7	0.64	1.5	0.48
Copper	NS	NS																											
Iron	NS	NS																											
Lead	Pb operational areas - 250 / non-Pb operational areas - 40	Pb operational areas - 250 / non-Pb operational areas - 40	36	33	32	30	29	29	28	28	27	21	21	17	17	16	15	15	15	14	14	13	13	13	12	11	10	10	9.8
Magnesium	NS	NS																											
Manganese	2,786	184	21	19	11	4.2	23	12	3	2.5	8.9	4.7	5.1	2.9	12	7.1	4.6	1.7	3	5.2	8.6	1.7	15	7.7	26	13	14	11	
Molybdenum	NS	NS	4.9	1.2	0.33		1.9	0.88			6.3	0.53	2		0.56	0.48	2.1				54		3.1	0.89	57	9.4	4.7	13	
Mercury	NS	NS																											
Nickel	13,935	929	8.6	7.9	2.6	2.9	6.9	7.8	2.5	2.2	3.1	4.8	44	1.2	4.9	3.7	1.1	15	1.9	2.6	8.7	2.2	6.3	5.8	5.2	4.2	5	4.5	44
Selenium	NS	NS																											
Silver	139	9.3																											
Tellurium	NS	NS																											
Thallium	NS	NS																											
Tin	NS	NS																											
Titanium	NS	NS																											
Vanadium	NS	NS	3.6	1.6	2.1	0.34	1.8	2.3		0.33	1.9	0.26	0.29	0.24	1.1	1.2	0.79		0.26		0.58		3.9	2.8	6.2	3.5	3.3	3.4	
Zinc	NS	NS																											

Notes:

All sample results are reported in µg/ft2.

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[1] Brookhaven National Laboratory Safety & Health Services Division Industrial Hygiene Group - IH-75190 Surface Wipe Sample Procure, March 4th, 2014

Table 6.1

Brookhaven National Laboratory - Photon Science Division		Sample Group Area:	Second Floor Rooms																										
	Sample Identification	Building Number:	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725
		Sample Date (mmddyy):	101714	101714	102014	101714	102014	101714	102014	101714	101714	101714	102014	101714	102014	101714	102014	102014	102014	101714	101714	101714	101714	102014	101714	102014	101714	102014	102014
		Requested Analyte(s):	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	Pb	20 Metals
		Sample ID:	023	046	071	027	097	024	099	042	061	031	093	056	063	038	065	070	101	025	033	043	044	074	060	104	028	084	085
NSLS Transition and Hazard Removal - Surface Metals Characterization	Sample Loation Description	Room Number:	2-161	2-177	2-180	2-169	2-116	2-161	2-109	2-160	AC6 Hall	AC6 Hall	2-124B	2-183	2-188	2-176	2-188	2-180	AC3 Hall	2-161	2-173	2-160	2-160	2-195	2-189	2-100	2-169	2-201	2-201
		Room Designation:	Office	Office	Kitchen	Office	Office	Office	Kitchen	Office	Corridor	Corridor	127 Workshop	Office	Corridor	Office	Office	Kitchen	Corridor	Office	Lavatory	Office	Office	Office	Office	Office	Office	Office	Office
Analytical Results		Collection Location:	Ceiling diffuser	Floor adj. to radiator	Floor along wall	Floor adj. to radiator	Floor behind door	Floor adj. to radiator	Top of mail shelf	Ceiling diffuser	Ceiling diffuser	Floor along wall	Top of kitchen counter	Floor along wall	Ceiling diffuser	Ceiling diffuser	Desk surface	Ceiling diffuser	Floor along wall	Top of file cabinet	Floor adj. to radiator	Corner of floor	Top of bookshelf	Corner of floor	Top of radiator	Top of desk surface	Top of bookshelf	Floor along wall	Top shelf of desk
		AC Area:	AC 6	AC 6	AC 6	AC 6	AC 3	AC 6	AC 3	AC 6	AC 6	AC 6	AC 12	AC 6	AC 6	AC 6	AC 6	AC 6	AC 3	AC 6	AC 6	AC 6	AC 6	AC 6	AC 6	AC 3	AC 6	AC 8	AC 8

Table 3 (BNL Surface Wipe Criteria For Metals)[1]																													
Analyte	Housekeeping	Equipment Release																											
	All	All																											
Aluminum	NS	NS																											39
Antimony	NS	NS																											<2.0
Arsenic	NS	NS																											<5.0
Beryillium	28	Be Operational Areas - 28	Public and non-Be operations areas - 1.9																										<0.035
Cadmium	27.9	1.9		0.8	0.34	1.2	0.33		1	1.1	0.53			1.6		0.39	0.35	42	0.45				0.37					0.77		<0.33
Calcium	NS	NS																											420
Chromium	6,968	464		3		5.1			4.7	2.9	3.8							2.3			2.6								<2.0
Cobalt	278.7	18.6		0.55	0.36	0.81	0.25		0.44	0.28	0.64	1.1	0.4			0.44	0.4	0.21	0.47		0.23		0.52	0.22	0.39	3				<0.20
Copper	NS	NS																											7.9
Iron	NS	NS																											69
Lead	Pb operational areas - 250	non-Pb operational areas - 40	Pb operational areas - 250	non-Pb operational areas - 40	9.7	9.6	8.1	7.8	7.8	7.5	7.5	6.3	5.8	5.7	5.5	5.4	5.2	4.9	4.9	4.8	4.1	3.9	3.9	3.6	3.4	3.4	3	3	2.7	2.6	2.6
Magnesium	NS	NS																											<160
Manganese	2,786	184		14	2.9	21	4.5	3.9	30	8.4	9.8	4.4	2.5			6.9	6.7		6.7	2.1	4.2	1.8	5.1		3.2	4.5	4.4		2.3	<1.5
Molybdenum	NS	NS		7.3		1.1			0.73	0.35	0.37	5.1				17	8.6		7.7		0.44		1		0.71				0.71	
Mercury	NS	NS																											
Nickel	13,935	929		4.2	23	17	2.3	2.1	3.3	2.7	6.9	1.6	23	0.98	1.9	2.2	1.8	7.1	2.1	0.77	2	0.63	1.7	0.54	1.7	2.1	1.3	1.5		0.77
Selenium	NS	NS																											<9.8
Silver	139	9.3																											
Tellurium	NS	NS																											<1.1
Thallium	NS	NS																											<4.1
Tin	NS	NS																											<1.6
Titanium	NS	NS																											1.1
Vanadium	NS	NS		3.5	0.25	2	0.36		0.78	1.2	2.7	0.9				1.7	1.3		1.8		0.41		0.27	0.25		0.24				<0.20
Zinc	NS	NS																											<120

Notes:

All sample results are reported in µg/ft2.

NS - No Standard

Blank cells denote the analyte was not analyzed for.

< - Non detect (no detectable result above the respective Limit of Quantification/Reporting Limit)

Yellow highlight denotes sample above its respective equipment release standard.

Red highlight denotes sample above its respective housekeeping standard

[1] Brookhaven National Laboratory Safety & Health Services Division Industrial Hygiene Group - IH-75190 Surface Wipe Sample Procure, March 4th, 2014

Brookhaven National Laboratory - Photon Science Division

NSLS Transition and Hazard Removal - Surface Metals Characterization

Analytical Results

		Sample Group Area:	Second Floor Rooms																											
Sample Identification		Building Number:	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725
		Sample Date (mmddyy):	101714	101714	102014	102014	101714	102014	102014	101714	101714	102014	101714	101714	102014	102014	102014	102214	102214	102214	102214	102214	101614	101614	101714	101714	101714	101714	101714	101714
		Requested Analyte(s):	Pb	20 Metals	20 Metals	Pb	Pb	Pb	Pb	Pb	Pb	Pb	20 Metals	Pb	Pb	Pb	Pb	Pb	Pb	Hg	Hg	Hg	Hg	Hg	Hg	Pb	Pb	Pb	Pb	Pb	20 Metals	Pb
		Sample ID:	039	047	081	089	057	094	100	053	040	105	032	034	072	075	088	107	108	109	111	112	113	021	022	029	041	051	052	
Sample Loation Description		Room Number:	2-176	2-177	2-175	2-192A	2-183	2-124	2-109	AC6 Hall	2-176	2-100	2-173	2-173	2-180	2-195	2-210	2-190B	2-177	2-201	2-175	2-209	2-100							
		Room Designation:	Office	Office	MER 4	Corridor	Office	124 Workshop	Kitchen	Corridor	Office	Office	Lavatory	Lavatory	Kitchen	Office	Office	190 Workshop	Office	Office	MER 4	MER 6	Office	BLANK	BLANK	BLANK	BLANK	BLANK	BLANK	
		Collection Location:	Corner of floor	Top of bookshelf	Top of AC unit	Center of hall	Top of radiator	Top of file cabinet	Floor along wall	Ceiling diffuser	Top shelf of desk	Floor along wall	Ceiling diffuser	Top of cabinet	Top of cabinet	Top of bookshelf	Top of radiator	Top of workbench	Top of bookshelf	Top shelf of desk	Top of AC unit	Top of AC unit	Top of desk surface							
		AC Area:	AC 6	AC 6			AC 6	AC 12	AC 3	AC 6	AC 6	AC 3	AC 6	AC 6	AC 6	AC 6	AC 8	AC 6	AC 6	AC 8			AC 3							

Table 3 (BNL Surface Wipe Criteria For Metals)[1]																														
Analyte	Housekeeping	Equipment Release																												
	All	All																												
Aluminum	NS	NS		<38	910							<38																<38	
Antimony	NS	NS		<2.0	91			2.7				<2.0	2.5											<2.0				<2.0	
Arsenic	NS	NS		<5.0	<5.0							<5.0																<5.0	
Beryillium	28	Be Operational Areas - 28 / Public and non-Be operations areas - 1.9		<0.035	<0.035							<0.035			0.035									<0.035				<0.035	
Cadmium	27.9	1.9		<0.33	1.3			2.3		1.2		<0.33	3.5			3.8								<0.33				<0.33	
Calcium	NS	NS		220	200							<120																<120	
Chromium	6,968	464		<2.0	8.3			15				<2.0	4.1	3.9	2	4	4.3							<2.0				<2.0	
Cobalt	278.7	18.6		<0.20	14		1.7	1.6				<0.20	1	0.64	0.34	1.7	0.44							<0.20				<0.20	
Copper	NS	NS		4.3	440							<3.6																<3.6	
Iron	NS	NS		66	4600							27																<8.0	
Lead	Pb operational areas - 250 / non-Pb operational areas - 40	Pb operational areas - 250 / non-Pb operational areas - 40	2.4	2.2	2.1	2.1	2	1.7	1.4	1.2	1.1	0.5	<0.5	<0.5	<0.5	<0.5	<0.5							4.5	4.8	<0.5	<0.5	<0.50	<0.5
Magnesium	NS	NS		<160	2000							<160																<160	
Manganese	2,786	184	2.1	<1.5	41		2.1	26		2.9		<1.5	14	10	32	7	9.4							<1.5				<1.5	
Molybdenum	NS	NS		0.66			0.54	2.1		9.3			0.69	0.45		1								<0.31				0.31	
Mercury	NS	NS																0.03	0.06	<0.020	0.08	0.16	<0.020						
Nickel	13,935	929	2.6		5.8	0.8	1.5	16	0.44		0.91	<0.40	5.1	3.5	1.7	4.3	7.9							<0.40				<0.40	
Selenium	NS	NS		<9.8	<9.8							<9.8																<9.8	
Silver	139	9.3																												
Tellurium	NS	NS		<1.1	1.8							<1.1																<1.1	
Thallium	NS	NS		<4.1	<4.1							<4.1																<4.1	
Tin	NS	NS		<1.6	18							<1.6																<1.6	
Titanium	NS	NS		0.89	28							0.53																<0.40	
Vanadium	NS	NS		<0.20	2.2			2.2		0.42		<0.20	2.5	0.77	0.81	1	1.1							<0.20				<0.20	
Zinc	NS	NS		<120	540							<120																<120	

Notes:

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Blank cells denote the analyte was not analyzed for.

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Yellow highlight denotes sample above its respective equipment release standard.

Red highlight denotes sample above its respective housekeeping standard

[1] Brookhaven National Laboratory Safety & Health Services Division Industrial Hygiene Group - IH-75190 Surface Wipe Sample Procure, March 4th, 2014

Brookhaven National Laboratory - Photon Science Division		Sample Group Area:	Second Floor Rooms					HVAC																				
	Sample Identification	Building Number:	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725	725
		Sample Date (mmddyy):	102014	102014	102014	102014	102214	103014	103014	103014	103014	103014	103014	103014	103014	103014	103014	103014	121914	121914	121914	121914	121914	121914	121914	121914	121914	121914
		Requested Analyte(s):	Pb	20 Metals	20 Metals	Pb	Hg	Pb	Pb	Pb	20 Metals	Pb	Pb	Pb	Pb	Hg	20 Metals	Hg	8 Metals	8 Metals	8 Metals	8 Metals	8 Metals	8 Metals	8 Metals	8 Metals	8 Metals	8 Metals	8 Metals
		Sample ID:	069	082	095	102	114	222	223	225	229	228	224	226	230	231	232	235	236	240	237	248	238	239	245	241	246	247
NSLS Transition and Hazard Removal - Surface Metals Characterization	Sample Loation Description	Room Number:	BLANK	BLANK	BLANK	BLANK	BLANK	1-201	1-207	1-115	1-121	1-121	1-115	1-123	1-121	BLANK	BLANK	1-110D	1-158	2-122	1-172A	1-115	Roof	Roof	1-168	2-209	BLANK	BLANK
		Room Designation:						Booster Quad Area	MER 2	Corridor	MER 4	MER 4	MER 3	Pb Laydown Area	MER 4			Storage Room	MER 8	RF Penthouse	MER 7	MER 3			LEGs	MER 6		
Analytical Results		Collection Location:						Return hatch in RF area	Return hatch in MER 2	Return hatch in hallway	Return hatch in MER 4	Return hatch in MER 4	Return hatch in MER 3	Diffuser in Pb laydown area	Return hatch in MER 4			AC 14 return hatch	AC 16 return hatch in MER 8	AC 10 (air handler 10a) return hatch	AC 17 return hatch in MER 7	AC 3 return vent in MER 3	AC 11 air handler	AC 12 air handler	AC 9 return vent in LEGs mezzanine	AC 8 return hatch in MER 6		
		AC Area:						AC 1	AC 2	AC 4	AC 6	AC 7	AC 5	AC 7	AC 6			14	16	10	17	3	11	12	9	8		

Table 3 (BNL Surface Wipe Criteria For Metals)[1]																												
Analyte	Housekeeping	Equipment Release																										
	All	All																										
Aluminum	NS	NS		<38	<38						6400					1.4												
Antimony	NS	NS		<2.0	<2.0						9.6					<0.50												
Arsenic	NS	NS		<5.0	<5.0						13					0.073												
Beryillium	28	Be Operational Areas - 28 / Public and non-Be operations areas - 1.9		<0.035	<0.035						0.23					<0.050		0.2	0.43	<0.050	0.052	<0.050	0.068	<0.050	<0.050	0.074	<0.050	<0.050
Cadmium	27.9	1.9		<0.33	<0.33						2.4					0.064		20	3.2	1.4	7.8	1.9	2.8	13	1.2	1.6	<0.050	<0.050
Calcium	NS	NS		150	140						18000					49												
Chromium	6,968	464		<2.0	<2.0						57					<1.0		95	42	7.7	30	4.7	9.2	46	9	8.5	<1.0	<1.0
Cobalt	278.7	18.6		<0.20	<0.20						13					<0.50		9.6	5.5	0.53	11	0.59	4.2	1.4	1.3	1.8	<0.50	<0.50
Copper	NS	NS		<3.6	<3.6						130					1.3												
Iron	NS	NS		<8.0	<8.0						11000					<5.0												
Lead	Pb operational areas - 250 / non-Pb operational areas - 40	Pb operational areas - 250 / non-Pb operational areas - 40	<0.50	<0.50	<0.50	<0.50		1,200	920	700	300	100	59	34		0.089		920	130	87	78	77	75	56	58	43	0.061	0.079
Magnesium	NS	NS		<160	<160						6200					68												
Manganese	2,786	184		<1.5	<1.5						170					<0.50		180	300	15	56	25	65	74	23	63	<0.050	<0.50
Molybdenum	NS	NS																										
Mercury	NS	NS					<0.020								0.26		<0.020											
Nickel	13,935	929		<0.40	<0.40						45					<0.50												
Selenium	NS	NS		<9.8	<9.8						27					<0.050												
Silver	139	9.3																19	0.54	1.7	4.9	<0.50	1.7	3.6	<0.50	<0.50	<0.050	<0.50
Tellurium	NS	NS		<1.1	<1.1																							
Thallium	NS	NS		<4.1	<4.1						0.17					<0.050												
Tin	NS	NS		<1.6	<1.6						9.2					1.2												
Titanium	NS	NS		<0.40	<0.40						210					<0.50												
Vanadium	NS	NS		<0.20	<0.20						48					<0.50												
Zinc	NS	NS		<120	<120						190000					31		30,000	72,000	11,000	7,900	18,000	150,000	21,000	43,000	48,000	33	30

Notes:

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