
Hard copy of this document, if not marked "CONTROLLED" in red,
is by definition uncontrolled and may be out of date.

Specification
for
Arsenic Protection Program

REVISION

Rev.	DCN No.	Change Summary	Release Date	DCN Initiator	Document Owner
1	DCN0242	Initial Release	5/2//07	C. Cervera/ J. Trodden	R. Segura

Prior revision history, if applicable, is available from the Document Control Office.

1. PURPOSE AND SCOPE

- 1.1 The purpose of this Program is to define the key elements of an Arsenic Protection Program for Workers involved in tasks or operations that present the potential for exposure to Inorganic Arsenic through inhalation, skin contact or indirect ingestion.
- 1.2 The primary goal of this Program is to ensure that protective control measures are implemented against arsenic exposures in order to maintain exposures below the ARL without regard to the use of respirators.
- 1.3 This Program is designed to accomplish the following:
 - 1.3.1 Ensure CNSE meets or exceeds governmental regulatory requirements relating to occupational employee exposures to inorganic arsenic.
 - 1.3.2 Meet CNSE internal policies and procedures regarding protecting employee from exposures to inorganic arsenic.
- 1.4 This Program applies to all CNSE employees, tenant employees, students, professors and contractors. Any deviations from the requirements set forth in this Program must be approved by the EHS department.
- 1.5 This Program does not apply to the following
 - 1.5.1 Electronic parts, components or wafers containing inorganic arsenic that is encapsulated or bound within the product in a way that does not allow arsenic to be released during tasks performed on or with the parts, components or wafers.
 - 1.5.2 Operations or tasks that involve working with, using or handling materials that have arsenic content less than 0.02% by weight. This should be determined by means of a laboratory analysis of representative bulk samples of the materials suspected of containing inorganic arsenic.
 - 1.5.3 Tasks or operations that involve arsine, but no other forms of inorganic arsenic – either as process chemicals or as process by-products. However, operations which use arsine as a process gas, and generate inorganic arsenic as a by-product do fall under the scope of this Program.
- 1.6 Tasks / Operations that fall under the scope of this program include the following:
 - 1.6.1 Preventative maintenance and service tasks on tools or equipment that are contaminated with arsenic and present the potential for employee exposures to inorganic arsenic.

- 1.6.2 Cleaning, refurbishing or recycling of parts from Ion Implanters or other tools equipment that have used arsenic as a dopant (e.g., arsine gas or solid arsenic sources) and may be contaminated with inorganic arsenic as a by-product from the tool process.
- 1.6.3 Collection of arsenic contaminated hazardous waste (e.g., collecting, emptying arsenic hazardous waste containers).
- 1.6.4 Housekeeping of areas potentially contaminated with inorganic arsenic. This could include floors, fume hoods, work benches and other surfaces that are potentially contaminated with inorganic arsenic. This also includes cleaning decontamination areas where fume hoods, bead blasters, or other arsenic-cleaning equipment are used (e.g., floors, other areas outside of equipment).
- 1.6.5 Facility maintenance tasks that involve working with equipment that is contaminated with inorganic arsenic; such as:
- Maintenance on point of use abatement systems for arsenic exhaust streams,
 - Maintenance of facility exhaust systems handling inorganic arsenic particulate and emissions,
 - Replacing filters in portable HEPA Vacuums or exhaust ventilation systems that handle inorganic arsenic particulate and emissions.

2. REFERENCES

- 2.1 Personal Protective Equipment Program EHS-00010
- 2.2 Respiratory Protection Program EHS-00015
- 2.3 Decommissioning and Decontamination Procedures EHS-00030 and EHS-00037 respectively.
- 2.4 ACGIH, Industrial Ventilation, A Manual of Recommended Practice, 24th edition, 2001.
- 2.5 ACGIH, Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposure Indices, – most current edition.

3. ACRONYMS & DEFINITIONS

- 3.1 **ACGIH** - American Conference of Governmental Industrial Hygienists.

- 3.2 **Action Required Level (ARL)** - The ARL for inorganic arsenic is 0.0025 mg/m³ as an 8 hour Time Weighted Average exposure.
- 3.3 **Administrative Controls** - The use of revised work practices, training, signs and labels, written procedures and other administrative (i.e., not engineering) controls to prevent or reduce employee exposures to potential health hazards.
- 3.4 **AIHA** - American Industrial Hygiene Association.
- 3.5 **Air Contaminant** - A substance (solid, liquid or gaseous) not found in the normal composition of the atmosphere.
- 3.6 **Area Sample** - A sample that represents the levels of chemicals (i.e., concentration), radiation or noise in a specific area but does **not** represent personal employee exposure results. Area samples can be integrated samples or direct reading measurements. Chemical Area samples are not collected in the Breathing Zone of the employee. Radiation and noise Area samples are collected in the area where the source is located but are not considered to be representative of the exposure(s) received by Workers.
- 3.7 **Arsenic (As)** - The 33rd element on the periodic table. Atomic Weight is 74.9
- 3.8 **Baseline Monitoring** - The initial exposure assessment monitoring performed for a specific potential health hazard (chemical, radiation, noise, etc.) and for a specific operation or task to establish the levels of exposure for future comparisons.
- 3.9 **Breathing Zone** - The volume surrounding a worker's nose and mouth from which he or she draws breathing air over the course of a work period. This zone can be pictured by inscribing a sphere with a radius of about 10 inches centered at the worker's nose.
- 3.10 **Carcinogen** - Confirmed or suspected human cancer causing agent as defined by the International Agency for Research on Cancer (IARC) or other recognized entities
- 3.11 **Certified Industrial Hygienist (CIH)** - An individual that has been certified by the American Board of Industrial Hygiene in the practice of industrial hygiene.
- 3.12 **Control Strategies** - Tools, techniques, methods and designs to reduce and control employee exposures to potential health hazards in the workplace. Examples include substitution of a less toxic agent; engineering controls such as local exhaust ventilation; administrative controls such as changes in work practices and training; and use of personal protective equipment.

- 3.13 **Emergency** - Any occurrence such as, but not limited to equipment failure, rupture of containers, or failure of control equipment which results in an unexpected and potentially hazardous release of inorganic arsenic-containing materials.
- 3.14 **Exposure** - The exposure of a worker to inorganic arsenic through skin contact, indirect ingestion and / or inhalation during tasks performed at the CNSE facility.
- 3.15 **Exposure Potential** - Potential employee exposure to a chemical or physical entity that may cause deleterious effects in an exposed worker.
- 3.16 **IH Exposure Monitoring Records** - Reports and other supporting information that relate to Industrial Hygiene sampling performed to evaluate the concentrations and exposures associated with specific tasks, operations or work areas. IH Monitoring Records fall into two basic categories:
- 3.16.1 Personal Employee Exposure Monitoring Records
- 3.16.2 Area, Wipe and Quick Survey Sample Monitoring Records
- 3.17 **Industrial Hygiene (IH)** - The recognition, evaluation and control of occupational health hazards in the work place.
- 3.18 **Inorganic arsenic** - For the purpose of this Program, inorganic arsenic includes elemental arsenic and all of its inorganic compounds, including copper acetoarsenite (Paris Green), **with the exception of arsine**. For the purposes and requirements of this definition, any substance with a total inorganic arsenic content of 0.02 percent or less, by weight, is excluded.
- 3.19 **Integrated Sample** - Sampling method in which the chemical contaminant is collected on a sampling media over the course of the sampling period. The sampling media is then sent to an analytical laboratory for analysis. The result represents the average concentration over the sampling time period.
- 3.20 **Job Hazard Analysis (JHA)** - The breakdown of specific tasks into an orderly series of steps to identify hazards associated with each step, to identify engineering controls and develop procedures and training to mitigate the hazards.
- 3.21 **Occupational Exposure Limit (OEL)** - The OEL is defined to be the lower of either the local regulatory limit or the most current ACGIH TLV for both chemical and physical hazards – except for Noise. The OEL for inorganic arsenic is 0.010 mg/m³ as an 8 hour Time Weighted Average exposure.

- 3.22 **Personal Samples** - A sample that represents the level of exposure received by an employee (i.e., dose) to a specific chemical, type of radiation or noise for a specific task or job title in a specific operation or work area. Chemical Personal samples are collected in the Breathing Zone of the employee. They can be integrated samples or direct reading measurements. Personal samples are representative of the exposure(s) received by workers when working in the area or performing the task(s) being addressed.
- 3.23 **Personal Employee Exposure Monitoring Report** - A report that summarizes the information and results from Personal Employee Exposure Monitoring for specific employee(s), specific environmental agents, and specific task, operation or work area. This does not include reports for Area samples, Wipe samples, and Quick Survey results.
- 3.24 **Potential Health Hazard** - The capability of an environmental agent to cause deleterious effects in an exposed worker. Whether a specific health effect actually results from an exposure is related to a variety of factors including concentration, duration of exposure, specific agent involved, physical state of the agent, route of entry and frequency of exposure.
- 3.25 **Qualitative Fit Testing** - A procedure which tests for leakage at the juncture of the respirator face piece and the wearer's face by determining whether or not the odor or taste of a test agent is detectable by the respirator wearer while exposed to a test atmosphere.
- 3.26 **Quantitative Exposure Assessment** - The assessment of employee exposures to chemicals, noise or physical agents in a workplace based upon quantitative measurement of the chemical or physical agent using direct reading instruments and / or collection of integrated samples that are analyzed by a laboratory to provide the results.
- 3.27 **Qualified Industrial Hygienist** - A person who has a college or university degree in engineering, chemistry, physics or medicine or related biological sciences and who by virtue of special studies and training has acquired competence in industrial hygiene.
- 3.28 **Restricted Access Area** - An area where employee exposure to airborne inorganic arsenic, without regards to the use of respirators, can exceed the ARL.
- 3.29 **Threshold Limit Value (TLV)** - TLVs refer to levels of exposure and conditions of chemical and physical agents under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse health effects. TLVs established by the ACGIH are the primary basis for establishing Applied OELs, except where a local regulatory limit is lower.

- 3.30 **Threshold Limit Value-Ceiling (TLV-C)** - The exposure limit for chemical agents that should not be exceeded during any part of the working day, even for an instant.
- 3.31 **Threshold Limit Value-Short Term Exposure Limit (TLV-STEL)** - A 15-minute TWA exposure for chemical agents that should not be exceeded at any time during a workday, even if the 8-hour TWA is within the TLV-TWA. Exposures above the TLV-TWA up to the TLV-STEL should not be longer than 15 minutes and should not occur more than four times per day. There should be at least 60 minutes between successive exposures in this range. Note that exposures to substances with both TLV-TWA and TLV-STEL limits must be controlled to levels that are below both limits for the appropriate time period.
- 3.32 **Threshold Limit Value-Time-Weighted Average (TLV-TWA)** - The time-weighted average exposure for chemical and physical agents for a conventional 8-hour workday and a 40-hour workweek. TLV-TWAs may be adjusted accordingly for work shifts longer than 8-hours.
- 3.33 **TWA** - Time Weighted Average: The average concentration over an eight hour period. Employee exposures to arsenic are expressed as TWA results based upon integrated samples collected over the exposure period.
- 3.34 **Wipe Sample** - A chemical sample collected on a surface to characterize the amount of chemical buildup over the course of the preceding time period prior to collecting the sample. Wipe samples can be used to indicate the adequacy of housekeeping and relate to the potential for employee exposures, but do **not** represent employee exposure levels.

4. RESPONSIBILITIES

- 4.1 The **Supervisors, Managers and/or Professors** are accountable for compliance with this Program and are responsible for:
- 4.1.1 Implementing this Program
- 4.1.2 Providing information needed to assess the potential for inorganic arsenic exposures.
- 4.1.3 Establishing timelines and providing resources & funding that allow for the timely implementation of this Program
- 4.1.4 Ensuring compliant training penetration for affected workers.
- 4.1.5 Ensuring medical surveillance participation by affected workers.

- 4.2 The **EHS Department** is responsible for:
- 4.2.1 Communicating responsibilities to the Managers/Supervisors/Professors including an assessment of the potential impacts of the program.
 - 4.2.2 Developing, maintaining and (if necessary) interpreting this document.
 - 4.2.3 Re-evaluating the overall effectiveness and applicability of the arsenic exposure control program on an annual basis.
 - 4.2.4 Providing assistance to employees, tenant employees, students and/or contractors on questions related to this Program including employee exposure assessments and implementing engineering controls, work practice controls or use of respiratory protection.
 - 4.2.5 Defining the content / scope of Medical Surveillance for affected workers.
 - 4.2.6 Identifying the clinics, medical analytical labs, appropriate lab analysis and other resources in support of Medical Surveillance for affected workers.
 - 4.2.7 Working with Managers/Supervisors/Professors to identify employees, students or contractors that should be included in the Medical Surveillance Program based upon the criteria in the Arsenic Program and tracking their participation.
 - 4.2.8 Reviewing the results for each employee to identify any results that require follow-up.
 - 4.2.9 Providing follow-up notification to employees, tenant employees and/or students and management on the steps to be taken in response to the Medical Surveillance results.
 - 4.2.10 Summarizing the Medical Surveillance results on a yearly basis in order to identify any trends or issues that need to be addressed on a Program-wide basis.
 - 4.2.11 Assisting supervisors/managers in the mitigation of hazards through engineering, administrative and PPE controls.
 - 4.2.12 Providing PPE training to Workers.
 - 4.2.13 Providing training as described in this program to Workers and others included in this Arsenic Protection Program.
 - 4.2.14 Performing employee exposure monitoring to document exposure levels and the effectiveness of the controls implemented in the building in accordance with tiered approach used in this Program.

- 4.2.15 Performing wipe sampling to verify the effectiveness of housekeeping procedures in accordance with the tiered approach used in this Program
- 4.2.16 Notifying Workers / management of exposure monitoring results.
- 4.2.17 Working with contractors, to facilitate employee exposure assessments of Contractors included in this Program at the CNSE facility.
- 4.3 **Facilities** is responsible for:
 - 4.3.1 Providing assistance in implementing engineering controls that require Facilities support (e.g., Local Exhaust Ventilation),
 - 4.3.2 Ensuring that Facilities Workers that are involved in tasks or operations that fall under the Scope of the Program are included in an Arsenic Protection Program.
- 4.4 **CNSE employees, tenant employees, students and contractors** are responsible for the following:
 - 4.4.1 Being familiar with the procedures and other requirements as described in this Program.
 - 4.4.2 Being familiar with the MSDS for all materials that contain arsenic.
 - 4.4.3 Getting a physical, fit test and training if required to wear a respirator.
 - 4.4.4 Participating in Medical Surveillance exams as directed by the EHS Department.
 - 4.4.5 Cleaning up the immediate work area at the end of the task or at the end of the work shift.
 - 4.4.6 Following the procedures and proper use of protective measures when performing maintenance, service or repair tasks that fall under the scope of this Program.
 - 4.4.7 Maintain respirators clean and in good working order.
 - 4.4.8 Properly dispose of arsenic contaminated waste.

5. **PROGRAM ELEMENTS AND PROTECTIVE CONTROL MEASURES**

- 5.1 The protective control measures and Program elements are the minimum requirements at the CNSE facility. These must be implemented for all those involved in tasks with the potential for arsenic exposures.

- 5.2 The protective control measures and Program elements have been subdivided into three groups as indicated below.
- 5.2.1 Worker Controls/Practices,
- 5.2.2 Engineering / Administrative Controls
- 5.2.3 Programmatic elements

6. WORKER CONTROLS/PRACTICES

6.1 Work Practices

6.1.1 Wet techniques should be used during manual parts cleaning.

6.1.2 Manual parts cleaning should be based upon the CNSE Arsenic Contaminated Parts Cleaning Work Instruction.

This is a detailed work procedure describing the steps involved in cleaning parts to remove accumulated arsenic contaminated materials. This procedure applies to cleaning tasks performed at the tool and in a dedicated remote parts cleaning room or area.

6.2 The following good hygiene and work practices should be used by all personnel that perform tasks that involve working with arsenic contaminated parts, tools, equipment or work surfaces.

These practices should be reviewed as part of arsenic training provided to workers involved in tasks with the potential for arsenic exposures.

6.2.1 Good Hygiene

6.2.1.1 Always wash hands and face after changing out of arsenic contaminated PPE following the completion of tasks involving the potential for arsenic exposures.

6.2.1.2 Always remove PPE and wash hands and face before eating, drinking or smoking.

6.2.1.3 No storage or consumption of food or beverages in the work area.

6.2.1.4 No smoking or chewing of tobacco products in the work area.

6.2.1.5 No gum chewing in the work area.

6.2.1.6 No storage or application of cosmetics in the work area.

- 6.2.1.7 Always dispose of arsenic contaminated materials in dedicated containers – never in general waste.
- 6.2.1.8 Replace torn or damaged gloves with new gloves.
- 6.2.1.9 Do not shake contaminated clothing or equipment to prevent the creation of airborne arsenic dust.
- 6.2.2 Good Work Practices
 - 6.2.2.1 Never dry sweep or dry clean contaminated surfaces, equipment or materials containing arsenic.
 - 6.2.2.2 Use wet methods or dedicated HEPA or ULPA Arsenic Vacuums for cleaning up contaminated areas.
 - 6.2.2.3 Do not use arsenic vacuums for other purposes.
 - 6.2.2.4 Do not use other vacuums for arsenic clean-up.
 - 6.2.2.5 Dispose of contaminated materials in dedicated arsenic disposal containers.
 - 6.2.2.6 Do not touch clean surfaces with contaminated gloves – remove the outer gloves first.
 - 6.2.2.7 Do not walk around clean room in contaminated PPE.

7. RESPIRATORY PROTECTION

- 7.1 Respiratory protection is required for the following tasks:
 - 7.1.1 All tasks that cannot be performed inside of a properly ventilated fume hood or an adequately exhausted abrasive blasting cabinet
 - 7.1.2 Tasks performed in-situ (at tool or equipment) that involves working with arsenic contaminated surfaces.
- 7.2** Respiratory protection for the tasks indicated above is not required if IH Employee Exposure Assessments have been performed to validate the effectiveness of these controls. The following criteria must be met in order to determine that respiratory protection is not required:
 - 7.2.1 Two successive IH Employee Exposure Assessments (at least 7 days apart) must be performed and demonstrate that the exposures are below the ARL for Arsenic of 0.0025 mg/m³ as an 8 hr. Time Weighted Average (TWA). These assessments must be based upon personal samples collected in worker's breathing zone while performing tasks that are

expected to result in the realistic worst case exposure levels. This sampling should be for the specific location and controls being used; i.e., data collected in one location or for one control should not be extrapolated to other locations or other controls. This testing must be performed in accordance with published regulatory requirements.

- 7.2.2 The controls must be validated to ensure that they are working properly and providing effective protection against arsenic exposures each time they are used based upon the following approach:
- Controls should be tested on a periodic basis to ensure that the controls meet the criteria in this Program (e.g., face velocity measurements on fume hood). The frequency for these validation tests will depend on the type of control.
 - Controls should be provided with a means of verifying that the control is operating at the minimum acceptable level of performance. Examples of these types of verification methods are; magnehelic gauge with minimum static pressure, alarms that are connected to a monitoring device (gauge, anemometer, etc.), velocity gauge at the duct with a readout or visual indicator to show velocity is in acceptable range.

If the control is operating at less than minimum acceptable level, respiratory protection must be used for any tasks that are performed using that control until it is operating at acceptable performance levels.

- 7.2.3 If the controls, the tasks or the operation are changed, testing must be repeated (as described above) to validate that the exposure levels have not increased. Respiratory protection must be used in the interim period while the repeat monitoring results are being collected.

7.3 Respiratory Protection Utilized

- 7.4 Respiratory protection must be selected in accordance with the CNSE Respiratory Protection Program, EHS-00015. The type of respiratory protection required will depend on the tasks performed and the levels of exposure during these tasks. This selection process should be based upon employee exposure monitoring results obtained.

- 7.5 The following are two types of respiratory protection that are used within the CNSE facility:

- 7.5.1 Full face air purifying respirator (APR) with HEPA cartridges should be used for tasks that can result in exposures to arsenic that do not exceed 0.125 mg/m³. This is the minimum level of protection (i.e., full face APR). The North Full Face Silicone respirator is an example of this type of respirator.

- 7.5.2 Air-supplied respirator in pressure demand mode should be used for tasks that present the potential for employee exposures to arsenic at concentrations above 0.125 mg/m³ or for arsine vapor at concentrations above the Arsine ARL of 0.0125 ppm (12.5 ppb) as an 8 hour TWA exposure. Arsine can sometimes be generated as a by-product when arsenic contaminated surfaces are wetted with water as part of a cleaning process or other task. The Scott Full Face Supplied Air Respirator is an example of this type of respirator.
- 7.6 Personal Protective Equipment (PPE) is used to provide protection against exposure and avoid secondary exposures from contaminated PPE.
- 7.6.1 PPE should be worn for all PM tasks performed by personnel that present the potential for Arsenic Exposure through skin contact and to prevent exposure of street clothing to arsenic contamination.
- 7.6.2 Street clothing cannot be used as protection for any tasks that present the potential for arsenic exposure through airborne emissions or skin contact. PPE worn over street clothing or in place of street clothing must be used for these types of tasks.
- 7.6.3 The PPE should consist of the following:
- 7.6.3.1 Coveralls or full body covering with head cover
- 7.6.3.2 Shoe covers that completely cover the shoes
- 7.6.3.3 Gloves. Use two layers of gloves so that the outer contaminated layer can be removed before touching / handling non-contaminated surfaces (e.g., door knobs, handles, etc.). Depending on the nature of the task, the outer layer may be clean room gloves; however, a more resistive glove may be required for some tasks: such as chemical resistant gloves and durable, abrasion-resistant gloves
- 7.6.3.4 Head cover

8. USE / REPLACEMENT OF LAUNDERED CLEAN ROOM CLOTHING

- 8.1 Laundered clean room clothing can be used as protection against arsenic if the clothing is handled adequately to prevent secondary exposures from reuse of contaminated clothing. The following approach is recommended as a method of avoiding exposures from contaminated clothing:
- 8.1.1 Laundered clean room clothing can be used as protection against arsenic if the clothing is replaced daily and is handled separately from non-contaminated PPE.

- 8.1.2 Disposable PPE should be used if laundered clothing is not replaced and handled as described below.
- 8.2 Removing Contaminated PPE
- 8.2.1 If the PPE is dusty, remove the coveralls and shoe covers and dispose of in the appropriate container labeled 'Arsenic Contaminated Hazardous Solid Waste' before removing the respirator.
- 8.2.2 Remove the respirator and other PPE.
- 8.2.3 Proceed to the hygiene facility to wash hands and face. Be sure to remove contaminated PPE before using the hygiene facility.
- 8.3 Disposing of Contaminated Clothing
- 8.3.1 Contaminated clean room clothing should be placed in a designated container/location. If it is not known whether clothing is contaminated, treat it as contaminated.
- 8.3.2 If disposable PPE is used (e.g., Tyvek), it should be disposed of after use in a dedicated arsenic waste container.
- 8.3.3 Contaminated PPE should not be cleaned by shaking or by the use of compressed air or other compressed gases. All contaminated clothing should be handled carefully to avoid the generation of airborne arsenic dust.
- 8.4 Housekeeping: It is the responsibility of each worker at the CNSE facility to be responsible for their immediate work area, personal work tools, and dedicated work cart.
- 8.4.1 Housekeeping of areas where arsenic contaminated materials are handled or worked with should be performed on a regular basis to prevent the accumulation of arsenic containing dust or particulate. A housekeeping plan should be developed in terms of location, method and frequency of cleaning.
- 8.4.2 Changing the HEPA vacuum filter is normally the responsibility of those working in the arsenic contaminated area. When the HEPA vacuum filter is changed, the filter should be changed inside of a fume hood. The vacuum filter and any contaminated cleaning materials (e.g., wet wipes) should be handled as hazardous waste and disposed of in an appropriate arsenic hazardous waste container.
- 8.4.3 The following general guidelines should always be followed when performing housekeeping tasks:

- NEVER dry sweep and / or dry clean the work area being cleaned.
- Only use a dedicated arsenic HEPA or ULPA vacuum (labeled with the appropriate arsenic warning labels) or wet methods for housekeeping performed under this Program.
- Never use an arsenic HEPA vacuum for general house cleaning of areas not contaminated with arsenic (e.g., adjacent tools or operations).
- Never use compressed air for cleaning up arsenic contaminated surfaces.
- Clean up the vacuum hose, transport cart and tools used after PM tasks are completed.
- Do not touch clean surfaces with contaminated gloves – remove the outer layer of gloves first.

9. ENGINEERING/ADMINISTRATIVE CONTROLS

- 9.1 Fume Hood: Laboratory Fume Hood should be used for tasks performed away from the tool or equipment (e.g., in a dedicated cleaning operation). The fume hood should include a sash to allow the size of the opening to be adjusted based upon the task being performed. The exhaust ventilation for the fume hood should provide an average of 150 fpm face velocity in the open sash position with no point on the face less than 125 fpm. The optimal approach is to have two dedicated fume hoods; a “Contaminated Parts” hood for cleaning contaminated parts from the tools and a “Clean Parts” hood for handling / assembling cleaned parts prior to replacement on the tool.
- 9.2 Exhausted Abrasive Blast Cabinet (if used): If an abrasive blasting cabinet is used, the abrasive blasting cabinet / enclosure should be provided with exhaust ventilation and should not allow the escape of dust from the enclosure during operation. A design guideline for this type of equipment is provided in the ACGIH *Industrial Ventilation Manual*. The exhaust ventilation provided for this control should meet the following criteria:
- 9.2.1 20 air changes per minute
- 9.2.2 500 fpm inward velocity at any opening in the enclosure
- 9.2.3 Minimum duct velocity of 4000 fpm
- 9.3 Remote / dedicated Arsenic clean room: Whenever possible, a remote, dedicated parts cleaning room or area should be used for parts cleaning and other tasks that involve the potential for generation of arsenic dust and particulate. This approach is a very effective means of limiting the extent of the facility in which arsenic is released and employee exposures can occur. This control will also help to prevent the spread of arsenic contamination throughout the Clean Room. The most effective approach is

to install the various engineering controls in this dedicated room or facility and perform those tasks that involve the potential for arsenic exposures in this area.

- 9.4 Snorkel at the tool for in-situ cleaning: Where possible, local portable exhaust ventilation should be used at the tool (e.g., snorkel exhaust) for tasks such as parts cleaning that cannot be performed remotely in a dedicated clean area. Note, whenever possible, tasks should be performed in a fume hood away from the tool / equipment rather than at the tool using local portable exhaust. Using a fume hood limits the locations where arsenic can be released into the facility.
- 9.5 Administrative Controls - Written Procedures
- 9.5.1 Use of Dedicated Parts Clean Room - If parts-cleaning is performed in a dedicated remote area / room, a procedure should be developed to address key aspects of the use of the room / area including the following.
- Parts transport procedures: The procedure should describe the steps to follow when transporting arsenic contaminated parts from the tool or another area of the facility to the remote area where parts cleaning or other tasks are performed.
 - Storage of contaminated parts and cleaned parts.
 - Use of controls to prevent exposures; e.g., location of controls, any instructions on proper use, means of ensuring the controls are operating correctly, maintenance schedule for controls (e.g., frequency for checking exhaust on fume hood, frequency for changing out vacuum filters, etc.).
 - Gowning procedures for putting on / taking off PPE: This procedure should describe the steps to follow when putting on protective clothing and when and where to remove contaminated protective clothing after PM tasks, and proper disposal of contaminated PPE.
- 9.5.2 Collection of waste containers - Those collecting arsenic contaminated waste from the collection containers in the facility must also receive Arsenic Protection training and be properly equipped when picking up arsenic contaminated waste.
- 9.6 HEPA Vacuum:** A HEPA vacuum should be used at each site where arsenic exposures may occur during PM tasks or clean-up of the immediate work areas.
- 9.6.1 Portable vacuums with High Efficiency Particulate Air (HEPA) filters or Ultra Particulate Air (ULPA) filters should be used for cleaning up arsenic contaminated areas, surfaces or equipment. The vacuum should be

designed for clean room application and for cleaning up toxic dusts including arsenic. ULPA vacuum filters provide very high efficiency removal of particulates (e.g., 99.999% of 0.12 micron sized particles). HEPA vacuum filters provide high particulate removal efficiency (99.97% of 0.3 micron sized particles). CAUTION: The HEPA or ULPA vacuum cleaners should be dedicated for use in cleaning up arsenic contaminated surfaces. Do not use dedicated arsenic vacuums for general cleanup applications because all of the waste must be treated as arsenic contaminated waste. Do not use general vacuum cleaners for arsenic contaminated areas because of the potential for arsenic contamination of the vacuum cleaner.

- 9.6.2 Filter Changes for HEPA Vacuums - This should be based upon the manufacturer's recommended bag changing procedure. This procedure should be performed inside of a Fume Hood.
- 9.7 Hygiene Facilities:
- 9.7.1 Workers potentially exposed to arsenic should be provided with hygiene facilities as follows:
- A location with sink with running water, soap and towels where Workers can wash their hands and face after PM tasks. This facility does not have to be dedicated to arsenic tasks or operations.
 - A location for eating, drinking, smoking that is clean and well-removed from the arsenic work areas.
- 9.7.2 If workers are exposed to airborne arsenic levels that exceed the Arsenic OEL of 0.010 mg/m³, the following facilities must be provided for workers involved in these tasks.
- Change rooms for PPE
 - Shower facilities
 - Lunch facilities

10. EMPLOYEE EXPOSURE ASSESSMENTS

- 10.1 Employee exposures associated with the tasks / operations that involve potential exposure to inorganic arsenic should be assessed to document the levels of exposure received by personnel in these job categories and to verify that the existing controls are adequate.
- 10.2 Sampling should be performed to represent the realistic worst case exposures.
- 10.3 The preferred sampling method is to collect full shift (i.e., at least 7 continuous hours) personal samples to represent each task being assessed. If individual PM tasks involving different arsenic exposures are performed on different shifts, the data should represent each of these shifts to cover all PM Tasks.
- 10.4 If workers are involved in other tasks that present the potential for airborne exposure to arsenic, discuss with EHS whether these workers should also be monitored to document the levels.
- 10.5 Employee exposure monitoring should be based upon the procedures set forth by OSHA and NIOSH.
- 10.6 **Baseline Monitoring:** Baseline monitoring should be performed initially for each job category / task at each location where the potential for employee exposures to arsenic exists.
- 10.7 **Follow-up Monitoring:** Follow-up monitoring should be performed based on results of baseline monitoring.
- 10.7.1 **Less than ARL:** Two rounds at least 7 days apart. Can discontinue monitoring if both sets of results are less than the ARL. Follow the criteria below if either exceeds the ARL or OEL.
- 10.7.2 **Greater than or equal to ARL but less than OEL.** Every 6 months. Continue monitoring until two sets of results at least 7 days apart are less than the ARL.
- 10.7.3 **Greater than the OEL.** Every 3 months. Continue monitoring until two sets of results at least 7 days apart are less than the ARL.
- 10.8 **Additional Monitoring.** Whenever there has been a personnel, production, process, control, or other change which may result in new or increased exposure to inorganic arsenic, additional monitoring which complies with this Program should be conducted for all potentially affected Workers within 30 days of any such change.

- 10.9 Workers must be notified of the results from the monitoring within 5 days of receipt of the results.

11. RESTRICTED ACCESS AREAS

- 11.1 EHS is responsible for identifying the need for Restricted Access Area based upon IH Monitoring results and discuss with supervisors/managers/professors regarding what tasks or operations are affected.

- 11.2 Areas in which operations are performed that present the potential for exposures to inorganic arsenic above the ARL, without regard to the use of respirators, should be identified as Restricted Access Areas. These areas should incorporate the following controls to reduce exposures for personnel that work in these operations.

- Protective Control Measures
- Respiratory Protection
- Personal Protective Equipment
- Housekeeping
- Good Work Practices
- Hygiene Facilities / Procedures (if levels exceed the OEL)
- Signs and Labels
- Employee Training
- Medical Surveillance

- 11.2.1 Access to Restricted Access Areas should be limited to personnel that have received the appropriate training, respiratory protection, PPE, and are included in the Medical Surveillance program for arsenic as described in this document.

- 11.2.2 Personnel not directly involved in tasks performed in these areas should not enter these areas.

- 11.2.3 Restricted Access Areas should be identified to warn personnel of the potential hazard and the need for controls as follows:

The sign format shown in Attachment B can be used. If tasks are performed at tools that can result in levels above the ARL, a temporary Restricted Access Area should be created; e.g., orange cones around the

area with a posted sign. The boundary indicators should be placed at the periphery of the operation well removed from the potential source of release of airborne arsenic from the tool (e.g., at least 12 feet away).

12. WIPE SAMPLES

- 12.1 Wipe samples should be collected on a periodic basis from horizontal and other work surfaces in areas where tasks with the potential for arsenic contamination are performed to validate the effectiveness of housekeeping and clean-up activities.
- 12.2 Areas sampled should be at least 100 cm² in size and should be analyzed for arsenic. The laboratory analytical method must be capable of providing a limit of detection that is less than 1 ug per filter.
- 12.3 The CNSE Surface Contamination Assessment Criterion for arsenic is 50 ug arsenic /100 cm² of surface area. Results that exceed the 50 ug/100 cm² criterion indicate that the housekeeping / clean-up procedures are not adequate and these areas require more frequent and / or more careful cleaning of residual accumulations of arsenic.

13. SIGNS AND LABELS

- 13.1 Labels and signs are intended as effective means of notifying personnel and others present in the work area of the following:
 - 13.1.1 Identifying bags / containers used for arsenic contaminated wastes including arsenic HEPA vacuums, fume hoods and snorkels with hazard warning labels.
 - 13.1.2 Identifying storage cabinets and other locations used for storing contaminated arsenic parts or materials with hazard warning labels.
 - 13.1.3 The potential arsenic exposure hazard present in Restricted Access Areas.
- 13.2 The format and content of signs and labels should comply with local regulations and requirements. Attachment B provides a standardized format and content for signs and labels which shall be used.
- 13.3 Note that the use of a Restricted Access Area should only be necessary if controls to reduce the exposures to below the ARL (outside of the respirator face piece) are not effective or cannot be implemented for an extended time period (e.g., > 1 month).

- 13.4 EXCEPTION: Labels are not required when the inorganic arsenic is encapsulated or bound within the product in such a manner as to make unlikely the possibility of exposure to airborne inorganic arsenic. Examples include semiconductors, wafers, light emitting diodes, and glass.

14. EMPLOYEE TRAINING

- 14.1 All workers performing tasks where they are potentially exposed to inorganic arsenic must take CNSE Inorganic Arsenic Training. The training will consist of two parts:

14.1.1 Generic training on arsenic toxicology, key work practices, controls, etc. that can be used in all locations, operations. This could be a web based training approach.

14.1.2 Facility specific training on specific locations with arsenic exposure potential, protocols for using PPE, disposal of PPE, etc. This will normally be an instructor led training class; however, the instructor could be a supervisor or other non-EHS personnel.

14.2 Frequency of Arsenic Training:

14.2.1 The generic section and the Facility specific training should be presented initially for all workers that fall under the Program.

14.2.2 Refresher training for both the generic and Facility specific training should be once every 2 years.

14.3 Inorganic Arsenic Training Program

14.4 Workers involved in tasks / operations that fall under the scope of this Program should be provided with training on arsenic. The training can be provided in two modules:

14.4.1 A generic training module that addresses information that is applicable to all work areas and operations.

14.4.2 A facility specific training module that addresses information that is specific to the facility. This can be presented by the supervisor or other knowledgeable individual from the EHS Department.

15. MEDICAL SURVEILLANCE

15.1.1 Employees who perform tasks where they are potentially exposed to inorganic arsenic should be included in the CNSE Arsenic Medical Surveillance Program. Employees who perform these tasks are included

in the program without regard to the number of times they are exposed to arsenic or whether they are wearing a respirator for these tasks.

- 15.1.2 The Medical Surveillance Program is administered by Occupational Health Center. This program includes annual urinary arsenic medical surveillance and medical clearance for respirators.

16. RECORDS

- 16.1 Employee Exposure Assessment Records:

- 16.1.1 Qualitative Exposure Assessment reports for operations involving arsenic and Quantitative Exposure Monitoring Records should be retained for a minimum of 30 years.

- 16.2 Employee Access to Records: workers must be provided copies of their records, upon request, as follows:

- 16.2.1 Exposure monitoring records must be provided to workers that were monitored and to workers performing the same tasks as those monitored. In most cases, this can be met through the Employee / Management Notification that is sent to workers after being monitored.

- 16.2.2 Employee medical records: Workers must be provided with a copy of their own personal medical results. Workers may not receive copies of other workers' medical records. Consult the EHS department for assistance in responding to employee requests for medical records.

- 16.3 Medical surveillance records, Respiratory Protection Records.

17. ATTACHMENTS

- 17.1 **Attachment A** – IH Employee Exposure Monitoring for Arsenic

- 17.2 **Attachment B** – Signs and Labels

ATTACHMENT A

IH EMPLOYEE EXPOSURE MONITORING FOR ARSENIC

Monitor employee exposures to airborne arsenic in accordance with the procedures and the criteria set forth by OSHA and NIOSH methodologies.

Perform IH Employee Exposure Monitoring for arsenic as follows:

- Collect Personal Samples to evaluate exposures. Area samples are not acceptable as the basis for evaluating employee exposures.
- Monitor each type of job or task performed that involves the potential for arsenic exposure.
- Monitor at each location (e.g., lab, clean room, etc.) where these tasks are performed. In general, monitoring results from one location should not be used represent a different location.
- Monitor on separate shifts if tasks to be assessed do not occur on the same shift.
- The assessment should address realistic worst case exposures for the specific task / operation.
- Sample on multiple Workers (if necessary) to address the various tasks performed.
- Two successive samples (7 days apart) should be collected in order to verify that exposures are below the Applied ARL and to determine that additional baseline sampling is not required.

Sampling Methodology

- The preferred sampling method is to collect full shift (i.e., at least seven hour) samples in the employee Breathing Zone. If the task performed does not last for 7 hours, and the exposure during the remainder of the shift is zero (i.e., no other tasks performed with the potential for arsenic exposure), the sampling should be for the duration of the task.
- Use portable pump + 0.8 micron Mixed Cellulose Ester filter
- Sample at 2 lpm airflow
- Follow the NIOSH sampling / analytical Method 7300.
- Use an AIHA Accredited or similarly qualified laboratory for analysis of collected samples.
- Use a laboratory and analytical method that can provide a limit of quantification of 0.2 ug (or less) per sample (i.e., filter) in order to ensure that the limit of detection for the airborne concentrations is less than 0.001 mg / m³ for all collected samples.

**ATTACHMENT B
SIGNS AND LABELS**

The sign format shown in this Attachment can be used to identify Restricted Access Areas



Labels should read as follows:

