THE NATION'S URANIUM PROCESSING FACILITY

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This document has been reviewed by a Y-12 DC / UCNI-RO and has been determined to be UNCLASSIFIED and contains no UCNI. This review does not constitute clearance for Public Release.

Name: A. L. Glover Date: 01/20/23

REVISION LOG

Revision 2 ☒ Intent ☐ Non-Intent

- These changes are in response to Condition Report 25774-000-GCA-GAM-04064, *Y-12 APMO Observation (O-1) – Notification of Industrial Hygiene Sampling Results Should Include Employee Signature (ASM-12.8.2021-5410)*
  - Added requirement to provide hazard assessment results to affected workers and requirement that workers sign UCN-23496, *UPF Hazard Assessment Results,* as proof of receipt of hazard information
- The following forms have been added as part of this revision:
  - UCN-23496, *UPF Hazard Assessment Results* – New
- An evaluation determination has been performed confirming that this Procedure does implement requirements tracked in the Programmatic Requirements Management System (PRMS)
- Other changes include:
  - Updated Sections 2.3, *Project Lead Industrial Hygienist*; 2.5, *BNI Environmental, Safety, and Health Representative*; 3.1, *Duty to Have Exposure Assessments to Chemical Substances & Physical Agents*; 3.2.1, *Approving & Disapproving Chemicals/Materials*
  - Updated references
  - Editorial changes

Revision 1 ☒ Intent ☐ Non-Intent

- These changes are in response to Condition Report 25774-000-GCA-GAM-02997,*Y-12 APMO-F-1: Procedures do not Adequately Address Some Aspects of Exposure Monitoring and Assessment as Required (ASRP-C&ESH-12.28.2020-902213)*
  - Updated multiple sections to include a method to record observations, testing, and monitoring results and a method to review site safety and health experience information
- This revision incorporates the changes identified in and supersedes PRCN-Y73-95-804-R00-01
- The following forms have been added as part of this revision:
  - CFN-1320, *Air Sampling Form - Welding (Manganese)*
  - CFN-1321, *Air Sampling Data Sheet*
- An evaluation determination has been performed confirming that this Procedure does not implement requirements tracked in the Programmatic Requirements Management System (PRMS)
- Other changes include:
  - Updated Section 2.0, *Responsibilities*
  - Updated Section 4.0, *Records*
  - Updated references
  - Updated acronyms
  - Editorial changes
- This revision is a total rewrite; due to the extent of changes, revision bars are not shown

Previous revisions on record

CONTENTS

1.0 INTRODUCTION

1.1 Purpose

This Procedure defines the Industrial Hygiene (IH) exposure assessment (EA) strategy and provides a process for development of qualitative and quantitative EAs at the Uranium Processing Facility (UPF) Project. This Procedure defines the methodology that UPF will utilize to comply with 10 Code of Federal Regulations (CFR) 851, *Worker Safety and Health Program*; specifically 10 CFR 851.21, *Hazard Identification and Assessment*; 10 CFR 851.22, *Hazard Prevention and Abatement*; 10 CFR 851, Appendix A, Section 6, *Industrial Hygiene*; and 10 CFR 851, Appendix A, Section 8, *Occupational Medicine*.

This Procedure implements the project/scope-specific requirements of Y73-010, *Safety and Industrial Hygiene Program*, and PL-PJ-801768-A007, *CNS UPF Environment, Safety, and Health (ES&H) Plan.*

1.2 Scope

This Procedure applies to all EAs and surveillance activities for chemical and physical agents conducted for UPF Project tasks. Exposure assessments shall be part of each task's Job Hazard Analysis (JHA) where workers are potentially exposed to chemical and/or physical agents in excess of 50% of the applicable occupational exposure limit (OEL) or action level (AL) established by regulatory standard. These agents include, but are not limited to, those found in the American Conference of Governmental Industrial Hygienists (ACGIH) *2016 TLVs® and BEIs® Based on the Documentation of the Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents & Biological Exposure Indices (BEIs)*. Where no TLV is established by ACGIH, Project IHs shall use the most conservative recommended exposure level (REL) available from the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs), or the National Institute for Occupational Safety and Health (NIOSH) REL.

2.0 RESPONSIBILITIES

2.1 Site Manager

The Site Manager is responsible for the following:

- Ensuring the implementation of this Procedure
- Ensuring that all Project personnel actively participate in their responsibilities as defined in this Procedure
- Providing worker support, facilities, and other resources necessary to effectively carry out this Procedure

2.2 Environmental, Safety, and Health Manager, BNI

The Environmental, Safety, and Health (ES&H) Manager, BNI has the overall authority to interpret the regulations associated with this Procedure and provide guidance as to its intent and application.

2.3 Project Lead Industrial Hygienist

The Project Lead Industrial Hygienist is responsible for the following:

- Providing the primary oversight for this Procedure
- Performing analysis of data to evaluate program performance
- Developing defensible sampling strategies based on regulatory requirements, Project/Corporate requirements, best practice, or as determined by professional judgment
- Maintaining the IH equipment to support IH personnel performing personal and area sampling for air contaminants

2.4 Industrial Hygienists

Industrial Hygienists are responsible for the following:

- Reviewing Scope of Work (SOW) documents and other work planning, controlling, and authorization documents to extract potential IH exposures
- Performing personal and area sampling/monitoring as directed by the Project Lead IH
- Notifying personnel impacted by monitoring/sampling activities (e.g., employee, Foreman, Superintendent, Site Manager) before scheduling and performing those activities
- Providing written documentation/notification of results and recommendations to the employee, employee's line management, and Occupational Health within the time frame required by regulation

2.5 BNI Environmental, Safety, and Health Representative

The ES&H Representative is responsible for the following:

- Participating in the development of EAs as appropriate
- Assisting IH in the collection of observations, instrumentation measurements, and samples during field operations
- Consulting with IH as field changes occur that impact EAs Responsible Superintendent

2.6 Discipline Superintendent/Startup Test Lead

The Discipline Superintendent/Startup Test Lead (STL) is responsible for the following:

- Being thoroughly familiar with this Procedure and having a full understanding of individual roles and responsibilities regarding compliance with and implementation of this Procedure
- Engaging ES&H personnel in pre-planning work activities to identify potential health hazards
- Ensuring that workers understand and adhere to the requirements of EAs and Exposure Control Plans (ECPs)

2.7 Supervisor

The Supervisor is responsible for the following:

- Coordinating with ES&H to facilitate measurements and sampling necessary for the development of Quantitative Exposure Assessments (QEAs)
- Ensuring workers are briefed to the requirements of applicable EAs and are implementing prescribed controls

3.0 EXPOSURE ASSESSMENT STRATEGY AND PROCESS

3.1 Duty to Have Exposure Assessments to Chemical Substances & Physical Agents

10 CFR 851 (hereinafter called The Rule), and specifically 10 CFR 851.21, requires Contractors to establish procedures to identify existing and potential workplace hazards and assess the risk of associated workers' injuries and illnesses.

Procedures must include methods that:

A. Assess worker exposure to chemical, physical, biological, or safety workplace hazards through appropriate workplace monitoring. Provide hazard assessment results to affected workers. Have worker sign UCN-23496, *UPF Hazard Assessment Results,* as proof of receipt of hazard information

B. Document assessment for chemical, physical, biological, and safety workplace hazards using recognized EA and testing methodologies and using accredited and certified laboratories

C. Record observations, testing, and monitoring results

D. Analyze designs of new facilities and modifications to existing facilities and equipment for potential workplace hazards

E. Evaluate operations, procedures, and facilities to identify workplace hazards

F. Perform routine job activity-level hazard analyses

G. Review site safety and health experience information

H. Consider interaction between workplace conditions and task-specific hazards and controls (e.g., respirator user performing welding in a confined space)

Contractors must perform the activities identified in item A. shown below, initially to obtain baseline information and as often thereafter as necessary to ensure compliance with the requirements in this Subpart.

The Rule incorporates, by reference, the ACGIH's TLVs® and BEIs® as regulatory limits. Currently, the TLVs and BEIs in the 2016 edition of the TLVs® are binding as regulatory limits under The Rule as amended on December 18, 2017.

Appendix A, Section 6 of The Rule, *Industrial Hygiene*, requires a Contractor to implement a comprehensive IH program that includes at least the following elements:

A. Initial or baseline surveys and periodic resurveys and/or exposure monitoring, as appropriate, of all work areas or operations to identify and evaluate potential worker health risks

B. Coordination with planning and design personnel to anticipate and control health hazards that proposed facilities and operations would introduce

C. Coordination with cognizant occupational medical, environmental, health physics, and work planning professionals

D. Policies and procedures to mitigate the risk from identified and potential occupational carcinogens

E. Professionally and technically qualified IHs to manage and implement the IH program

F. Use of respiratory protection equipment tested under DOE-STD-1167-2003, *Respirator Acceptance Program for Supplied-Air Suits*, when NIOSH-approved respiratory protection does not exist for U.S. Department of Energy (DOE) tasks that require such equipment

The UPF Project will comply with requirements using the strategy that exposure assessments are developed for each task where exposure to chemical substances and/or physical agents is reasonably anticipated. Initially, the QEA will be prepared prior to work and in concert with the preparation of the JHA. Following initiation of work on a given task sampling and measurements is conducted to build a body of baseline data permitting preparation of a QEA on which final exposure control methods will be specified using objective data.

Initially, a QEA is executed for a task using best available data and information from Safety Data Sheets (SDSs), professional journals and applicable research literature, industry experience, consideration of interaction between workplace hazards and other hazards, review of offsite safety and health experience, and professional judgment of the IH executing the assessment. Air sampling data will be recorded on CFN-1320, *UPF Air Sampling Form - Welding (Manganese),* or CFN-1321, *Air Sampling Data Sheet*. This assessment, when completed, will replace the QEA and will:

- Revise, modify, remove, or add protective measures based on objective data
- Provide baseline data to which periodic resampling or measurement will be compared to assess the continued effectiveness of engineered and personal protective equipment (PPE) controls
- Define the interval of review and resampling, or measurement for the substances and/or agents of concern for the duration of the task

3.2 Review and Approval of Chemical Substances

Chemical substances and hazardous materials represent a substantial hazard to worker health in construction operations. To better control this class of hazard and in accordance with UPF-CP-202, *UPF Hazard Communication Program,* the UPF ES&H IH will review and approve, disapprove, or conditionally approve all chemical substances and hazardous materials used or stored on or in UPF controlled areas and facilities. This approval applies to all Subcontractor materials as well as those procured by the UPF Project.

3.2.1 Approving & Disapproving Chemicals/Materials

Evaluation and control of chemicals or hazardous materials to be used at the UPF is critical to the control of exposures to hazardous agents. This section of the Procedure applies to all SDSs submitted to ES&H for approval of chemicals or materials (e.g., welding rods).

This Procedure begins as an assigned reviewer (Industrial Hygienist or designee) receives notification of an evaluation needed through the sdsevaluation@pxy12.doe.gov.

Use **Table 1** to designate "Approved" substances. To be "Approved," a substance meets both A AND B criteria and either criterion C, D, or E.

Table 1. Criteria "Approved" with No Restrictions

Criterion	Detail
A	The product is used in the workplace consistent with the manufacturer's intended purpose and product usage. This can be verified by comparing the label to the stated activity.
AND	(Meets both A AND B)
B	The chemical has a pH between 3 and 11, and a National Fire Protection Association health hazard ranking of 2 or less.
AND	(After meeting A AND B, it also meets C, D, or E)
C	The product does not list any hazardous ingredients, or the listed ingredients do not have an OEL.
D	The product's hazardous ingredients are less than 10% by weight or volume AND the applicable OEL is greater than 100 ppm AND it has a boiling point twice the expected temperature (in Fahrenheit) of the application.
E	The product's hazardous ingredients include particulates, which can become airborne and the OEL is greater than 3 mg/m^3.

Designate "Approved with Restrictions" substances meeting at least one criterion in **Table 2.**

NOTE: *Define the restrictions using established hazard controls, or through EA, and a subsequent UCN-23350,* Exposure Control Plan (ECP)*, as established by* ***Section 3.3,*** **Exposure Assessment Preparation.**

Table 2. Criteria "Approved with Restriction"

Criterion	Detail
A	The product is used in the workplace for a purpose other than the manufacturer's intended purpose.
B	Professional experience in using this type of product could have potential exposure issues.
C	Lack of professional experience and information on the product needs further evaluation.

Criterion	Detail
D	Product has chemicals with an OEL(s) and the potential for >25% exposure.
E	The product requires additional non-standard PPE such as chemical gloves (nitrile, butyl, silver shield), chemical goggles, Tyvek suit, etc.
F	The product contains a carcinogen (International Agency for Research on Cancer [IARC] Group 2B or worse) and/or a teratogen and it has been determined there are no suitable substitutes.

Where chemicals or materials represent a serious exposure potential, known human carcinogen, or in the professional opinion of a Certified Industrial Hygienist represent an unacceptable potential health or environmental risk when used as intended by the manufacturer will be rejected as Disapproved. The requestor will be responsible for specification of an alternative chemical or material that will represent a lesser risk.

3.3 Exposure Assessment Preparation

The process for exposure assessment preparation is described in **Appendix B, *Exposure Assessment, Exposure Control Plans, and Exposure Surveillance Plans Preparation Methodology***. It begins as the assigned IH receives an SOW detailing the activities to be performed with the materials involved. The IH then follows the QEA to create an initial ranking value and exposure estimate. This estimate is compared to any existing data through quantitative analysis to determine if a more accurate estimate can be assigned. Modifications to the estimate can change the ranking value which is then used to determine the classification (negligible, marginal, uncertain, or unacceptable), the need for controls, and any surveillance requirements. The initial (baseline) EA ends when the IH determines that the exposure is adequately characterized and has the correct combination of controls to reduce exposures to their lowest practical and compliant levels.

4.0 RECORDS

Records generated by this Procedure shall be maintained in accordance with Y15-95-800, *UPF Document Management*. Record types for documents managed by the UPF Document Management Center (DMC) in InfoWorks are identified in ML-PS-801768-A004, *Uranium Processing Facility Project Records Retention and Turnover List*, as prescribed by Y15-95-806, *UPF Records Retention and Turnover*. Quality Type is listed as Quality-Lifetime (QA-L), Quality-Nonpermanent (QA-NP), or Non-Quality (Non-QA) in accordance with E-PROC-3114, *Records Management*.

Records generated during the performance of this Procedure include:

Record or Form Number	Record Title	Record Holder	System/ Location	Document Type	Quality Type
UCN-23349	*Qualitative Exposure Assessment*	UPF DMC	Infoworks	HQEA	Non-QA
UCN-23350	*Exposure Control Plan*	UPF DMC	Infoworks	HECP	Non-QA
UCN-23351	*Exposure Surveillance Plan*	UPF DMC	Infoworks	HESP	Non-QA

Record or Form Number	Record Title	Record Holder	System/ Location	Document Type	Quality Type
UCN-23352	*Quantitative Analysis (CFN-1320 and CFN-1321 may be attached)*	UPF DMC	Infoworks	HQA	Non-QA
UCN-23496	*UPF Hazard Assessment Results*	UPF DMC	InfoWorks	HAR	QA-L
CFN-1320	*Air Sampling Form - Welding (Manganese)*	UPF DMC	Infoworks	HQA	Non-QA
CFN-1321	*Air Sampling Data Sheet*	UPF DMC	Infoworks	HQA	Non-QA

5.0 REFERENCES

5.1 Source References

American Industrial Hygiene Association (AIHA), *A Strategy for Assessing and Managing Occupational Exposures,* Fourth Edition

Chemical and Biological Exposure Assessments Strategies AIHA, *Essentials of Exposure Assessment II*

Los Alamos National Laboratory (LANL), *Laboratory Industrial Hygiene and Safety Manual (LIHSM)*, Revision 7.1

OSHA, *OSHA Technical Manual*

5.2 Interfacing References

10 CFR 851, *Worker Safety and Health Program*

10 CFR 851, *Appendix A, Functional Area - Industrial Hygiene*

10 CFR 851.21, *Hazard Identification and Assessment*

10 CFR 851.22, *Hazard Prevention and Abatement*

10 CFR 851.23, *Safety and health standards*

29 CFR 1910, *Occupational Safety and Health Standards*

29 CFR 1910.134(d)(2), *Respirators for IDLH atmospheres*

29 CFR 1910.134(d)(3)(i)(A), *Assigned Protection Factors (APFs)*

29 CFR 1926, *Safety and Health Regulations for Construction*

ACGIH, *2016 TLVs® and BEIs® Based on the Documentation of the Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposure Indices*

DOE-STD-1167-2003, *Respiratory Acceptance Program for Supplied-Air Suits*

E-PROC-3114, *Records Management*

ML-PS-801768-A004, *Uranium Processing Facility Project Records Retention and Turnover List*

NIOSH, *NIOSH Pocket Guide to Chemical Hazards*

PL-PJ-801768-A007, *CNS UPF Environment, Safety, and Health (ES&H) Plan*

UPF-CP-202, *UPF Hazard Communication Program*

Y15-95-800, *UPF Document Management*

Y15-95-806, *UPF Records Retention and Turnover*

Y73-010, *Safety and Industrial Hygiene Program*

6.0 SUPPLEMENTAL INFORMATION

Appendix A, *Acronyms and Definitions*

Appendix B, *Exposure Assessment Methodology, Control Plans, and Surveillance Plans*

APPENDIX A
Acronyms and Definitions

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Acronyms

ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
AL	Action Level
BEI	Biological Exposure Index
BNI	Bechtel National, Inc.
CFR	Code of Federal Regulations
CR	Confidence Rating
DMC	Document Management Center
DOE	U.S. Department of Energy
EA	Exposure Assessment
ECP	Exposure Control Plan
EEF	Exposure Effects Factor
ER	Exposure Rating
ES&H	Environmental, Safety, and Health
HER	Health Effect Rating
IARC	International Agency for Research on Cancer
IH	Industrial Hygiene
JHA	Job Hazard Analysis
LANL	Los Alamos National Laboratory
LIHSM	Laboratory Industrial Hygiene and Safety Manual
NIOSH	National Institute for Occupational Safety and Health
Non-QA	Non-Quality
OEL	Occupational Exposure Limit
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
PPE	Personal Protective Equipment
PRMS	Programmatic Requirements Management System
QA-L	Quality-Lifetime
QA-NP	Quality-Nonpermanent
QEA	Quantitative Exposure Assessment
REL	Recommended Exposure Limit (or Level)
SDS	Safety Data Sheet
SOW	Scope of Work
STL	Startup Test Lead

APPENDIX A
Acronyms and Definitions

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TLV	Threshold Limit Value
TWA	Time Weighted Average
UCL	Upper Confidence Limit
UPF	Uranium Processing Facility
VP	Vapor Pressure

Definitions

Action Level (AL)	A percentage of the OEL that indicates that some action takes place. This is generally set to 50%.
Boundary	An area set where the exposure is expected to be ≤ 25% of the OEL for a particular substance.
Exposure Assessment (EA)	The process whereby potential or actual exposure to occupational health hazards are evaluated.
Occupational Health Hazard	A chemical or biological agent in the workplace having a recognized potential to cause detrimental effects to humans.
Permissible Exposure Limit (PEL)	OELs mandated by OSHA 29 CFR 1926, *Safety and Health Regulations for Construction*, Subpart Z.
Quantitative Exposure Assessment (QEA)	Exposure assessments provided through development and implementation of an exposure surveillance plan which includes taking measurements and providing data analysis.
Threshold Limit Values (TLVs)	OELs propagated by ACGIH and codified by 10 CFR 851.23, *Safety and health standards*, for construction work executed for the DOE.
Time Weighted Average (TWA)	The average measured exposure during a given working period.

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Qualitative Exposure Assessments

A. Review the SOW and ascertain whether it has been previously evaluated with the materials listed

NOTE 1: *SDSs designated as "Approved" are classified as negligible and do not need to follow this process.*

- Complete form UCN-23349, *Qualitative Exposure Assessment*

NOTE 2: *All sections of this and other IH forms are to be filled in. Non-applicable sections are marked "N/A."*

- Retrieve any SDSs for the substance(s) involved in the SOW. If there are more than one, repeat Sections 2 and 3 for each SDS
- Fill in Section 1 on page 1 of the form

B. Review and prioritize the list of hazardous ingredients by the associated OELs in Sections 2 and 3

- The published OSHA PEL can be found by looking in the *NIOSH Pocket Guide to Chemical Hazards*
- The ACGIH TLV is contained in the 2016 ACGIH TLV book

NOTE 3: *SDSs often have OEL information that may not be accurate.*

C. Using the SDS, add hazardous reactants and/or decomposition products that are likely to occur with the stated activity

D. Reprioritize the hazardous ingredients list using the OELs associated with the selected hazardous reactants and/or decomposition products

E. Record the top four substances of greatest concern on the form

F. Use the 2016 ACGIH TLV book, the *NIOSH Pocket Guide*; and the SDS as primary sources to complete the information on this form

- Skin notations are those listed in the 2016 ACGIH TLV book
- The Vapor Pressure (VP) column is only applicable to liquids and certain solids. Find the VP in the SDS or *NIOSH Pocket Guide*
- The "percent in product" is the highest percentage listed of the hazardous ingredient. Reactants and decomposition products tend to be considerably less, but require professional judgment
- The "Quantity" is the amount of product expected to be used
- "Route(s) of Exposure" include (Inh)alation, (Ing)estion, (Inj)ection, (Con)tact, and (Abs)orption. This information is available in the SDS and the *NIOSH Pocket Guide*

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- The "Physical States" are solid, liquid, or gas. If you expect the exposure to release in a particular form, like mist, vapor, or fume, record it on UCN-23349

Exposure Rating (ER) Factors

After entering the information directed above, the IH assigns values and performs the calculation to score each potential exposure.

A. Using the information on pages one and two of UCN-23349, estimate the Exposure Effects Factors (EEFs) listed in **Table 3**. Record the scores in the appropriate section on the form

Table 3. Exposure Effects Factors

Rank	Frequency (% of shift)	Controls	Potential Exposure Quantity	Dust, Gas, or Mist Generation	(Not for Gases) VP (mm Hg)
1	< 25%	Closed process	Low	None	<1
2	25 - < 50%	Local exhaust	Moderate	Minor	1- ≤ 10
3	50 - < 75%	Dilution ventilation	High	Moderate	10 - ≤ 100
4	75 - 100%	No controls in place	Very High	Significant	>100

B. Average all the EEF rankings (round up) and record that number in EEF Mean

Table 4. Health Effects Rankings

Rank	OEL-ppm	OEL-mg/m^3
1	>100	>3
2	10 – 100	1-3
3	1-10	0.1-1
4	0.1-1	0.01-0.1
5	<0.1	<0.01

C. Use **Table 4** to select the Health Effect Rating (HER) that best represents the substance. Record the value on the form

D. Choose a Confidence Rating (CR) that represents experience and confidence in qualitatively ranking these substances. Record the value on the form

Table 5. Confidence Ratings

Rank	
1	Previously sampled this or similar substance
2	Closely related experience
3	Some related experience
4	Unrelated experience
5	No experience close to this substance

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Calculate ER

A. Calculate the overall ER by multiplying EEF Mean * HER * CR

B. Look at the ratings created and compare them to **Table 6** in this section, and perform the required action(s) listed

Table 6. Exposure Ratings

ER Range	Classification		Est. Exposure (% OEL)	Required Action(s)
1-10	Negligible		<25%	Follow manufacturer's instructions.
11-30	Marginal		25 - <50%	Perform step C below.
31-60	Uncertain		50 - <100%	Create and implement control and surveillance plans. Analyze the exposure surveillance plan using the Quantitative Analysis.
61-100	Unacceptable		≥100%	Create and implement control and surveillance plans. Analyze the exposure surveillance plan using the Quantitative Analysis.

C. If the substance is classified as "Marginal," perform the following:
   - If a skin sensitizer, create an ECP (UCN-23350)

D. Determine if a survey is needed to validate the exposure is "Marginal"
   - If an exposure model can be used to estimate the exposure and if it agrees with the "Marginal" classification (or less), create a record of the calculation (include name, date, equation, and result) and attach it to the form
   - If information is available on likely exposures through a credible reference, document the source/information in the "Summary of Exposure Evaluation Potential(s)"
   - If a model cannot be used and no credible exposure estimates can be obtained, perform at least one survey to validate results
   - Where survey is performed, if it equals or is less than the "Marginal" classification, the initial (baseline) EA is complete. Record the survey results in the "Summary of Exposure Evaluation Potential(s)" section of the form

E. (Optional) Record any additional information learned and/or assumptions made in the "Summary of Exposure Evaluation Potential(s)" section of the form

F. Pass the form (all pages) to the Lead Industrial Hygienist for Peer review, and then transmitted to the DMC for retention in Project records

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Quantitative Analysis

The Quantitative Analysis is the process of reviewing and making decisions about the data. The results of this process determine whether the substance is appropriately classified, the initial (baseline) EA is complete, and whether the exposure control and surveillance plans need to be adjusted.

A. Obtain form UCN-23352, *Quantitative Analysis*, any previous data results, and a copy of the signed QEA

B. Transfer SOW information from the QEA

C. Select “Baseline” when conducting an initial assessment and “Routine monitoring” when analyzing routine monitoring results (which may include the baseline results)

D. Fill in “Expected (Personal Sampling) Mean.” This is either:
   - An estimated % OEL range extracted from **Table 7**
   - The average of the existing data
   - A best estimate obtained by researching or modeling the exposure

E. Fill in the remainder of the form as indicated
   - For the Statistical Data section:
     - The values analyzed need to be from personal samples in Time Weighted Averages (TWAs) over the period sampled
     - Input the units of the sample results in “Exposure as Unit”
     - Assume the results are normally distributed to calculate the mean and upper confidence limit (UCL) for the sample sets
     - The UCL for a one sided normal distribution is shown in **Figure 2** (i.e., Formula 1):

Formula 1: 95% Upper Confidence Limit

$$UCL(95\%) = \bar{x} + 1.645 \frac{SD}{\sqrt{N}}$$

$\bar{x}$ = sample mean, SD = Standard Deviation, N = number of samples taken

Figure 2. UCL Formula

   - A software package, such as Excel, may be used to calculate the mean, SD, and the UCL. Ensure that the package calculates a one-sided confidence interval

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- Alternatively, use a software package to determine whether the data is best represented as normal or lognormal distributions
- Record the sample mean and UCL values from the calculations. If not using a normal distribution, record the distribution used in the "Comments and Justification" section
- Divide the mean by the OEL and turn it into a percent. Record this in the box provided. Repeat for the UCL

F. For question 5, classifications are shown in **Table 7**

G. For question 6, reexamine exposure controls when the UCL exceeds the AL

- Ensure that controls follow the IH hierarchy of controls (Elimination, Substitution, Engineering, Administrative, and PPE)
- Evaluate controls for potential hazards (such as heat stress, noise, lack of visual acuity, etc.)
- Ensure the controls reduce exposures to the lowest practical exposures after considering control costs
- If additional controls would or could reduce exposures, discuss suggestions with a supervisor

H. For question 7, close the baseline exposure when:

- The exposure is accurately characterized, meaning it is known what range of exposures to expect using the current ECP

AND

- The ECP does not need to be changed to reduce exposures

I. For question 8, if the exposure classification has changed, update the sample frequency according to **Table 7** unless:

- If the substance is a recognized carcinogen (IARC Group 2B or worse), then increase the sample frequency by one step (to a maximum of Quarterly)
- Professional judgment dictates otherwise (Subject to approval)

Table 7. Sampling Frequencies

% of OEL	Classification	Sample Validation Frequency
0 - <25	Negligible	When the process changes
25 - <50	Marginal	Annually
50 - <100	Uncertain	Every six months
≥ 100	Unacceptable	Quarterly

J. Record pertinent assumptions, justifications and changes to plans in the "Comments and Justification" section

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K. When signed by the Peer Reviewer, send the original to the DMC for retention in the Project records

Exposure Control Plans

A. Review and transfer pertinent information from the completed EA

B. Choose Engineering controls based on the potential to create and control airborne hazards:

- If local exhaust is selected, specify the type of local exhaust, the filter type, the required flow rate, and capture distance needed to control the hazard
- If the substance could be controlled by using a barrier, such as plastic over the work area, specify it in the space provided

C. Choose Administrative controls beneficial to controlling the hazard. Complete the appropriate boxes

D. Specify respiratory protection when the exposure is suspected to exceed 50% of the OEL

- Select respiratory type (e.g., ½ face, full face, Self-Contained Breathing Apparatus) according to the assigned protection factor as dictated by OSHA in 29 CFR 1910.134(d)(3)(i)(A), *Assigned Protection Factors (APFs)*. For unknown atmospheres, follow the procedures in 29 CFR 1910.134(d)(2), *Respirators for IDLH atmospheres*
- If using a cartridge to filter contaminants, select the cartridge type according to the agent(s) of concern
- Where appropriate, determine the cartridge change out schedule
- Gather the information by selecting a manufacturer, respirator model, and cartridge
- Use the manufacturer's program, available by Internet or phone call, to determine the recommended time to cartridge breakthrough
- Use the best exposure estimated through qualitative EA and quantitative analysis processes
- Choose a change out schedule consistent with protecting workers from the estimated breakthrough time

NOTE: *Some manufacturers are extremely conservative in their change out recommendation. For example, Mine Safety Appliances recommends at least daily change out of cartridges. Seek expert advice before deviating from their schedule.*

E. Complete the section marked "Protective Clothing (chemical protection)." Consider the implications of heat stress with your selections

- Select boots according to the type needed. Use the "Other" space to choose unlisted boot types

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- Describe clothes when needed to protect from a chemical hazard (including certain particulates)
- Indicate an inspection or change frequency for the coveralls in the space provided

NOTE: *Generally, disposable coveralls are thrown out daily and non-disposable coveralls are inspected daily or before use.*

- Choose gloves according to resistance to the agent(s) of concern
- Assign a change schedule to the gloves in accordance with manufacturer's recommendation
- Change schedules can be created by looking at the manufacturer's listed chemical breakthrough times
- Disposable gloves are either a one shift or one-time use. State this in the change schedule
- Non-disposable gloves need to be inspected prior to use. Look for rips, tears, patches, discoloration, abrasions, etc.
- Select Eye/Face protection according to the hazard. If "Other" is selected, record a choice in the space provided

F. Sign and Date the form. After reviewing, submit to ES&H Records and Archives and to UPF DMC for records retention

Exposure Surveillance Plan

A. Obtain form UCN-23351, *Exposure Surveillance Plan*, and have a copy of the QEA available

B. Using the QEA form:

- Transfer SOW information
- Determine the agent(s) that requires sampling
- Record the validation frequency
- Ascertain whether the substance is an OSHA expanded standard which dictates sample frequency (e.g., lead, arsenic, cadmium, chromium VI)
- If not an OSHA expanded standard, record the number based on the classification listed in **Table 7**
- If the substance is a carcinogen (IARC Group 2B or worse), increase the sample frequency by one step (to a maximum of Quarterly)
- Designate the number of minimum samples needed
- If this is a first pass, assume samples are normally distributed and set the number to 6
- If data is available, gather the data and discuss the number of samples with the Project Industrial Hygiene Lead

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- Minimum sample numbers are reviewed and may be changed through question 8
  - Complete the remainder of the information on the form
  - Complete each section as applicable to the type of sampling
- If performing air sampling, include the analytical method (see the *NIOSH Pocket Guide,* or contact the Lab)
- Request the form be reviewed and signed by a peer
- Send the original to the DMC for retention in the Project's records