Los Alamos NATIONAL LABORATORY EST.1943

Integrated Work Document (IWD) Part 1, Activity Specific Information

IWD #: MST-8-3-1698-C135-2 Revision #: 6			Activity/Task Title Electron Microscopy of Radioactive Materials.
Work Document #			Planner/Preparer (Name/Z #/Date) Rodney McCabe / 178257 / 3/8/19
TA 03	Building 1698	Room C-135	Other Location(s)(TA) as required

Activity Description/Overview: This IWD covers electron and ion beam processing and analysis in the electron microscopy laboratory (EML) of radioactive materials using scanning electron microscopes (SEMs), scanning / transmission electron microscopes (S/TEMs), and dual beam Focused Ion Beam (FIB)/SEMs. Low-level radioactive materials (to exclude Pu isotopes) will be received from other facilities via approved means. Low-level radioactive materials are defined as those with dose rates not to exceed 50 mrem/hr on contact and/or 5 mrem/hr at 30 cm. Higher level radioactive materials will require an RWP. The tasks and necessary safety precautions depend on several factors: sample activity, analysis method (*i.e.* FIB), sample form (*i.e.* mounted metallographic polished metal sample versus powder), whether the sample may change during the analysis time, and whether the radionuclides present are easy or hard-to-detect. Prior to analyzing a new type (material or form) of material, it is necessary to engage the PIC and RP to define into which category the sample falls.

Different categories require different levels of RCT support. The lists can be updated to include additional samples and/or analysis with PIC and RP approval.

A. No RCT support required before or after microscope session. Tasks 0, 0A, 1A

Non-destructive SEM (no physical change of sample during analysis) of low level-radioactive material in solid form and/or TEM analysis of FIB lamella. Samples must have been appropriately surveyed at the point of origin for removable contamination and dose on contact and at 30 cm. Processing with the FIB always alters the specimen and will not fall in this category. Unfixed powders will not fall in this category. Non-low-level samples will not fall in this category. Hard to detect radionuclides will not fall in this category. A FIB sample for which the FIB lamella is damaged during analysis would become Category B for unloading procedures. The following is the approved list of sample types currently populating this category.

a. Stable, metal samples that have been surveyed for removable contamination and dose at the facility of origin.
b. TEM samples that have been prepared by FIB
c. Mechanically sound, pressed and sintered uranium compounds (i.e. UO2, UN, Uranium Silicide) that have been surveyed for removable contamination and dose at the facility of origin.

B. RCT support required after microscope session. It is the user's option to have RCT support for loading the sample. Tasks, 0, 0B,1B
   a. Samples that may change during analysis, i.e. decay, chemical change (i.e. hydriding, oxidation), damage.
   b. All FIB processing. FIB of samples listed in (C) require RCT support while loading sample, too.
   c. TEM of samples that were **not** prepared by FIB (i.e. electropolishing, ion milling, etc.). These samples come in physical contact with the TEM holder, hexring, and anti-twist washer if used.

C. RCT support required both before and after microscope session
   a. Any powder forms of material
   b. Any materials with removable contamination, i.e. removable oxide
   c. Hard to detect Radio-nuclides.

In this IWD, hard-to-detect isotopes will be sampled differently than easy-to-detect materials and tasks are mostly separate.

An exposure assessment was completed for this activity (AU# 0003422).

Hazard Analysis (HA) Method Used: ☒ Brainstorming ☐ Other:

List Names of HA Team (Attach sheet if necessary): Rodney McCabe, Eric Tegtmeier, Matthew Schneider, Antonio Maestas Date HA Performed: Feb 2013, Apr 2016, April 2019

The RLM approval indicates Integrated Work Management (IWM) has been applied appropriately, work is authorized, workers are qualified, work will be performed in accordance with Environment, Safety, Health, and Quality (ESH&Q)/Security and Safeguards (S&S) requirements and the IWD, and facility safety basis, aggregate hazards, and collocated hazards were appropriately included in the hazard analysis. RLM acknowledges completion of a peer review.

RLM (Signature/Z#/Date) **Required**: 187042 5/29/2019

The Facility Operator Director (FOD) approval on Form 2100 indicates work is appropriate to be conducted in this facility (the activity is within the Authorization Basis [AB] and the work is appropriate for the facility), and facility safety basis, aggregate hazards, and collocated hazards will be managed.

Work activities in multiple FOD jurisdictions, e.g., additional facility safety envelopes, require FOD or Representative approval.

FODs or FOD Representatives (Signature/Z#/Date/TA) **Required**: 190035 6/12/2019 TA3

Subject Matter Expert(s) (SME[s]) Review (Signature/Z#/Date) **If Required**: 124K 5/14/19 AT 152423 5/29/19 (RP)

317874/5/28/19 IH

Hazard Determination by Hazard Grading Table ☐ Low-Hazard ☒ Moderate-Hazard ☐ High-hazard/Complex **IWD Type:** ☐ Standing IWD ☒ Standard IWD	Expiration Date: _____ **RLM and FOD or FOD Representative** reapproval is required. **Annual Review Completed** (RLM Initial/Date): _____ Name of **Primary Person in Charge (PIC)** (Print): Rodney McCabe Name of **Alternate PIC**: Ben Morrow Name of **Alternate PIC**: Roberta Beal		Classification review completed, if required. _____ **Reviewer** Signature/Z#/Date	
Work Tasks/Steps Identify work steps/tasks in sequence when such sequencing contributes to safety, security, and/or environmental protection.	**Hazards, Concerns, and Potential Accidents/Incidents** Identify both activity and work-area hazards for each task/step.	**Controls, Preventive Measures, and Bounding Conditions** Specify preventive measures, controls for each hazard (e.g., lockout/tagout points, specific Personal Protective Equipment [PPE], Tamper Indicating Devices [TIDs], alarms, safes, recycle, waste minimization).	**Reference Documents** List permits, operating manuals, security plans, and other reference procedures.	**Training** List training and qualification requirements. (P300, Integrated Work Management, Section 6.1)
Task 0: Radioactive Sample handling and long-term storage **All Samples** Step 1) **Ensure all work performed is within mass and dose limits**. Step 2) Notify a PIC of any rad work occurring in the EML Step 3) Post the microscope with signage indicating rad work Step 4) Wear appropriate PPE and use rad dedicated tools and sample adapters provided by the EML	Radioactive Dose Radioactive Contamination	EML PIC will be notified of all rad work occurring in the EML Personnel handling radioactive samples must wear a TLD, neoprene and/or nitrile gloves, and safety glasses. Only tools (tweezers, tongs) dedicated to radioactive samples can be used for handling radioactive samples. SEM and FIB work will require dedicated sample holders for radioactive materials. All handling waste (i.e. gloves) will be disposed of in rad trash, a receptacle will be stored in a locked cabinet in C-135Fx. All rad tools and holders will be stored in the same locked cabinet in C-135Fx when not in use. There shall be no long-term storage of rad samples (beyond time spent while analyzing samples) in microscope rooms. Non-accountable samples can be stored in the locked rad cabinet in C-135Fx with PIC approval and appropriate logging in the rad cabinet logbook. The room will be posted and controlled indicating the presence of radioactive material (RCA/RMA) if the samples exceed 10 % of table 16A of P121.	P121 Radiation Protection	Radiation Worker II CURRICULUM 115
Task 0A, 0B: Sample loading for SEM, TEM, and FIB of **samples listed under Category A and B above.** RCT Support is not necessary during loading of these samples.	Radioactive Dose Radioactive Contamination	Samples must have been surveyed at the point of origin for removable contamination and dose on contact and at 30 cm. See Task 0 for handling of all radioactive materials	P121 Radiation Protection	Radiation Worker II CURRICULUM 115

Task 0C: Sample handling for SEM, TEM, and FIB of **samples listed under Category C above.** Contact RCT for support during handling and loading of samples. See Tasks 2 or 3 depending on whether the present radionuclides are easy-to-detect or hard-to-detect	Radioactive Dose Radioactive Contamination	See Task 0 for all handling of radioactive materials The sample will arrive pre-loaded into a sample holder that is inserted into the electron microscope. Any items that touch the sample or holder tip should be treated as potentially contaminated. The sample holder will be verified surveyed at the point of origin for removable contamination and dose on contact and at 30 cm To minimize the spread of hard-to-detect contamination, the handling of radioactive samples at the EML must be kept to a minimum. Every effort should be made to ensure samples are shipped in a sample holder ready for loading. An RCT shall be present when samples listed under Category C above are received, unpacked and loaded to perform contamination and external radiation surveys. RCT sampling will depend on whether the isotopes present are easy-to-detect or hard-to detect as described below. When scheduling RCT support operators need to let the RCT know what type of radioactive material (ie.radionuclides) will be mounted so that the RCT knows what surveys to take.	P121 Radiation Protection	Radiation Worker II CURRICULUM 115
Task 1A: Sample unloading for SEM and TEM of **samples listed under Category A above.** RCT Support is not necessary during unloading of Samples listed under Category A above	Radioactive Dose Radioactive Contamination	Samples must have been surveyed at the point of origin for removable contamination and dose on contact and at 30 cm prior to loading See Task 0 for all handling of radioactive materials	P121 Radiation Protection	Radiation Worker II CURRICULUM 115
Task 1B, 1C: Sample unloading from SEM, TEM, and FIB and packaging of **samples listed under Category B or C above.**	Radioactive Dose Radioactive Contamination	See Task 0 for all handling of radioactive materials An RCT shall be present when samples listed under Category B or C above are unloaded, repacked, and	P121 Radiation Protection IWD# 6-3-1698-C135B-1, EML FEI	Radiation Worker II CURRICULUM 115

Contact RCT for support during handling and loading of samples.		removed from the facility to perform contamination and external radiation surveys. During unloading, the sample is removed from the microscope. The sample (and holder) is placed into appropriate packaging after survey. For SEM work, the sample holder and interior surfaces of the microscopes shall be surveyed for contamination by an RCT following each analysis (post-job survey). For TEM work, the sample holder, anti-twist washer (if used), and/or the hexring shall be surveyed for contamination by an RCT following each analysis (post-job survey). RCT sampling will depend on whether the isotopes present are easy-to-detect or hard-to detect as described below. When scheduling RCT support operators need to let the RCT know what type of radioactive material (ie.radionuclides) will be mounted so that the RCT knows what surveys to take. Microscopes may not be used until contamination survey results are reviewed by RCT.	TF30 TEM Operation IWD# 6-3-1698-C135A-1, EML FEI Titan 80-300 TEM Operation, IWD#6-3-1698-C135G-1, EML FEI Inspect F SEM Operation IWD# 6-3-1698-C135C, EML FEI Apreo Operation	
Task 2: Sampling For **Easy-to-Detect** Radionuclides Microscope will not be cleared for further use until RCT clears instrument for samples listed under Category B or C above	Radioactive Dose Radioactive Contamination	RCT will take liquid scintillation smears on samples that will be submitted to HPAL for analysis.	P121 Radiation Protection	Radiation Worker II CURRICULUM 115
Task 3: Sampling for **Hard to Detect** Radionuclides Microscope will not be available for further use until RCT clears instrument for samples listed under Category B or C above	Radioactive Dose Radioactive Contamination	RCT will perform a dose rate survey all radioactive samples prior to any handling. Any sample greater than 50 mrem/h on contact or 5 mrem/hr at 30 cm will be returned to the shipping organization unless covered by an RWP. For TEM of hard to detect radionuclides, the sample shall be loaded into the holder at a different location	P121 Radiation Protection	Radiation Worker II CURRICULUM 115

		under a different IWD, and arrive ready for insertion into the microscope. A variance to the performance of a receipt survey at TA3-1698-EML and the survey of the transport vehicle prior to departing has been approved by RCT for hard to detect samples received from TA48. Radiological survey results must be provided to the RCT MSL resident personnel and accepted *prior* to the shipment of any radioactive samples from TA48. During unloading, the sample is removed from the microscope. The sample (and holder) is placed into appropriate packaging after survey. The sample holder and, for SEM work, the interior surfaces of the microscope shall be surveyed for contamination by an RCT following each analysis involving radioactive samples (post-job survey). Smears are to be taken to the TA-48 count room for analysis. The smears will be packaged in a plastic bag in a DOT shipping box that was kept out of the area where the radioactive material was handled. A LANL vehicle will be used to bring the smears to the count room at TA-48. The shipping box does not need to be released prior to shipping. Once the smears have been counted, the survey results will be reviewed by RCT. Microscopes may not be used until contamination survey results are reviewed by RCT. The sample holder may be packaged for shipment pending contamination survey results. The sample holder and transportation container will be released for shipment according to RCT procedure.		

Use Form 2100 Continuation Page for additional Tasks/Steps (if needed) or attach pages to clearly communicate ES&H/S&S hazards and associated controls.

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Integrated Work Document (IWD) Part 3, Validation and Work Release

IWD #MST-8-3-1698-C135-2 Revision #:6 **Work Release**

By signing below, I verify this activity is compatible with current facility configuration and operating conditions.

FOD designated Ops Mgr or other facility point-of-contact for work area

Signature/Z#/Date **(If required by FOD)**: _____

Note: For Standing IWD, release may be given concurrently with signatures on Part 2.

By signing below, I have verified the following:

- I have verified authorization by ensuring approval signatures of the RLM and FOD.
- I have jointly conducted a validation walkdown with workers to confirm the IWD can be performed as written, required initial conditions and other prerequisites are in-place.
- The assigned workers are authorized and are qualified to perform the work in a safe, secure, and environmentally responsible manner.
- I have conducted the pre-job briefing, and all workers (including support workers) have been briefed.
- I have ensured coordination with any required FOD work-area representatives (*e.g., area work coordinators*).

Primary PIC (Signature/Z#/Date) **Required**: 247959 6/13/2019

Alternate PIC Signatures **acknowledges** PIC authority is assumed for the first time *(Note: Alternate PICs are required to sign only once, but formal handoff includes conferring with previous PIC to obtain all required information associated with the handoff).*

Alternate PIC (Signature/Z#/Date) **Required**: 178257 / 6-11-19

Alternate PIC (Signature/Z#/Date) **Required**: 322242 / 6-13-19

Pre-Job Brief Content

- What are the critical steps or phases of this activity?
- How can we make a mistake at that point?
- What is the worst thing that can go wrong?
- What controls, preventive measures, and bounding conditions are needed?
- What work permits are required and how will we meet their requirements?
- What are the handoffs and coordination requirements among workers and multiple PICs?
- Are there hold-points including those that require sign-offs?
- What are the pause/stop work responsibilities and expectations (e.g. for unanticipated conditions or hazards)?
- How would we respond to alarms and emergencies?
- Are there lessons learned from previous similar work?
- Is other information needed to perform this activity in a safe, secure, and environmentally responsible manner?
- Does everyone agree to the work tasks/steps, hazards, and controls and commit to follow them?

Pre-Job Brief Attendance Roster

By signing below **as required**, I agree to the following:

- I agree to follow the work steps and implement the controls as written as applicable to my work assignments.
- I agree to pause/stop work when conditions or hazards change or when I encounter unexpected conditions during the execution of work, or when work cannot be performed as written, or instructions become unclear during execution.
- I confirm that I am authorized, qualified, and fit to perform the work.

Worker (Signature/Z#/Date) 178257 / 6-11-19	**Worker** (Signature/Z#/Date) 335773 / 6-11-19
Worker (Signature/Z#/Date) 327231 / 6-11-19	**Worker** (Signature/Z#/Date) 322242 / 6-13-19
Worker (Signature/Z#/Date) 288527 / 6-11-19	**Worker** (Signature/Z#/Date) 303566 6/13/19
Worker (Signature/Z#/Date) 315119 6/11/19	**Worker** (Signature/Z#/Date) 264760 6/14/19

Form 3024

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Integrated Work Management
Responsible Line Manager (RLM)
Delegation Form

According to P300, *Integrated Work Management*, "One RLM must be identified as responsible and accountable for the safety, security, and environmental compliance of each work activity." This form may be used by the RLM for activities involving workers from multiple organizations. The form documents the delegation of the RLM responsibilities for a worker from another organization to the RLM who owns the operation. The delegations will expire concurrent with the expiration date of the Integrated Work Document (IWD). The RLM or designee (normally the Person in Charge [PIC]), will maintain this form with the IWD through completion of the work (see P300, Section 3.1.3.d, *Worker Authorization*).

IWD #	IWD Title	PIC	IWD Expiration Date
MST-8-3-1698-CL	Electron Microscopy of Radioactive Materials	Rodney McCabe / 178257	5/29/2022

RLM Delegating RLM Responsibilities for Worker		
Name (print) of Delegating RLM/Z #	Signature	Date
Jennifer McEahern / 200845		6/11/19
RLM Accepting RLM Responsibilities for Worker		
Name (print) of Accepting RLM/Z #	Signature	Date
Kimberly Obrey 187042		6/11/19
Worker Acknowledging RLM Delegation		
Name (print) of Acknowledging Worker/Z #	Signature	Date
Jessica Lopez 327231		6-11-2019
RLM Delegating RLM Responsibilities for Worker		
Name (print) of Delegating RLM/Z #	Signature	Date
Jennifer McEahern / 200845		6/11/19
RLM Accepting RLM Responsibilities for Worker		
Name (print) of Accepting RLM/Z #	Signature	Date
Kimberly Obrey 187042		6/11/19
Worker Acknowledging RLM Delegation		
Name (print) of Acknowledging Worker/Z #	Signature	Date
Robert Forsyth 198736	Robert T. Forsyth	6/11/19

RLM Delegating RLM Responsibilities for Worker		
Name (print) of Delegating RLM/Z #	Signature	Date
Jennifer McEachern / 200845		6/11/19
RLM Accepting RLM Responsibilities for Worker		
Name (print) of Accepting RLM/Z #	Signature	Date
Kimberly Obrey 187042		6/11/19
Worker Acknowledging RLM Delegation		
Name (print) of Acknowledging Worker/Z #	Signature	Date
Eric Teetmeier / 288527		6/11/19

RLM Delegating RLM Responsibilities for Worker		
Name (print) of Delegating RLM/Z #	Signature	Date
Jennifer McEachern / 200845		6/11/19
RLM Accepting RLM Responsibilities for Worker		
Name (print) of Accepting RLM/Z #	Signature	Date
Kimberly Obrey 187042		6/11/19
Worker Acknowledging RLM Delegation		
Name (print) of Acknowledging Worker/Z #	Signature	Date
Kevin Bohn 315119		6/11/19

RLM Delegating RLM Responsibilities for Worker		
Name (print) of Delegating RLM/Z #	Signature	Date
~~Jennifer McEachern / 200845~~		~~6/11/19~~
RLM Accepting RLM Responsibilities for Worker		
Name (print) of Accepting RLM/Z #	Signature	Date
~~Kara Luitjohan / 335113~~	~~Kara Luitjohan~~	~~6/11/19~~
Worker Acknowledging RLM Delegation		
Name (print) of Acknowledging Worker/Z #	Signature	Date