

JOB HAZARD ANALYSIS

SCAR-40007
ESSAP LABS
SOIL PREPARATION

PROCEDURE SP3 Revision 5

JOB STEP	JOB HAZARD	HAZARD CONTROL
<p style="text-align: center;">STEP 3.1.2</p> <p>Dry the entire sample in an appropriate container. Place samples in drying oven from top to bottom. Dry at 120°C, typically 8 – 16 hours. Turn on exhaust fan while ovens are in use.</p>	<p>Possible radiological hazard Possible biological hazard Heat hazard</p>	<p>Wear safety glasses, a laboratory coat, and chemical resistant gloves. Utilize heat resistant gloves when removing sample containers from oven. Make sure exhaust fan is on and working.</p>
<p style="text-align: center;">STEP 3.1.3</p> <p>Allow samples to cool completely. Remove samples from drying oven from bottom to top.</p>	<p>Possible radiological hazard Possible dust hazard</p>	<p>Make sure exhaust fan is on and working. Wear safety glasses, a laboratory coat, and chemical resistant gloves.</p>
<p style="text-align: center;">STEP 3.1.4</p> <p>Pulverize sample using large metal pestle. Position sample container in the lab hood and strike repeatedly to reduce particle size.</p>	<p>Possible radiological hazard Possible dust hazard Noise hazard</p>	<p>Wear safety glasses, a laboratory coat, and chemical resistant gloves. Wear hearing protection. Perform work in lab hood.</p>
<p style="text-align: center;">STEP 3.1.5 – 3.1.7</p> <p>Pulverize sample using a one gallon (paint style) metal container. Add sample and 3 to 5 stainless steel balls. Attach lid, fasten can securely into mechanical shaker. Set timer, start. Exit room.</p>	<p>Possible radiological hazard Possible dust hazard Noise hazard</p>	<p>Wear hearing protection, safety glasses, a laboratory coat, and chemical resistant gloves. Do not use severely dented paint cans. Do not shake for more than 1 hour. Exit area while shaker is in operation.</p>
<p style="text-align: center;">STEP 3.1.8</p> <p>If necessary, pass the sample through a 0.25” sieve.</p>	<p>Possible radiological hazard Possible dust hazard</p>	<p>Wear safety glasses, a laboratory coat, and chemical resistant gloves. Perform work in lab hood.</p>
<p style="text-align: center;">STEP 3.1.9</p> <p>Pour samples into the appropriate counting container.</p>	<p>Possible radiological hazard Possible dust hazard</p>	<p>Wear safety glasses, a laboratory coat, and chemical resistant gloves. Perform work in lab hood.</p>
<p style="text-align: center;">STEP 3.2.3</p> <p>Turn on exhaust fan. Ash sample, if necessary, at 500°C overnight. Place small sample portion in an ashing container. Position container in ashing furnace. Close door and turn unit on.</p>	<p>Radiological hazard</p>	<p>Wear safety glasses, a laboratory coat, and chemical resistant gloves Make sure exhaust fan is on and working.</p>

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STEP 3.2.4 Turn off ashing furnace. Do NOT open door. Allow to cool for a minimum of two hours with door closed. Open door, allow to cool for a short period of time. Remove sample to cool to room temperature before further processing.	Heat hazard Possible radiological hazard Possible fume hazard	Utilize heat resistant gloves and long handled metal tongs when removing sample crucibles from oven. Wear safety glasses and lab coat. Make sure exhaust fan is on and working.
STEP 3.4.1 Unless suspended and dissolved solid results are required by the client or there are radioisotopes present that could possibly be volatilized by acidification, acidify all water samples to a pH of 1-2 using nitric or hydrochloric acid.	Possible radiological hazard Possible chemical hazard	Wear safety glasses, a laboratory coat, and chemical resistant gloves. Perform work in lab hood.

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SCAR-40004
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GROSS ALPHA AND BETA

Procedure AP1 (Revision 15)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 2.0 Reagent Preparation.	Possible chemical hazard and exposure	Wear safety glasses with side shields, laboratory coat, and acid resistant gloves. Perform work in fume hood as required.
STEP 4.2.1 Acidify sample to a pH of 2, using nitric acid or hydrochloric acid. (NOTE: step is optional depending on acidity of sample.)	Possible acid and radioactivity exposure	Wear safety glasses, a laboratory coat, and acid resistant gloves. Treat all samples as radioactive.
STEP 4.2.2 Filter sample through a 0.45 µm pore sized membrane filter. Retain and count filter paper. Acidify filtered sample as in 4.1. (NOTE: step is optional.)	Possible radioactivity or chemical exposure	Wear safety glasses, a laboratory coat, and acid resistant gloves. Treat all samples as radioactive.
STEP 4.2.4 Measure samples	Possible radioactivity or chemical exposure	Wear safety glasses, laboratory coat, and acid resistant gloves. Treat all samples as radioactive.
STEP 4.2.5 Heat sample to reduce volume.	Heat exposure, splatter exposure	Maintain hotplate temperature so that sample does not boil or splatter.
STEP 4.2.6 Add concentrated HNO ₃ to a sample.	Possible acid and radioactivity exposure	Wear safety glasses, laboratory coat, and acid resistant gloves. Treat all samples as radioactive.
STEP 4.2.7 Transfer reduced sample volume to planchet quantitatively using 0.1 M nitric acid.	Possible acid and radioactivity exposure	Wear safety glasses, laboratory coat, and acid resistant gloves. Treat all samples as radioactive. Perform work in hood.
STEP 4.2.8 Heat sample on hot plate until dry, then oxidize nitrates with high heat.	Possible burn exposure to hotplate	Wear safety glasses, gloves, and a laboratory coat. Do not touch heated hotplate under any circumstances. Permit planchets and hotplates to cool before handling. Continue all work in the hood.
STEP 4.3.1 Weigh sample and transfer to a centrifuge tube.	Possible radioactivity or chemical exposure	Wear safety glasses, a laboratory coat, and gloves. Treat all samples as radioactive.

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Procedure AP1 (Revision 15)

Given: Good Laboratory Practices

STEP 4.3.2 Transfer sample to a tared planchet using deionized H ₂ O.	Possible radioactivity exposure	Wear safety glasses, a laboratory coat, and gloves. Treat all samples as radioactive.
STEP 4.3.3 Heat planchets on hot plate slowly.	Possible radioactivity or burn exposure	Wear safety glasses, gloves, and a laboratory coat. Do not touch heated hotplate under any circumstances.
STEP 4.3.4 Add glue/acetone mixture to the planchets and continue to slowly evaporate samples until dry.	Possible radioactivity or chemical exposure	Wear safety glasses, a laboratory coat, and gloves. Do not touch heated hotplate under any circumstances. Permit planchets and hotplates to cool before handling. Treat all samples as radioactive.
STEP 4.3.5 Take to counting room to be counted by low background proportional counter.	Possible radioactivity exposure and possibility of drop samples creating a contaminated area	Wear safety glasses, a laboratory coat, and gloves.
STEP 4.3.6 Weigh planchet and record weight.	Possible radioactivity exposure	Wear safety glasses, a laboratory coat and gloves. Treat all samples as radioactive.

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TRITIUM**

Procedure AP2 (Revision 16)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 5.3.2 Measure sample(s) into round bottomed distillation flask(s).	Possible radioactive exposure	Wear safety glasses, laboratory coat, and gloves. Treat all samples as radioactive.
STEP 5.3.3 Add deionized water to samples. Add 10% Foam Blast 432 to samples. Add NaOH to samples.	Possible radioactive exposure Possible chemical exposure	Wear safety glasses, laboratory coat, and acid resistant gloves. Treat all samples as radioactive.
STEP 5.3.4a Distillation (glassware) apparatus setup.	Possible broken glassware	Wear safety glasses, laboratory coat, and gloves. Use proper clamps and ring stands to secure glassware.
STEP 5.3.4b Hookup cold water tubing to condensers.	Slip hazard or accidents due to water spraying all over if cold water tubes are not connected correctly	Wear safety glasses, laboratory coat, and gloves. Preheat tubing in hot water and secure tubing to cold water connections. Make sure all tubing is secure, and use caution when turning on cold water. Tubing will contract upon cooling.
STEP 5.3.4c Connection of rheostats to heating mantels.	Electrical shock	Wear safety glasses, laboratory coat, and gloves. Check for frayed wiring. Check for water leaks before plugging into outlets. Make sure bench area is clear of standing water.
STEP 5.3.4d Turn on rheostats. Check glass joint connections after distillation has started.	Possible radioactive exposure	Wear safety glasses, laboratory coat, and heat resistant gloves. Maintain visual inspection of all ground glass joints. Make sure bench area is clear of standing water.
STEP 5.3.5 Collect distillate in centrifuge tube.	Possible radioactive exposure Possible heat exposure Possible spilling of sample	Wear safety glasses, a laboratory coat, and heat resistant gloves. Place beaker underneath centrifuge tube to prevent spilling.
STEP 5.3.6 Continue distillation and collect the next 30 mL in a centrifuge tube. Do not go to dryness.	Possible radioactive exposure Possible heat exposure Possible spilling of sample	Samples must not be allowed to “bump” too violently or go to dryness. Maintain close watch on these samples once the distillation process starts.

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TRITIUM**

Procedure AP2 (Revision 16)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 5.3.7 Add scintillation cocktail to vial and shake to thoroughly mix. Prepare tritium efficiency standard.	Possible radioactive exposure Possible chemical exposure Possible spilling of sample	Wear safety glasses, a laboratory coat, and gloves. Treat all samples as radioactive.
STEP 5.3.8 Allow samples to dark adapt and then count samples in a liquid scintillation counter.	Possible radioactive exposure Possible spilling of sample	Wear safety glasses, a laboratory coat, and gloves. Treat all samples as radioactive.
STEP 5.5.1 Place smears in glass scintillation vials with 10 mL H ₂ O. Add 10 mL of scintillation cocktail.	Possible radioactive exposure Possible chemical exposure Possible spilling of sample	Wear safety glasses, a laboratory coat, and gloves. Treat all samples as radioactive.
STEP 5.5.3 Submit samples to counting room.	Possible radioactive exposure Possible spilling of sample	Wear safety glasses, a laboratory coat, and gloves. Treat all samples as radioactive.
STEP 5.5.4 Add a known amount of H-3 standard to each sample.	Possible radioactive exposure Possible spilling of sample	Wear safety glasses, a laboratory coat, and gloves. Treat all samples as radioactive.

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DETERMINATION OF TOTAL RADIOSTRONTIUM

Procedure AP4 (Revision 14)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 2.0 Reagent preparation.	Possible chemical hazard and exposure	Wear safety glasses with side shields, laboratory coat, and acid resistant gloves. Perform work in fume hood as required.
STEP 4.2.1 Measure Samples.	Possible chemical hazard Possible radioactivity hazard Possible biological hazard	Wear safety glasses, a laboratory coat, and acid resistant gloves. Keep biological samples refrigerated. Treat all samples as radioactive.
STEP 4.2.2 Add a known amount of Sr/Y carrier.	Possible radioactive hazard Possible chemical hazard	Wear safety glasses, a laboratory coat, and acid resistant gloves. Treat all samples as radioactive.
STEP 4.2.3 Transfer sample to the laboratory hood.	Possible radioactive hazard Possible dropping hazard	Wear safety glasses, a laboratory coat and gloves. Maintain good laboratory practices in the work area so not to lose footing. Use caution.
STEP 4.2.4 Add KHF_2 to the sample while in the laboratory hood.	Possible chemical hazard (KHF_2) Possible radioactive hazard	Wear safety glasses, laboratory coat, and acid resistant gloves. Make sure glass shield is below sash height.
STEP 4.2.5 Place platinum dish on ring stand using a nichrome triangle.	Possible dropping hazard Possible radioactive hazard	Be careful with dish so as not to spill. Wear safety glasses, laboratory coat, and acid resistant gloves. Treat all samples as radioactive.
STEP 4.2.6 Heat sample with blast burner until dry.	Possible radioactive hazard Possible chemical hazard Possible heat hazard Possible splatter hazard Possible fume hazard	Wear safety glasses, laboratory coat, and acid resistant gloves. In the hood, use a heat resistant glass shield. Use heat resistant gloves. Use long handle tongs to move the sample dish. Position the hood sash for maximum protection behind the shield. Continue all work in the hood.
STEP 4.2.7 When dry, adjust blast burner sufficiently to reach 900° F. Swirl hot melt.	Possible heat hazard Possible fume hazard Possible chemical hazard Possible radioactive hazard	Wear safety glasses, a laboratory coat, acid resistant gloves, and heat resistant gloves. Use long handle tongs, glass shield, and a heat absorbent pad for the platinum dish to sit on. Be careful not to heat too fast, to avoid splattering.

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Procedure AP4 (Revision 14)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 4.2.8 Remove the melt from burner and swirl gently to form a thin layer. Wait 45 seconds before proceeding to step 4.2.9.	Fume hazard Possible dropping hazard Possible radioactive hazard	Use safety glasses, laboratory coat, acid resistant gloves, heat resistant gloves, long handle tongs and glass shield. Use caution when swirling the sample to prevent spilling. Wait the designated time for the cake to cool.
STEP 4.2.9 Add sulfuric acid to platinum dish. Heat until fluoride cake is totally dissolved.	Definite fume hazard (SiF ₄) Possible heat hazard Possible splatter hazard	Work in hood. Use a heat resistant glass shield. Sash must be at proper height. Wear safety glasses, and a laboratory coat. Use long handled tongs and heat resistant gloves.
STEP 4.2.10 Heat rapidly until fluoride cake is totally dissolved.	Definite fume hazard (SiF ₄) Possible heat hazard	Work in hood. Use a heat resistant glass shield. Sash must be at proper height. Wear safety glasses, and a laboratory coat. Use long handled tongs and heat resistant gloves.
STEP 4.2.11 Remove from blast burner and cool. Add Na ₂ SO ₄ to slurry. Heat slowly.	Possible heat hazard (burn) Possible chemical hazard Possible radioactive hazard	Keep glass shield in place. Use heat absorbent pad. Wear safety glasses, laboratory coat and acid and heat resistant gloves. Use long handle tongs.
STEP 4.2.12 Remove from heat and swirl while cooling.	Possible heat hazard (burn) Possible spilling hazard Possible radioactive hazard	Use long handle tongs. Use heat absorbent pad. Wear safety glasses, laboratory coat and acid resistant gloves.
STEP 4.2.13 Transfer hardened pyrosulfate cake to sample container.	Possible dropping hazard Possible radioactive hazard	Wear safety glasses, a laboratory coat and acid resistant gloves.
STEP 4.2.14 Add 350 mL of water, 10 g Na ₂ SO ₄ and 7 mL HCl to beaker. Boil water. Add sample. Boil for 10 minutes.	Possible heat/steam hazard Possible chemical hazard Possible radioactive hazard	Wear safety glasses, a laboratory coat and acid resistant gloves. Work in a hood. Use long handled tongs.
STEP 4.2.15 Add H ₂ O ₂ and Pb (NO ₃) ₂ . Boil. Repeat lead addition two more times.	Possible heat/steam hazard Possible chemical hazard Possible radioactivity hazard	Wear safety glasses, laboratory coat and acid resistant gloves.
STEP 4.2.16 Remove from heat, cool and add another portion of Pb (NO ₃) ₂ and allow to settle overnight.	Possible heat hazard Possible chemical hazard Possible radioactivity hazard	Wear safety glasses, laboratory coat and acid resistant gloves.

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Procedure AP4 (Revision 14)

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JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 4.2.17 Siphon liquid and discard. Transfer to a centrifuge tube. Add K_2SO_4 . Centrifuge. Decant liquid and discard the supernate in HCl waste container.	Possible chemical hazard Possible pressure buildup (tube) Possible radioactivity hazard Possible mechanical hazard	Use a bench top absorbent mat. Wear safety glasses, laboratory coat and acid resistant gloves. Load and unload the centrifuge safely and correctly. (Do not manually stop the centrifuge).
STEP 4.2.18 Add water and metacresol purple. Stir. Add NaOH while stirring. Add EDTA, stir. Heat in hot water bath.	Possible heat/steam hazard Possible chemical hazard Possible pressure buildup (tube) Possible radioactivity hazard Possible mechanical hazard	Wear safety glasses, laboratory coat and acid resistant gloves. Heat slowly to keep water from boiling too hard. Turn cap of tube carefully to release any pressure that has built up during the heating process.
STEP 4.2.19 Na_2SO_4 , and glacial acetic acid to the endpoint. Heat in hot water bath. Centrifuge. Decant and discard into lead waste container.	Possible chemical hazard Possible heat/steam hazard Possible radioactive hazard Possible mechanical hazard	Wear safety glasses, laboratory coat and acid resistant gloves. Load and unload the centrifuge safely and correctly. (Do not manually stop the centrifuge).
STEP 4.2.20 Add 5 mL of 6 M acetic acid. Heat in water bath. Centrifuge. Decant and discard supernate.	Possible pressure buildup (tube) Possible heat/steam hazard Possible chemical hazard Possible radioactivity hazard Possible mechanical hazard	Wear safety glasses, laboratory coat and acid resistant gloves. Load and unload the centrifuge safely and correctly. (Do not manually stop the centrifuge). Turn cap of tube carefully to release any pressure that has built up during the heating process.
STEP 4.2.21 Loosen precipitate. Add Na_2CO_3 . Heat. Centrifuge. Decant and discard liquid into the strontium reagent, waste container.	Possible pressure buildup (tube) Possible heat/steam hazard Possible chemical hazard Possible radioactivity hazard Possible mechanical hazard	Wear safety glasses, laboratory coat and acid resistant gloves. Load and unload the centrifuge safely and correctly. (Do not manually stop the centrifuge). Turn cap of tube carefully to release any pressure that has built up during the heating process.
STEP 4.2.22 Add 2 mL of 6 M HCl to the strontium carbonate. Add 5 mL of 0.2 M DPTA, 1 drop of phenolphthalein, and 10 M NaOH drop-wise to red endpoint.	Possible chemical hazard Possible radioactivity hazard	Heat slowly. Wear safety glasses, a laboratory coat, and acid resistant gloves.

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Procedure AP4 (Revision 14)

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JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 4.2.23 Add 1 mL of 0.9% BaCl ₂ and 5 mL of 1 M sodium chromate. Heat for 2 minutes.	Possible pressure buildup (tube) Possible chemical hazard Possible radioactivity hazard Possible heat/steam hazard	Heat slowly. Wear safety glasses, a laboratory coat, and acid resistant gloves. Turn cap of tube carefully to release any pressure that has built up during the heating process.
STEP 4.2.24 Add 1 drop of phenolphthalein and glacial acetic acid drop-wise to yellow endpoint of the chromate ion.	Possible chemical hazard Possible radioactivity hazard	Heat slowly. Wear safety glasses, a laboratory coat, and acid resistant gloves.
STEP 4.2.25 Add 6 M acetic acid and heat for 10 minutes.	Possible pressure buildup (tube) Possible chemical hazard Possible radioactivity hazard Possible heat/steam hazard Possible mechanical hazard	Heat slowly. Wear safety glasses, a laboratory coat, and acid resistant gloves. Load and unload the centrifuge safely and correctly. (Do not manually stop the centrifuge). Turn cap of tube carefully to release any pressure that has built up during the heating process.
STEP 4.2.26 Place a DM-450 filter on planchet and dry under heat lamp. Cool and record weight.	Possible heat hazard	Wear safety glasses, laboratory coat and acid resistant gloves.
STEP 4.2.27 Add Na ₂ SO ₄ and glacial acetic acid. Heat. Centrifuge and decant and discard liquid.	Possible pressure buildup (tube) Possible radioactivity hazard Possible mechanical hazard Possible chemical hazard	Wear safety glasses, laboratory coat and acid resistant gloves. Load and unload the centrifuge safely and correctly. (Do not manually stop the centrifuge.) Turn cap of tube carefully to release any pressure that has built up during the heating process.
STEP 4.2.28 Loosen precipitate. Add Na ₂ CO ₃ . Heat and stir for 10 minutes. Cool.	Possible chemical hazard Possible radioactivity hazard Possible heat/steam hazard Possible mechanical hazard	Wear safety glasses, laboratory coat and acid resistant gloves
STEP 4.2.29 Filter SrCO ₃ on 0.45 μm filter. Wash filter with reagent water and ethanol.	Possible radiation hazard Possible chemical hazard	Work in hoods. Wear safety glasses, a laboratory coat and acid resistant gloves.
STEP 4.2.30 Dry filter under heat lamp. Weigh planchet. Count sample on low background proportional counter	Possible radiation hazard Possible heat hazard	Use forceps to handle samples. Treat all samples as radioactive.

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DETERMINATION OF TOTAL RADIOSTRONTIUM

Procedure AP4 (Revision 14)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 4.2.31 Discard the liquid filtrate in the strontium reagent waste container.	Possible radiation hazard	Treat all samples as radioactive. Wear safety glasses, a laboratory coat and gloves.
Step 5.2.1 To 9-12 centrifuge tubes, add 1 mL of the Y ³⁺ carrier.	Possible chemical hazard Possible spill hazard	Wear safety glasses, laboratory coat and acid resistant gloves.
Step 5.2.2 Add 5 mL reagent water and 5 mL 5% (NH ₄) ₂ C ₂ O ₄ ·H ₂ O to each tube.	Possible chemical hazard Possible spill hazard	Wear safety glasses, laboratory coat and acid resistant gloves.
Step 5.2.3 Heat in a hot water bath for 10 minutes.	Possible pressure buildup (tube) Possible spill hazard Possible chemical hazard	Wear safety glasses, laboratory coat and acid resistant gloves.
Step 5.2.5 Vortex solution. Filter through DM-450 filter.	Possible pressure buildup (tube) Possible spill hazard Possible chemical hazard	Wear safety glasses, laboratory coat and acid resistant gloves. Turn cap of tube carefully to release any pressure that has built up during the heating process.
Step 5.2.7 Weigh the Y ₂ (C ₂ O ₄) ₃ ·9H ₂ O.	Possible spill hazard Possible chemical hazard	Wear safety glasses, laboratory coat and acid resistant gloves.
Efficiency Calibration Only Step 5.3.9 Add 16.4 <u>M</u> NaOH. Heat for 10 minutes. Centrifuge and discard liquid.	Possible pressure buildup (tube) Possible radioactivity hazard Possible mechanical hazard Possible chemical hazard	Wear safety glasses, laboratory coat and acid resistant gloves. Load and unload the centrifuge safely and correctly. (Do not manually stop the centrifuge). Turn cap of tube carefully to release any pressure that has built up during the heating process.
Step 5.3.10 Add 2 mL of 6 <u>M</u> HNO ₃ .	Possible radioactivity hazard Possible chemical hazard Possible heat/steam hazard	Wear safety glasses, laboratory coat and acid resistant gloves.
Step 5.3.11 Add 3 mL 10 <u>M</u> NaOH. Heat for 5 minutes. Centrifuge for 5 minutes and discard supernate into the sanitary sewer using copious amounts of water.	Possible radioactivity hazard Possible chemical hazard Possible heat/steam hazard	Wear safety glasses, laboratory coat and acid resistant gloves.

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DETERMINATION OF TOTAL RADIOSTRONTIUM**

Procedure AP4 (Revision 14)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
Step 5.3.12 Add 1 mL 6 <u>M</u> HNO ₃ .	Possible radioactivity hazard Possible chemical hazard	Wear safety glasses, laboratory coat and acid resistant gloves.
Step 5.3.13 Add 5 mL 5% (NH ₄) ₂ C ₂ O ₄ ·H ₂ O. Heat for 5 minutes.	Possible radioactivity hazard Possible chemical hazard Possible heat/steam hazard	Wear safety glasses, laboratory coat and acid resistant gloves.

JOB HAZARD ANALYSIS

SCAR-40008
ESSAP LABS
TECHNETIUM-99

Procedure AP5 (Revision 17)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 2.0 Reagent preparation.	Possible chemical hazard and exposure	Wear safety glasses with side shields, laboratory coat, and acid resistant gloves. Perform work in fume hood as required. Calcium glutamate available for HF exposure. Apply freely to exposed area for 10 to 15 minutes. Seek medical help.
STEP 4.2 FOR WATER SAMPLES: Measure sample into the appropriate container and adjust pH into beaker and go to step 4.3.8.	Possible radiological hazard Possible spilling hazard Possible chemical hazard	Wear safety glasses, a laboratory coat, and chemical resistant gloves. Treat all samples as radioactive.
	STEPS 4.3.1 through 4.3.7 are for Soil, Sediment and Smear samples.	
STEP 4.3.1 Weigh samples into beakers.	Possible radiological hazard Possible spilling hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat. Treat all samples as radioactive.
STEP 4.3.2 Leach samples with dilute nitric acid.	Possible radiological hazard Possible chemical hazard Possible heat exposure	Wear safety glasses, chemical resistant gloves, and laboratory coat.
STEP 4.3.3 Heat beaker on hot plate.	Possible radiological hazard Possible heat exposure	Wear safety glasses, chemical resistant gloves, a laboratory coat and heat resistant gloves.
STEP 4.3.5 Transfer solution into a centrifuge tube and centrifuge at 2000 rpm.	Possible radiological hazard Possible mechanical hazard	Wear safety glasses, gloves, and a laboratory coat. Do not open centrifuge until it has completely stopped.
STEP 4.3.7 Add 1 M HNO ₃ . Vortex and centrifuge. Decant.	Possible radiological hazard Possible chemical hazard Possible mechanical hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat. Do not open centrifuge until it has completely stopped.
STEP 4.3.8 Add 30% H ₂ O ₂ . Heat at 80°C.	Possible radiological hazard Possible chemical hazard Possible heat exposure	Wear safety glasses, a laboratory coat, and gloves. Treat all samples as radioactive.
STEP 4.3.10 Filter sample through DM-450 filter paper.	Possible radiological hazard Possible mechanical hazard	Wear safety glasses, a laboratory coat, and gloves. Treat all samples as radioactive.

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TECHNETIUM-99

Procedure AP5 (Revision 15)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 4.3. 11 Add dilute NH ₄ OH.	Possible radiological hazard Possible chemical hazard	Wear safety glasses, laboratory coat, and gloves. Conduct work in fume hood.
STEP 4.4.2 Prepare TEVA resin extraction chromatography columns by draining them and then running 0.01 M HNO ₃ through them.	Possible radiological hazard Possible chemical hazard	Wear safety glasses, laboratory coat, and acid resistant gloves. Treat all samples as radioactive.
STEP 4.5.1 Pour sample from 4.3. 9 or 4.3.11 through columns.	Possible radiological hazard Possible spilling hazard	Wear safety glasses, a laboratory coat and gloves. Treat all samples as radioactive.
STEP 4.5.3 Pour 0.02 M HNO ₃ – 0.05 M HF through the columns.	Possible radiological hazard Possible chemical hazard	Wear safety glasses, laboratory coat, and acid resistant gloves. Treat all samples as radioactive.
STEP 4.5.4 Pour 0.01 M HNO ₃ through each column.	Possible radiological hazard Possible chemical hazard	Wear safety glasses, laboratory coat, and acid resistant gloves. Treat all samples as radioactive
STEP 4.5.5 Cut column and place resin in scintillation vials.	Possible radiological hazard Exposure to sharp objects	Wear safety glasses, laboratory coat, and gloves. Treat all samples as radioactive. Use extreme care when cutting the plastic columns.
STEP 4.5.6 Add cocktail and submit for counting.	Possible radiological hazard Possible chemical hazard	Wear safety glasses, laboratory coat, and gloves. Treat all samples as radioactive.
STEP 5.1 Cut column and place resin in scintillation vials.	Possible radiological hazard Exposure to sharp objects	Wear safety glasses, laboratory coat, and acid resistant gloves. Treat all samples as radioactive. Use extreme care when cutting the plastic columns.
STEP 5.2 Add cocktail and shake well. and allow resin to settle for one hour before submitting for counting.	Possible radiological hazard Possible chemical hazard	Wear safety glasses, laboratory coat, and gloves. Treat all samples as radioactive.
STEP 5.3 Add Tc-99 standard directly to the resin, shake well. and allow resin to settle for one hour before submitting for counting.	Possible radiological hazard Possible chemical hazard	Wear safety glasses, laboratory coat, and gloves. Treat all samples as radioactive.

JOB HAZARD ANALYSIS

SCAR-40003
IEAV LABS
TRITIUM AND CARBON 14 USING
BIOLOGICAL MATERIALS OXIDIZER

Procedure AP6 (Revision 17)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 4.2.5 – 4.2.6 Use of nitrogen and oxygen with the instrument.	Pressurized release of gases Flammable gas	Ensure all connections are properly attached with absolutely no leaks. Follow operating manual and posted instructions on required gas regulator pressures and instrument gas flow rates.
STEP 4.3.2 – 4.3.3 Use of scintillation cocktails with the instrument.	Possible chemical hazard	Wear safety glasses with side shields, chemical resistant gloves, and laboratory coat. Conduct work in Hood.
STEP 4.4.5.2 Use of radioactive standards.	Possible chemical and radiological hazard	Wear safety glasses with side shields, chemical resistant gloves, and laboratory coat.
STEP 4.4.5.3 Handling of samples.	Possible chemical and radiological hazard	Wear safety glasses with side shields, laboratory coat, and gloves.
STEP 4.4.6 Handling of combustion ladles and boats.	Possible heat exposure and burn	Wear safety glasses with side shields, laboratory coat, and gloves. Use the ladle handle when removing from combustion chamber and placing on cool-down holder. Place ladles and boats on cool-down holder in a position that prevents accidental touching. Do not touch ladles and/or boats until each has cooled down.

JOB HAZARD ANALYSIS

SCAR-40022
ESSAP LABS
RADIUM-226

AP7 (Revision 17)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 2.0 Reagent preparation.	Possible chemical hazard and exposure	Wear safety glasses with side shields, laboratory coat, and acid resistant gloves. Perform work in fume hood as required. Calcium glutamate available for HF exposure. Apply freely to exposed area for 10 to 15 minutes. Seek medical help.
STEP 4.2.1 Measure water samples into beakers and add Ba-133 tracer to all samples.	Possible radiological hazard Possible spill hazard	Wear safety glasses, a laboratory coat, and chemical resistant gloves. Treat all samples as radioactive.
STEP 4.2.3 Add 1 mL HCl, 3 mL 9 M H ₂ SO ₄ , 5 g K ₂ SO ₄ , and 2 g Na ₂ SO ₄ .	Possible radiological hazard Possible spill hazard Possible burn hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat.
STEP 4.2.5 Add three 1 mL portions of Pb(ClO ₄) ₂ .	Possible chemical hazard Possible spill hazard Possible burn hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat.
STEP 4.2.7 Transfer solution to a centrifuge tube.	Possible radiological hazard Possible chemical hazard Possible spill hazard	Wear safety glasses, chemical resistant gloves, and a laboratory coat. Conduct work in a fume hood.
STEP 4.2.8 Centrifuge and decant supernate into the dilute acid waste container.	Possible radiological hazard Possible chemical hazard Possible spill hazard Possible mechanical hazard	Wear safety glasses, chemical resistant gloves, and a laboratory coat. Do not open centrifuge while in operation.
STEP 4.2.9 Add 10 mL of potassium wash and vortex. Centrifuge and decant supernate into the dilute acid waste container.	Possible radiological hazard Possible chemical hazard Possible spill hazard Possible mechanical hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat. Do not open centrifuge while in operation.
STEP 4.2.10 Loosen pellet, using vortex mixer. Add 3 mL 0.1 M DTPA. Place in hot water bath to dissolve precipitate.	Possible radiological hazard Possible chemical hazard Possible spill hazard Possible heat exposure	Wear safety glasses, chemical resistant gloves, and laboratory coat. Conduct work in a fume hood.

JOB HAZARD ANALYSIS

SCAR-40022
ESSAP LABS
RADIUM-226

AP7 (Revision 17)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 4.2.12 Add 3 mL 40% Na ₂ SO ₄ .	Possible radiological hazard Possible chemical hazard Possible spill hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat.
STEP 4.2.13 Add 3 drops 50% acetic acid. Swirl to mix.	Possible radiological hazard Possible chemical hazard Possible spill hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat.
STEP 4.3.1 Weigh 0.1 to 0.25 g dried soil into a platinum crucible.	Possible radiological hazard Possible spill hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat.
STEP 4.3.2 Add the Ba-133 tracer.	Possible radiological hazard Possible spill hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat.
STEP 4.3.3 Add 3 to 5 g KHF ₂ to the crucible.	Possible radiological hazard Possible chemical hazard Possible spill hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat.
STEP 4.3.5 Start heating the sample over a blast burner with low flame.	Possible radiological hazard Possible chemical hazard Possible burn hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat. Perform work in fume hood.
STEP 4.3.6 Perform fluoride fusion.	Possible radiological hazard Possible chemical hazard Possible burn hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat. Perform work in fume hood.
STEP 4.3.7 Remove the melt from the burner and swirl gently around the dish to form a thin layer upon cooling. Wait 45 seconds before adding the sulfuric acid.	Possible radiological hazard Possible chemical hazard Possible spill hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat. Perform work in fume hood. Wait the designated time for the cake to cool.
STEP 4.3.8 Add 3 to 5 mL 18 M H ₂ SO ₄ to dissolve the fluoride cake.	Possible radiological hazard Definite chemical hazard Possible splatter hazard	Wear safety glasses, laboratory coat, and acid resistant gloves. Perform work in fume hood.
STEP 4.3.9 Heat as much as frothing will allow until the fluoride cake is totally dissolved.	Possible radiological hazard Definite chemical hazard Possible spill hazard Possible burn hazard	Wear safety glasses, laboratory coat, and acid resistant gloves. Perform work in fume hood.
STEP 4.3.10 Remove from heat and add ~2 g anhydrous Na ₂ SO ₄ to the slurry. Perform pyrosulfate fusion.	Possible radiological hazard Definite chemical hazard Possible spill hazard	Wear safety glasses, laboratory coat, and acid resistant gloves. Perform work in fume hood.

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SCAR-40022
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RADIUM-226

AP7 (Revision 17)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 4.3.11 Remove the melt from the burner and swirl gently around the dish to form a thin layer upon cooling.	Possible radiological hazard Possible spill hazard	Wear safety glasses, laboratory coat, and acid resistant gloves. Perform work in fume hood.
STEP 4.3.12 Transfer pyrosulfate cake to a 150 mL beaker.	Possible radiological hazard Possible spill hazard	Wear safety glasses, laboratory coat, and acid resistant gloves.
STEP 4.3.13 Add 35 mL water and 1 mL 12 M HCl to the crucible. Heat if necessary. Transfer the solution to the 150 mL beaker.	Possible radiological hazard Possible chemical hazard Possible spill hazard	Wear safety glasses, laboratory coat, and acid resistant gloves. Perform work in fume hood.
STEP 4.3.15 Add stir bar and heat to boiling. Add 2 g of K ₂ SO ₄ , and 2 g of Na ₂ SO ₄ . Evaporate the solution to 35 or 40 mL.	Possible radiological hazard Possible chemical hazard Possible spill hazard Possible burn hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat. Perform work in fume hood.
STEP 4.3.16 Add three 1 mL portions of Pb(ClO ₄) ₂ , while stirring. Wait 5 minutes between each addition.	Possible radiological hazard Possible chemical hazard Possible burn hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat. Perform work in fume hood.
STEP 4.3.17 Transfer to a 50 mL centrifuge tube using the potassium wash.	Possible radiological hazard Possible spill hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat.
STEP 4.3.18 Centrifuge at 2000 RPM for 5 minutes. Decant and discard supernate into the dilute acid waste container.	Possible radiological hazard Possible chemical hazard Possible spill hazard Possible mechanical hazard	Wear safety glasses, laboratory coat, and acid resistant gloves. Do not open centrifuge while in operation.
STEP 4.3.19 Add 10 mL of potassium wash. Vortex to wash the precipitate. Centrifuge at 2000 RPM for 5 minutes. Discard supernate.	Possible radiological hazard Possible chemical hazard Possible spill hazard Possible mechanical hazard	Wear safety glasses, laboratory coat, and acid resistant gloves. Do not open centrifuge while in operation.
STEP 4.3.20 Add 3 mL 0.1 M DTPA solution to dissolve precipitate. Heat in hot water bath if necessary.	Possible radiological hazard Possible chemical hazard Possible spill hazard	Wear safety glasses, laboratory coat, and acid resistant gloves. Perform work in fume hood.

JOB HAZARD ANALYSIS

**SCAR-40023
ESSAP LABS
RADIUM-228**

AP8 (Revision 3)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 2.0 Reagent preparation.	Possible chemical hazard and exposure	Wear safety glasses with side shields, laboratory coat, and acid resistant gloves. Perform work in fume hood as required. Calcium glutamate available for HF exposure.
STEP 4.2.1 Measure sample into beaker.	Possible radiological hazard Possible spill hazard	Wear safety glasses, a laboratory coat, and chemical resistant gloves.
STEP 4.2.2 Add Ba-133 tracer to all samples.	Possible radiological hazard Possible spill hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat.
STEP 4.2.3 Add Ra-228 to batch standard.	Possible chemical hazard Possible spill hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat.
STEP 4.2.4 While stirring, carefully add 10 mL of 18 M H_2SO_4	Possible spill hazard Possible chemical hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat.
STEP 4.2.5 Add 1 mL of Ba carrier to each sample.	Possible radiological hazard Possible chemical hazard Possible spill hazard	Wear safety glasses, chemical resistant gloves, and a laboratory coat. Conduct work in a fume hood.
STEP 4.2.6 Filter the precipitate through a DM-450 filter.	Possible radiological hazard Possible chemical hazard Possible spill hazard	Wear safety glasses, chemical resistant gloves, and a laboratory coat. Conduct work in a fume hood.
STEP 4.2.8 – 4.2.9 Add 10 mL of water and vortex to remove the precipitate from the filter paper.	Possible radiological hazard Possible spill hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat.
STEP 4.2.11 Add 20 mL of 50% K_2CO_3 . Vortex. Heat for 30 minutes in boiling water to metastasize the precipitate to $BaCO_3$.	Possible radiological hazard Possible chemical hazard Possible spill hazard Possible heat exposure	Wear safety glasses, chemical resistant gloves, and laboratory coat. Conduct work in a fume hood.
STEP 4.2.12 Centrifuge the samples at 2000 RPM for five minutes.	Possible radiological hazard Possible chemical hazard Possible spill hazard Possible mechanical hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat. Do not open centrifuge until it comes to a complete stop.

JOB HAZARD ANALYSIS

**SCAR-40023
ESSAP LABS
RADIUM-228**

Non-Routine AP8 (Revision 3)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 4.2.13 Rinse the precipitate with water and centrifuge at 2000 RPM.	Possible radiological hazard Possible chemical hazard Possible spill hazard Possible mechanical hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat. Do not open centrifuge until it comes to a complete stop.
STEP 4.2.16 Condition columns using 10 mL of 0.095 M HNO ₃ .	Possible chemical hazard Possible spill hazard	Wear safety glasses, laboratory coat, and acid resistant gloves.
STEP 4.2.17 Dissolve precipitate from step 4.13 with 5 mL 0.095 M HNO ₃ .	Possible radiological hazard Possible chemical hazard Possible spill hazard	Wear safety glasses, laboratory coat, and acid resistant gloves.
STEP 4.2.19 Pour the load solution for each sample onto a column and collect.	Possible radiological hazard Possible chemical hazard Possible spill hazard	Wear safety glasses, laboratory coat, and acid resistant gloves.
STEP 4.2.20 Rinse each centrifuge tube with 5 mL of 0.095 M HNO ₃ and add to each column. Collect in the same centrifuge tube as step 4.19.	Possible radiological hazard Possible chemical hazard Possible spill hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat.
STEP 4.2.21 Rinse each column 3 times with 5 mL of 0.095 M HNO ₃ and collect in the same centrifuge tube as step 4.19.	Possible radiological hazard Possible chemical hazard Possible spill hazard Possible mechanical hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat. Do not open centrifuge until it comes to a complete stop.
STEP 4.2.24 Elute the Ac-228 from each column with 10 mL of 0.35 M HNO ₃ .	Possible radiological hazard Possible chemical hazard Possible spill hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat.
STEP 4.2.25 Add Ce carrier and 2 mL of 28 M HF to each sample, mix, and wait 10 minutes.	Possible radiological hazard Definite chemical hazard Possible spill hazard	Wear safety glasses, laboratory coat, and acid resistant gloves.
STEP 4.2.27 Filter each sample onto a 0.1 µm filter paper.	Possible radiological hazard Definite chemical hazard Possible spill hazard	Wear safety glasses, laboratory coat, and acid resistant gloves.

JOB HAZARD ANALYSIS
SCAR-40024
ESSAP LABS
CARBON-14 DISTILLATION

AP9 (Revision 4)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 3.0 Reagent preparation.	Possible chemical hazard and exposure	Wear safety glasses with side shields, laboratory coat, and acid resistant gloves. Perform work in fume hood as required.
STEP 5.2.1 Distillation glassware apparatus setup.	Possible broken glassware	Wear safety glasses, laboratory coat, and gloves. Use proper clamps and ring stands to secure glassware.
STEP 5.2.2-5.2.3 Adding trapping cocktail to scintillation vial and purge the system.	Possible chemical exposure	Wear safety glasses, laboratory coat, and protective gloves.
STEP 5.2.4 Measure sample(s) into round bottomed distillation flask.	Possible radioactive exposure Possible electrical shock	Wear safety glasses, laboratory coat, and gloves. Ensure area is dry and electrical connections are in good order.
STEP 5.2.5 Addition of reagents to initiate release of CO ₂ and begin heating.	Possible chemical exposure Possible burn from hot plate	Wear safety glasses, laboratory coat, and gloves. Make sure bench area is clear of standing water.
STEP 5.2.6 Remove trapping cocktail from system.	Possible radioactive exposure Possible chemical exposure	Wear safety glasses, laboratory coat, and gloves. Make sure bench area is clear of standing water.
STEP 5.2.7 Take samples to counting room.	Possible radioactive exposure Possible breakage of sample	Wear safety glasses, a laboratory coat, and gloves. Place samples in proper carrying container.
STEP 5.3.1 Add scintillation cocktail to the smear samples.	Possible radioactive exposure Possible chemical exposure	Wear safety glasses, a laboratory coat, and gloves. Place samples in proper carrying container.
STEP 5.3.2 Prepare counting efficiency standard in trapping scintillation cocktail.	Possible radioactive exposure Possible chemical exposure	Wear safety glasses, a laboratory coat, and gloves.
STEP 5.3.1 Prepare counting efficiency standard for smear samples.	Possible radioactive exposure Possible chemical exposure	Wear safety glasses, a laboratory coat, and gloves.

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ESSAP LABS**SEQUENTIAL DETERMINATION OF THE ACTINIDES IN ENVIRONMENTAL
SAMPLES USING TOTAL SAMPLE DISSOLUTION AND EXTRACTION
CHROMATOGRAPHY**

Procedure AP11 (Revision 4)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 2.0 Reagent preparation.	Possible chemical hazard and exposure	Wear safety glasses with side shields, laboratory coat, and acid resistant gloves. Perform work in fume hood as required. Calcium glutamate available for HF exposure. Apply freely to exposed area for 10 to 15 minutes. Seek medical help.
STEP 4.2.1 Measure aqueous samples.	Possible radiological hazard Possible biological hazard Possible chemical exposure	Wear safety glasses with side shields, laboratory coat, and acid resistant gloves. Treat all samples as radioactive.
STEP 4.2.2 Add a know amount of radioactive tracer.	Possible radiological hazard	Wear safety glasses with side shields, laboratory coat, and acid resistant gloves. Treat all samples as radioactive.
STEP 4.2.3 Add fusion solution.	Possible chemical hazard and exposure	Wear safety glasses with side shields, laboratory coat, and acid resistant gloves. Perform work in fume hood as required.
STEP 4.3.1 Measure solid and unfiltered samples.	Possible radiological hazard Possible biological hazard Possible chemical Exposure	Wear safety glasses with side shields, laboratory coat, and acid resistant gloves. Treat all samples as radioactive. Keep biological samples refrigerated.
STEP 4.3.2 Add a known amount of radioactive tracer.	Possible radiological hazard	Wear safety glasses with side shields, laboratory coat, and acid resistant gloves. Treat all samples as radioactive.
STEP 4.4.1 Add 12 to 15 g KHF_2 to the sample.	Exposure to KHF_2	Wear safety glasses with side shields, laboratory coat, and acid resistant gloves. Perform work in hood.
STEP 4.4.2 Place platinum dish on ring stand using a nichrome triangle.	Possible dropping hazard Possible radioactive hazard	Good Laboratory. Be careful with dish so as not to spill. Wear safety glasses, laboratory coat, and acid resistant gloves. Treat all samples as radioactive.

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JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 4.4.3 Heat sample with blast burner until dry.	Possible chemical hazard Possible heat exposure Possible splatter hazard Possible fume hazard	In the hood, use a heat resistant glass shield. Use heat resistant gloves. Use long handle tongs to move the sample dish. Position the hood sash for maximum protection behind the shield. Continue all work in the hood.
STEP 4.4.4 When dry, adjust blast burner to reach 900°C (Dish turns cherry red). When total dissolution occurs, remove from heat and cool.	Possible fume hazard Possible spill hazard Possible radioactive hazard Possible heat and burn exposure Possible chemical hazard	Use safety glasses, laboratory coat, acid resistant gloves, heat resistant gloves, long handle tongs and glass shield. Use caution when swirling the sample to prevent spilling.
STEP 4.4.5 Remove the melt from burner and swirl gently to form a thin layer. Wait 45 seconds before adding the sulfuric acid.	Possible fume hazard Possible splatter hazard Possible radioactive hazard	Use safety glasses, laboratory coat, acid resistant gloves, heat resistant gloves, long handle tongs and glass shield. Use caution when swirling the sample to prevent spilling. Waiting the designated time for the cake to cool.
STEP 4.4.6 Add ~8 mL sulfuric acid to the platinum dish. Repeat step.	Definite fume hazard (SiF ₄) Possible splatter hazard	Work in hood. Sash must be positioned at correct level. Long handle tongs and heat resistant gloves.
STEP 4.4.7 Heat until fluoride cake is totally dissolved.	Definite fume hazard (SiF ₄) Possible heat and burn exposure	Work in hood. Use a heat resistant glass shield. Glass shield must be below sash height. Wear safety glasses, and a laboratory coat. Use long handled tongs and heat resistant gloves.
STEP 4.4.8 Remove from blast burner and cool. Add ~3 g Na ₂ SO ₄ to slurry. Heat slowly.	Possible heat and burn exposure Possible chemical hazard Possible radioactive hazard	Keep glass shield in place. Use heat absorbent pad. Wear safety glasses, laboratory coat and acid and heat resistant gloves. Use long handle tongs.
STEP 4.4.9 Remove platinum dish from blast burner and cool.	Possible heat and burn exposure	Use long handle tongs. Keep glass shield in place. Use heat absorbent pad. Wear safety glasses with side shields, laboratory coat and acid resistant gloves.

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Procedure AP11 (Revision 4)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 4.4.10 Transfer hardened pyrosulfate cake to sample container.	Possible dropping hazard Possible radioactive hazard	Be careful. Wear safety glasses, a laboratory coat and acid resistant gloves.
STEP 4.5.1 Boil 350 mL water and 25 mL 12 <u>M</u> HCl.	Possible chemical hazard Possible heat exposure	Tongs suitable for holding an 800 mL beaker, wear safety glasses with side shields, laboratory coat and acid resistant gloves. Perform work in hood.
STEP 4.5.2 - 4.5.5 Add 5 g Na ₂ SO ₄ to solution. Add 10 g K ₂ SO ₄ to solution. Add 3 g K ₂ S ₂ O ₅ to solution. Add 15 mL of 0.45% BaCl ₂ .	Possible fume hazard (steam and acid) Possible heat exposure	Work in the hood, use large tongs, and wear safety glasses with side shields, laboratory coat and acid resistant gloves.
STEP 4.5.6 Filtering hot solution through a Teflon filter into the flask.	Possible fume hazard (steam and acid) Possible heat exposure	Work in the hood, use large tongs, and wear safety glasses with side shields, laboratory coat and acid resistant gloves.
STEP 4.5.10 - 4.5.12 Add Safranin-O, TiCl ₃ and 12 mL of 0.45% BaCl ₂ .	Possible fume hazard (steam and acid) Possible heat exposure	Work in the hood, use large tongs, and wear safety glasses with side shields, laboratory coat and acid resistant gloves.
STEP 4.5.13 Filtering hot solution through a Teflon filter into the flask.	Possible fume hazard (steam and acid) Possible heat exposure	Work in the hood, use large tongs, and wear safety glasses with side shields, laboratory coat and acid resistant gloves.
STEP 4.5.14 Add 20 mL 0.05 <u>M</u> KEDTA and 2-5 drops 10 <u>M</u> KOH and heat.	Possible chemical burn Pressure build-up Possible radiological hazard	Wear safety glasses with side shields, laboratory coat, acid resistant gloves and heat resistant gloves.
STEP 4.5.15 Add 4 drops TiCl ₃ and 2 mL 10 <u>M</u> KOH, heat, and centrifuge.	Possible chemical burn Pressure build-up Possible radiological hazard Possible mechanical hazard	Wear safety glasses with side shields, laboratory coat, acid resistant gloves and heat resistant gloves. Load and unload the centrifuge safely and correctly. (Do not manually stop the centrifuge.)
STEP 4.5.16 Add 10 mL 3 <u>M</u> HCl and heat.	Possible chemical burn Pressure build-up Possible radiological hazard	Wear safety glasses with side shields, laboratory coat, acid resistant gloves and heat resistant gloves.

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JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 4.5.17 Filter and collect sample in a centrifuge tube. Discard filter.	Possible chemical burn Possible radiological hazard	Wear safety glasses with side shields, laboratory coat, acid resistant gloves and heat resistant gloves.
STEP 4.6.1 Boil 350 mL water and 25 mL 12 M HCl.	Possible chemical hazard Possible heat exposure	Tongs suitable for holding an 800 mL beaker, wear safety glasses with side shields, laboratory coat and acid resistant gloves.
STEP 4.6.2 - 4.6.5 Add 5 g Na ₂ SO ₄ to solution. Add 10 g K ₂ SO ₄ to solution. Add 3 g K ₂ S ₂ O ₅ to solution.	Possible fume hazard (steam and acid) Possible heat exposure	Work in the hood, use large tongs, wear safety glasses with side shields, laboratory coat and acid resistant gloves.
STEP 4.6.6 - 4.6.8 Add Safranin-O, TiCl ₃ , and 21 mL of 0.45% BaCl ₂ .	Possible fume hazard (steam and acid) Possible heat exposure	Work in the hood, use large tongs, and wear safety glasses with side shields, laboratory coat and acid resistant gloves.
STEP 4.6.9 Filtering hot solution through a Teflon filter into the flask.	Possible fume hazard (steam and acid) Possible heat exposure	Work in the hood, use large tongs, and wear safety glasses with side shields, laboratory coat and acid resistant gloves.
STEP 4.6.10 Add 20 mL 0.05 M KEDTA and 2-5 drops 10 M KOH and heat.	Possible chemical burn Pressure build-up Possible radiological hazard	Wear safety glasses with side shields, laboratory coat, acid resistant gloves and heat resistant gloves.
STEP 4.6.11 Add 4 drops TiCl ₃ and 2 mL 10 M KOH, heat, and centrifuge.	Possible chemical burn Pressure build-up Possible radiological hazard Possible mechanical hazard	Wear safety glasses with side shields, laboratory coat, acid resistant gloves and heat resistant gloves. Load and unload the centrifuge safely and correctly. (Do not manually stop the centrifuge.)
STEP 4.6.12 Add 13 mL load solution and heat.	Possible chemical burn Possible radiological hazard	Wear safety glasses with side shields, laboratory coat, acid resistant gloves and heat resistant gloves.
STEP 4.6.14 Filter and collect sample in a centrifuge tube. Discard filter.	Possible chemical burn Possible radiological hazard	Wear safety glasses with side shields, laboratory coat, acid resistant gloves and heat resistant gloves.

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Procedure AP11 (Revision 4)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 4.7.1.6 Add 5 mL 3 <u>M</u> HNO ₃ to cartridges.	Possible chemical burn Possible radiological hazard	Wear safety glasses with side shields, laboratory coat, acid resistant gloves and heat resistant gloves.
STEP 4.7.2 Add 0.5 mL 1.5 <u>M</u> sulfamic acid and mix.	Possible chemical burn Possible radiological hazard	Wear safety glasses with side shields, laboratory coat, acid resistant gloves and heat resistant gloves.
STEP 4.7.3 Add 1.5 mL 1.5 <u>M</u> ascorbic acid and mix.	Possible chemical burn Possible radiological hazard	Wear safety glasses with side shields, laboratory coat, acid resistant gloves and heat resistant gloves.
STEP 4.7.4 Add 2 mL 4 <u>M</u> NaNO ₂ and mix.	Possible chemical burn Possible radiological hazard	Wear safety glasses with side shields, laboratory coat, acid resistant gloves and heat resistant gloves. Perform work in hood.
STEP 4.7.6 Add 5 mL 3 <u>M</u> HNO ₃ to cartridges.	Possible chemical burn Possible radiological hazard	Wear safety glasses with side shields, laboratory coat, acid resistant gloves and heat resistant gloves.
STEP 4.7.7 Add three 5 mL portions 3 <u>M</u> HNO ₃ to cartridges.	Possible chemical burn Possible radiological hazard	Wear safety glasses with side shields, laboratory coat, acid resistant gloves and heat resistant gloves.
STEP 4.7.12 Add 3 mL 9 <u>M</u> HCl to TEVA cartridge.	Possible chemical burn Possible radiological hazard	Wear safety glasses with side shields, laboratory coat, acid resistant gloves and heat resistant gloves.
STEP 4.7.13 Add 15 mL 4 <u>M</u> HCl to TRU cartridge.	Possible chemical burn Possible radiological hazard	Wear safety glasses with side shields, laboratory coat, acid resistant gloves and heat resistant gloves.
STEP 4.7.14 Add 30 mL 8 <u>M</u> HCl to TEVA cartridge.	Possible chemical burn Possible radiological hazard	Wear safety glasses with side shields, laboratory coat, acid resistant gloves and heat resistant gloves.
STEP 4.7.17 Add 20 mL 4 <u>M</u> HCl/0.1 <u>M</u> HF to TRU cartridge.	Possible chemical burn Possible radiological hazard	Wear safety glasses with side shields, laboratory coat, acid resistant gloves and heat resistant gloves.

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Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 4.7.18 Add 30 mL 0.1 <u>M</u> HCl - 0.05 <u>M</u> HF - 0.02 <u>M</u> TiCl ₃ to TEVA cartridge.	Possible chemical burn Possible radiological hazard	Wear safety glasses with side shields, laboratory coat, acid resistant gloves and heat resistant gloves.
STEP 4.7.19 If analyzing for Np, rinse the TRU column with 10 mL of 1 <u>M</u> HCL/0.05 <u>M</u> H ₂ C ₂ O ₄ to remove any Np that may have been retained on the column.	Possible chemical burn Possible radiological hazard	Wear safety glasses with side shields, laboratory coat, acid resistant gloves and heat resistant gloves.
STEP 4.7.20 Add 20 mL 0.1 <u>M</u> NH ₄ HC ₂ O ₄ · 1/2H ₂ O to TRU cartridge.	Possible chemical burn Possible radiological hazard	Wear safety glasses with side shields, laboratory coat, acid resistant gloves and heat resistant gloves.
STEP 4.8.1 Add 10 mL 16 <u>M</u> HNO ₃ , 3 mL 11.7 <u>M</u> HClO ₄ , and 2 mL fusion solution. Heat to dryness.	Possible chemical burn Possible radiological hazard	Wear safety glasses with side shields, laboratory coat, acid resistant gloves and heat resistant gloves. Perform work in Perchloric acid hood.
STEP 4.8.2 Add 10 mL 0.5 <u>M</u> HCl.	Possible chemical burn Possible radiological hazard	Wear safety glasses with side shields, laboratory coat, acid resistant gloves and heat resistant gloves.
STEP 4.9.1 Add 5 mL DTPA to each column.	Possible chemical hazard Possible radiological hazard	Wear safety glasses with side shields, laboratory coat and acid resistant gloves.
STEP 4.9.2 Add 2 mL Ce, 1 drop H ₂ O ₂ , and NH ₄ OH.	Possible chemical hazard Possible radiological hazard	Wear safety glasses with side shields, laboratory coat and acid resistant gloves.
STEP 4.9.4 Add HNO ₃ and heat.	Possible HNO ₃ exposure. Pressure buildup in the tube Possible radiological hazard	Work in hood. Use long handled tongs. Wear safety glasses with side shields, laboratory coat and acid resistant gloves.
STEP 4.9.5 Add 1 <u>M</u> hydroxylamine hydrochloride and 10 mL DTPA.	Possible chemical exposure Possible radiological hazard	Wear safety glasses with side shields, laboratory coat and acid resistant gloves.
STEP 4.9.7 Add 5 mL DTPA.	Possible chemical exposure Possible radiological hazard	Wear safety glasses with side shields, laboratory coat and acid resistant gloves.

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Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 4.9.8 Add 15 mL DTPA.	Possible chemical exposure Possible radiological hazard	Wear safety glasses with side shields, laboratory coat and acid resistant gloves.
STEPS 4.10.1-4.10.2 1 drop 0.1% Safranin-O, 4 drops TiCl ₃ , Cerium carrier and 2 mL 48% HF.	Definite chemical hazard Possible radiological hazard	Wear safety glasses with side shields, laboratory coat, acid resistant gloves and heat resistant gloves. Pay special attention to detail and pour only what is needed. Use extreme caution with HF - only dispense what is needed. Ensure all HF containers are plastic.
STEP 4.10.5 Deposit sample onto filter.	Possible chemical hazard Possible radiological hazard	Wear safety glasses with side shields, laboratory coat and acid resistant gloves. Special instructions are to be very careful using HF.
STEP 4.10.9 Dry samples under heat lamp.	Possible burn hazard Possible radiological hazard	Wear safety glasses with side shields, laboratory coat and acid resistant gloves.
STEPS 4.11.1 - 4.11.4 Add Ce, HF and deposit sample on to filter.	Definite chemical hazard Possible fume hazard Possible radiological hazard	Wear safety glasses with side shields, laboratory coat, acid resistant gloves and heat resistant gloves. Pay special attention to detail and pour only the amount needed. Use extreme caution with HF. Ensure all HF containers are plastic.
STEP 4.11.8 Dry samples under heat lamp.	Possible burn hazard Possible radiological hazard	Wear safety glasses with side shields, laboratory coat and acid resistant gloves.

JOB HAZARD ANALYSIS

SCAR-40027
ESSAP LABS
NICKEL-63

API2 (Revision 6)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 2.0 Reagent preparation.	Possible chemical hazard and exposure	Wear safety glasses with side shields, laboratory coat, and acid resistant gloves. Perform work in fume hood as required.
STEP 4.2.1 Filter and measure sample into beaker. Add Ni carrier. Add Ni-63 to standard and batch yield.	Possible radiological hazard Possible spill hazard	Wear safety glasses, a laboratory coat, and chemical resistant gloves. Treat all samples as radioactive.
STEP 4.2.2 Add 12 <u>M</u> HCl and evaporate to dryness.	Possible radiological hazard Possible chemical hazard Possible heat exposure	Wear safety glasses, chemical resistant gloves, and laboratory coat.
STEP 4.3.1 Dissolve residue in 20 mL 10 <u>M</u> HCl.	Possible radiological hazard Possible chemical hazard Possible spill hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat. Treat all samples as radioactive.
STEP 4.3.3 Pour 50 mL 10 <u>M</u> HCl into each column. Allow the solution to drain by gravity into the waste beakers.	Possible radiological hazard Possible chemical hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat.
STEP 4.3.5 Rinse the columns with 100 mL 10 <u>M</u> HCl.	Possible radiological hazard Possible chemical hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat.
STEP 4.3.6 Place the beakers on a hot plate and gently bring each solution down to 1-2 mL.	Possible radiological hazard Possible spill hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat. Treat all samples as radioactive.
STEP 4.4.1 Weigh samples into beakers. Add Ni-63 to the standard and batch yield sample.	Possible radiological hazard Possible spill hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat. Treat all samples as radioactive.
STEP 4.4.2 Add Ni carrier to each sample.	Possible radiological hazard Possible chemical hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat.
STEP 4.4.3 Leach samples with nitric and hydrochloric acids.	Possible radiological hazard Possible chemical hazard Possible heat exposure	Wear safety glasses, chemical resistant gloves, and laboratory coat.
STEP 4.4.4 Heat beaker on hot plate. Add HNO ₃ and HCl.	Possible radiological hazard Possible heat exposure Possible chemical hazard	Wear safety glasses, chemical resistant gloves, a laboratory coat and heat resistant gloves. Be very careful when adding HCl as it tends to have a vigorous reaction.

JOB HAZARD ANALYSIS

SCAR-40027
ESSAP LABS
NICKEL-63

API2 (Revision 6)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 4.4.6 Filter samples through a Supor-450 filter membrane.	Possible radiological hazard Possible spill hazard	Wear safety glasses, gloves, and a laboratory coat. Handle samples carefully.
STEP 4.4.8 Add 8 <u>M</u> HCl.	Possible radiological hazard Possible chemical hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat.
STEPS 4.5.1-4.5.3 Prepare anion exchange column.	Possible radiological hazard Possible chemical hazard	Wear safety glasses, a laboratory coat, and gloves.
STEP 4.5.7 Evaporate sample to dryness.	Possible radiological hazard Possible chemical hazard Possible heat exposure	Wear safety glasses, a laboratory coat, and gloves. Treat all samples as radioactive. Conduct work in fume hood.
STEP 4.5.8 Dissolve residue in 10 mL of 1 <u>M</u> HCl.	Possible radiological hazard Possible chemical hazard	Wear safety glasses, a laboratory coat, and gloves. Treat all samples as radioactive. Conduct work in fume hood.
STEP 4.6.1 Add 1 mL of 1 <u>M</u> ammonium citrate and adjust to pH 8-9 with concentrated NH ₄ OH.	Possible radiological hazard Possible chemical hazard	Wear safety glasses, laboratory coat, and gloves. Conduct work in fume hood.
STEP 4.6.5 Prepare Ni resin extraction chromatography columns by draining them and adding 5 mL of 0.2 <u>M</u> ammonium citrate pH 8-9 through them.	Possible radiological hazard Possible chemical hazard	Wear safety glasses, laboratory coat, and acid resistant gloves. Treat all samples as radioactive.
STEP 4.6.6 Pour sample from 4.3.3 through columns.	Possible radiological hazard Possible spill hazard	Wear safety glasses, a laboratory coat and gloves. Treat all samples as radioactive.
STEP 4.6.7 Rinse the column with 5 mL of 0.2 <u>M</u> ammonium citrate pH 8-9.	Possible radiological hazard Possible chemical hazard	Wear safety glasses, laboratory coat, and acid resistant gloves. Treat all samples as radioactive.
STEP 4.6.8 Rinse the column with 50 mL of 0.2 <u>M</u> ammonium citrate pH 8-9.	Possible radiological hazard Exposure to sharp objects	Wear safety glasses, laboratory coat, and gloves. Treat all samples as radioactive. Use extreme care when cutting the plastic columns with the knife.
STEP 4.6.10 Strip Ni with a minimum amount of 3 <u>M</u> HNO ₃ .	Possible radiological hazard Possible chemical hazard	Wear safety glasses, laboratory coat, and gloves. Treat all samples as radioactive.

JOB HAZARD ANALYSIS

SCAR-40027
ESSAP LABS
NICKEL-63

AP12 (Revision 6)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 4.6.11 Pour the solution into a 50 mL beaker.	Possible radiological hazard Possible chemical hazard Possible spill hazard	Wear safety glasses, a laboratory coat, and gloves. Treat all samples as radioactive.
STEP 4.6.12 Heat to near dryness.	Possible radiological hazard Possible heat hazard	Wear safety glasses, a laboratory coat, and gloves. Treat all samples as radioactive. Conduct work in fume hood.
STEPS 4.6.13 – 4.6.14 Evaporate to 1 mL and transfer to scintillation vial.	Possible radiological hazard Possible chemical hazard Possible spill hazard	Wear safety glasses, laboratory coat, and gloves. Conduct work in fume hood.
STEP 4.6.15 Rinse beaker in small increments with water. Total volume not to exceed 3 mL.	Possible radiological hazard Possible chemical hazard Possible spill hazard	Wear safety glasses, laboratory coat, and acid resistant gloves. Treat all samples as radioactive.
STEP 4.6.16 Add 17 mL of scintillation cocktail and shake well.	Possible radiological hazard Possible chemical hazard Possible spill hazard	Wear safety glasses, a laboratory coat and gloves. Treat all samples as radioactive.
STEP 5.1.1 Add Ni carrier.	Possible chemical hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat.
STEP 5.1.2 Add scintillation cocktail.	Possible chemical hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat.
STEP 5.2.1 Add Ni carrier.	Possible chemical hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat.
STEP 5.2.2 Add Ni-63.	Possible chemical hazard Possible radiological hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat.
STEP 5.2.4 Add scintillation cocktail.	Possible chemical hazard Possible radiological hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat.

JOB HAZARD ANALYSIS		
SCAR-40028 ESSAP LABS IRON-55		
Procedure AP13 (Revision 5)		Given: Good Laboratory Practices
JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 2.0 Reagent preparation.	Possible chemical hazard and exposure	Wear safety glasses with side shields, laboratory coat, and acid resistant gloves. Perform work in fume hood as required.
STEP 4.2.1 Filter and measure sample into beaker. Add Fe carrier and Fe-55 to the standard and batch yield sample.	Possible radiological hazard Possible spill hazard Possible chemical hazard	Wear safety glasses, a laboratory coat, and chemical resistant gloves. Treat all samples as radioactive.
STEP 4.2.2 Add 20 mL of concentrated HNO ₃ and evaporate to near dryness.	Possible radiological hazard Possible chemical hazard Possible spill hazard Possible heat exposure	Wear safety glasses, chemical resistant gloves, and laboratory coat. Treat all samples as radioactive. Conduct work in fume hood.
STEP 4.2.5 Condition cartridge with 5 mL of 8 M HNO ₃ .	Possible chemical hazard Possible spill hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat. Treat all samples as radioactive.
STEP 4.2.6 Add 20 mL of 8 M HNO ₃ to each sample.	Possible radiological hazard Possible chemical hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat.
STEP 4.2.7 Load sample from step 4.2.7 onto cartridge.	Possible radiological hazard Possible chemical hazard Possible spill hazard	Wear safety glasses, chemical resistant gloves, and a laboratory coat.
STEP 4.2.8 Rinse sample beaker with 5 mL of 8 M HNO ₃ and add to cartridge.	Possible radiological hazard Possible chemical hazard Possible spill hazard	Wear safety glasses, chemical resistant gloves, and a laboratory coat.
STEP 4.2.9 Rinse cartridge with 10 mL of 8 M HNO ₃ and drain to waste.	Possible radiological hazard Possible chemical hazard Possible spill hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat.
STEP 4.2.11 Strip the Fe with 15 mL of 2 M HNO ₃ .	Possible radiological hazard Possible chemical hazard Possible spill hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat. Treat all samples as radioactive.
STEP 4.2.12 Add 10 mL of concentrated NH ₄ OH to precipitate the iron as iron hydroxide and digest in a hot water bath for 15 minutes.	Possible radiological hazard Possible chemical hazard Possible heat hazard	Wear safety glasses, chemical resistant gloves, and laboratory coat. Treat all samples as radioactive. Conduct work in fume hood.
STEP 4.2.13 Centrifuge the sample(s) at 2000 rpm for 10 minutes and then decant the supernate.	Possible radiological hazard Possible mechanical hazard Possible spill hazard	Be careful loading and unloading the centrifuge. Wear safety glasses, chemical resistant gloves, and laboratory coat. Treat all samples as radioactive.

JOB HAZARD ANALYSIS

**SCAR-40028
ESSAP LABS
IRON-55**

Procedure AP13 (Revision 5)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 4.2.14 Add 3 mL of 0.5 M HCl to dissolve the precipitate and heat in a water bath for 10 minutes.	Possible radiological hazard Possible heat exposure Possible chemical hazard	Wear safety glasses, laboratory coat, and acid resistant gloves. Treat all samples as radioactive. Conduct work in fume hood.
STEP 4.2.15 Add 17 mL of scintillation cocktail and mix with vigorous shaking.	Possible radiological hazard Possible chemical hazard Possible spill hazard	Wear safety glasses, laboratory coat, and acid resistant gloves. Treat all samples as radioactive.

JOB HAZARD ANALYSIS

SCAR- 40025
ESSAP LABS
SULFUR-35

Non-Routine AP14 (Revision 7)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 2.0 All chemicals are hazardous. See MSDS for specific precautions.	Possible chemical exposure	Read MSDS associated with each chemical used in this procedure. Any questions concerning chemical hazard(s) should be discussed with lab manager or designee. Wear safety glasses, laboratory coat, and acid resistant gloves.
STEP 4.2.1 Weigh approximately 2-3 g sample and transfer to a 250 mL Erlenmeyer flask. Add 1 drop 18 M H ₂ SO ₄ .	Possible radiological hazard Possible chemical exposure	Wear safety glasses, laboratory coat, and acid resistant gloves.
STEP 4.2.2 Add 20 mL 16 M HNO ₃ and 20 mL 11.7 M HClO ₄ to each Erlenmeyer flask. Place flask on medium temperature hot plate. Continue slow boil ~45 minutes.	Possible radiological hazard Possible chemical exposure Possible burn hazard	Wear safety glasses, laboratory coat, and acid resistant gloves.
STEP 4.2.3 Swirl sample periodically, as it is heated. Carefully add 1 mL H ₂ O ₂ dropwise to each sample. Repeat H ₂ O ₂ additions until brown fumes of nitrogen oxides no longer evolve.	Possible radiological hazard Possible chemical exposure Possible burn hazard Possible fume hazard	Wear safety glasses, laboratory coat, and acid resistant gloves. Perform work in fume hood.
STEP 4.2.4 Heat sample an additional 15 minutes to eliminate all HNO ₃ . Remove Erlenmeyer from hot plate and allow solution to cool.	Possible radiological hazard Possible chemical exposure Possible spill hazard	Wear safety glasses, laboratory coat, and acid resistant gloves.
STEP 4.2.5 Transfer sample to 50 mL centrifuge tube. Cool the solution in cold water bath. Centrifuge 2000 RPM for 5 minutes. Decant supernate into a 50 mL centrifuge tube. Discard precipitate. Put the supernate into a centrifuge tube.	Possible radiological hazard Possible chemical exposure Possible spill hazard Possible mechanical hazard	Wear safety glasses, laboratory coat, and acid resistant gloves. Operate centrifuge safely.
STEP 4.2.6 Place open centrifuge tube into slow boiling water bath. Boil solution, using low heat.	Possible radiological hazard Possible chemical exposure Possible burn hazard	Wear safety glasses, laboratory coat, and acid resistant gloves.

JOB HAZARD ANALYSIS

SCAR- 40025
ESSAP LABS
SULFUR-35

Non-Routine AP14 (Revision 7)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 4.2.7 Add 10 mL 20% (w/v) BaCl ₂ and continue boiling solution for 5 minutes.	Possible radiological hazard Possible chemical exposure Possible burn hazard	Wear safety glasses, laboratory coat, and acid resistant gloves.
STEP 4.2.8 Centrifuge 2000 RPM for 5 minutes. Decant supernate.	Possible radiological hazard Possible chemical exposure Possible spill hazard	Wear safety glasses, laboratory coat, and acid resistant gloves.
STEP 4.2.9 Transfer precipitate with reagent water to a counting vial and bring final volume to 7 mL.	Possible radiological hazard Possible chemical exposure Possible spill hazard	Wear safety glasses, laboratory coat, and acid resistant gloves.
STEP 4.2.10 Vortex to suspend the barium sulfate precipitate.	Possible radiological hazard Possible spill hazard Possible mechanical hazard	Wear safety glasses, laboratory coat, and acid resistant gloves. Operate vortex safely.
STEP 4.2.11 Add 13 mL Insta-Gel scintillation suspension to the vial. Shake vigorously to mix.	Possible radiological hazard Possible spill hazard	Wear safety glasses, laboratory coat, and acid resistant gloves.
STEP 4.2.12 Centrifuge at 500 RPM for 1 minute to remove air bubbles from the scintillation gel.	Possible radiological hazard Possible spill hazard Possible mechanical hazard	Wear safety glasses, laboratory coat, and acid resistant gloves. Operate centrifuge safely.

JOB HAZARD ANALYSIS
SCAR- 40030
ESSAP LABS
ANALYSIS FOR POLONIUM-210

AP15 Revision 1

Given: Good Housekeeping Practices

ACTIVITY	HAZARD	CONTROLS
<p>STEP 2.0</p> <p>All chemicals are hazardous. See MSDS for specific precautions.</p>	<p>Possible chemical exposure</p>	<p>Read MSDS associated with each chemical used in this procedure. Any questions concerning chemical hazard(s) should be discussed with lab manager or designee. Wear safety glasses, laboratory coat, and acid resistant gloves.</p>
<p>STEP 4.1.1</p> <p>To water samples add concentrated hydrochloric acid to achieve 0.5-1 M HCl.</p>	<p>Possible radiological hazard Possible chemical exposure</p>	<p>Wear safety glasses, laboratory coat, and acid resistant gloves.</p>
<p>STEP 4.1.2</p> <p>Add enough Po-209 tracer to obtain the desired counting statistics, typically 5-15 pCi.</p>	<p>Possible radiological hazard</p>	<p>Wear safety glasses, laboratory coat, and acid resistant gloves.</p>
<p>STEP 4.1.3</p> <p>Evaporate to a volume of 20 mL and transfer to a 250 mL beaker.</p>	<p>Possible radiological hazard Possible fume hazard Possible burn hazard</p>	<p>Wear safety glasses, laboratory coat, and acid resistant gloves. Perform evaporation in fume hood.</p>
<p>STEP 4.1.4</p> <p>Add enough 1M HCl to fill the beaker 3/4 full. Add 2 mL saturated ascorbic acid and 2 mL 50% hydroxylamine hydrochloride.</p>	<p>Possible radiological hazard Possible chemical exposure Possible spill hazard</p>	<p>Wear safety glasses, laboratory coat, and acid resistant gloves.</p>
<p>STEP 4.1.5</p> <p>Prepare the nickel disc as follows: polish the nickel disc by sanding it with a rotary sander. Paint the unpolished side of the disc with an acid resistant acrylic paint and let dry. Drill a small hole near the edge of the disc with a 1/16" drill bit.</p>	<p>Possible mechanical hazard Possible chemical exposure Possible spill hazard Possible mechanical hazard</p>	<p>Wear safety glasses, laboratory coat, and gloves</p>

JOB HAZARD ANALYSIS
SCAR- 40030
ESSAP LABS
ANALYSIS FOR POLONIUM-210

AP15 Revision 1

Given: Good Housekeeping Practices

ACTIVITY	HAZARD	CONTROLS
<p>STEP 4.1.7 Place the paper clip across the 250 mL beaker and heat to a temperature of 80°C and stir for 4 hours.</p>	<p>Possible radiological hazard Possible chemical exposure Possible burn hazard</p>	<p>Wear safety glasses, laboratory coat, and acid resistant gloves. Perform work in a fume hood.</p>
<p>STEP 4.1.9 Alpha count the disc.</p>	<p>Possible radiological hazard</p>	<p>Wear safety glasses and handle disc with forceps.</p>
<p>STEP 4.2.1 Weigh and transfer 0.5 to 1.0 g dried soil or biota, or an air filter, into a 250 mL beaker. For miscellaneous samples, use an appropriate sample quantity which may be the entire sample if the suspected activity is the result of surface contamination. Add enough Po-209 tracer to obtain the desired counting statistics, typically 5-15 pCi. Keep air filters as flat and close to bottom as possible.</p>	<p>Possible radiological hazard Possible chemical exposure Possible spill hazard</p>	<p>Wear safety glasses, laboratory coat, and acid resistant gloves.</p>
<p>STEP 4.2.2 Add 10 mL 16 M nitric acid. Gently heat on a hot plate and carefully add 35% hydrogen peroxide dropwise. Gently swirl solution. Continue adding nitric acid and peroxide until sample digestion is achieved, usually after 1-2 hours.</p>	<p>Possible radiological hazard Possible chemical exposure Possible spill hazard</p>	<p>Wear safety glasses, laboratory coat, and acid resistant gloves. Perform work in a fume hood.</p>
<p>STEP 4.2.3 Slowly evaporate the solution to a volume of 5 mL. Do not allow the sample to go to dryness.</p>	<p>Possible radiological hazard Possible spill hazard Possible burn hazard</p>	<p>Wear safety glasses, laboratory coat, and acid resistant gloves. Perform the work in a fume hood.</p>
<p>STEP 4.2.4 Transfer sample to centrifuge tube using 1 M HCl. Centrifuge at 2000 rpm for five minutes. Decant and pour supernate into a 250 mL beaker.</p>	<p>Possible radiological hazard Possible spill hazard Possible mechanical hazard</p>	<p>Wear safety glasses, laboratory coat, and acid resistant gloves. Operate the centrifuge carefully.</p>

JOB HAZARD ANALYSIS

SCAR-40031
ESSAP LABS

DETERMINATION OF IRON-55 IN SOIL AND OTHER SOLID MATRICES

Procedure AP16 (Revision 1)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 2.0 Reagent preparation.	Possible chemical hazard and exposure	Wear safety glasses with side shields, laboratory coat, and acid resistant gloves. Perform work in fume hood as required. Calcium glutamate available for HF exposure. Apply freely to exposed area for 10 to 15 minutes. Seek medical help.
STEP 4.2.1 Measure solid samples in a platinum dish.	Possible radiological hazard Possible biological hazard Possible chemical exposure	Wear safety glasses with side shields, and laboratory coat. Treat all samples as radioactive.
STEP 4.2.2 Add a known amount of Fe-55 radioactive tracer.	Possible radiological hazard	Wear safety glasses with side shields, laboratory coat, and acid resistant gloves. Treat all samples as radioactive.
STEP 4.3.1 Add 12 to 15 g KHF ₂ to the sample.	Possible chemical hazard and exposure	Wear safety glasses with side shields, laboratory coat, and acid resistant gloves. Perform work in fume hood as required.
STEP 4.3.2 Place platinum dish on ring stand using a nichrome triangle.	Possible dropping hazard Possible radioactive hazard	Be careful with dish so as not to spill. Wear safety glasses, laboratory coat, and acid resistant gloves. Treat all samples as radioactive.
STEP 4.3.3 Heat sample with blast burner until dry.	Possible chemical hazard Possible heat exposure Possible splatter hazard Possible fume hazard	In the hood, use a heat resistant glass shield. Use heat resistant gloves. Use long handle tongs to move the sample dish. Position the hood sash for maximum protection behind the shield. Continue all work in the hood.
STEP 4.3.4 When dry, adjust blast burner to reach 900°C (Dish turns cherry red). When total dissolution occurs, remove from heat and cool.	Possible fume hazard Possible spill hazard Possible radioactive hazard Possible heat and burn exposure Possible chemical hazard	Use safety glasses, laboratory coat, acid resistant gloves, heat resistant gloves, long handle tongs and glass shield. Use caution when swirling the sample to prevent spilling.
STEP 4.3.5 Remove the melt from burner and swirl gently to form a thin layer. Wait 45 seconds before adding the sulfuric acid.	Possible fume hazard Possible splatter hazard Possible radioactive hazard	Use safety glasses, laboratory coat, acid resistant gloves, heat resistant gloves, long handle tongs and glass shield. Use caution when swirling the sample to prevent spilling. Waiting the designated time for the cake to cool.

JOB HAZARD ANALYSIS

SCAR-40031
ESSAP LABS

DETERMINATION OF IRON-55 IN SOIL AND OTHER SOLID MATRICES

Procedure AP16 (Revision 1)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 4.3.6 Add ~8 mL sulfuric acid to the platinum dish. Repeat step.	Definite fume hazard (SiF ₄) Possible splatter hazard	Work in hood. Sash must be positioned at correct level. Long handle tongs and heat resistant gloves.
STEP 4.3.7 Heat until fluoride cake is totally dissolved.	Definite fume hazard (SiF ₄) Possible heat and burn exposure	Work in hood. Use a heat resistant glass shield. Glass shield must be below sash height. Wear safety glasses, and a laboratory coat. Use long handled tongs and heat resistant gloves.
STEP 4.3.8 Remove from blast burner and add ~3 g Na ₂ SO ₄ to slurry. Heat slowly.	Possible heat and burn exposure Possible chemical hazard Possible radioactive hazard	Keep glass shield in place. Use heat absorbent pad. Wear safety glasses, laboratory coat and acid and heat resistant gloves. Use long handle tongs.
STEP 4.3.9 Remove platinum dish from blast burner and cool.	Possible heat and burn exposure	Use long handle tongs. Keep glass shield in place. Use heat absorbent pad. Wear safety glasses with side shields, laboratory coat and acid resistant gloves.
STEP 4.3.10 Transfer hardened pyrosulfate cake to sample container.	Possible dropping hazard Possible radioactive hazard	Be careful. Wear safety glasses, a laboratory coat and acid resistant gloves.
STEP 4.4.1 To a clean 150 mL beaker, add 50 mL of water and 5 mL of concentrated HCl. Add a stir bar and heat to boiling on a hot plate.	Possible chemical hazard Possible heat exposure	Tongs suitable for holding a 150 mL beaker, wear safety glasses with side shields, laboratory coat and acid resistant gloves. Perform work in hood.
STEP 4.4.3 While stirring, add concentrated NH ₄ (OH) dropwise until Fe(OH) ₃ forms. Add an additional 5 mL of concentrated NH ₄ (OH) to ensure complete precipitation. Remove the stir bar and allow the precipitate to settle for about 30 minutes.	Possible heat and burn exposure Possible chemical exposure	Wear safety glasses with side shields, laboratory coat and acid resistant gloves. Perform work in hood.

JOB HAZARD ANALYSIS

SCAR-40031
ESSAP LABS

DETERMINATION OF IRON-55 IN SOIL AND OTHER SOLID MATRICES

Procedure AP16 (Revision 1)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 4.4.6 Add 10 mL of 10 <u>M</u> HCl and vortex to dissolve the precipitate.	Possible dropping hazard Possible chemical exposure	Be careful. Wear safety glasses, a laboratory coat and acid resistant gloves.
STEP 4.5.1 Make a slurry of the anion exchange resin using 10 <u>M</u> of HCl and allow to equilibrate for at least 30 minutes.	Possible chemical hazard	Wear safety glasses with side shields, laboratory coat and acid resistant gloves. Perform work in hood.
STEP 4.5.3 Pour 25 mL of 10 <u>M</u> HCl through the column and collect as waste.	Possible chemical exposure	Work in the hood, wear safety glasses with side shields, laboratory coat, and acid resistant gloves.
STEP 4.5.5 Rinse the centrifuge tube with 5 mL of 10 <u>M</u> HCl and pour through the column and collect as waste.	Possible chemical exposure	Work in the hood, wear safety glasses with side shields, laboratory coat, and acid resistant gloves.
STEP 4.5.6 Rinse the column with 3 additions of 15 mL of 10 <u>M</u> HCl and collect as waste. Allow each addition to drain before adding the subsequent additions	Possible chemical exposure	Work in the hood, wear safety glasses with side shields, laboratory coat, and acid resistant gloves.
STEP 4.5.7 Rinse the column with 3 additions of 15 mL of 6 <u>M</u> HCl and collect as waste. Allow each addition to drain before adding the subsequent additions.	Possible chemical exposure	Work in the hood, wear safety glasses with side shields, laboratory coat, and acid resistant gloves.
STEP 4.5.8 Rinse the column with 15 mL of 4 <u>M</u> HCl.	Possible chemical exposure	Work in the hood, wear safety glasses with side shields, laboratory coat, and acid resistant gloves.
STEP 4.6.2 Slowly add concentrated NH ₄ (OH) dropwise until Fe(OH) ₃ precipitates. Add 5 more mL of concentrated NH ₄ (OH) to ensure complete precipitation.	Possible chemical exposure	Work in the hood, wear safety glasses with side shields, laboratory coat, and acid resistant gloves.

JOB HAZARD ANALYSIS

SCAR-40031
ESSAP LABS

DETERMINATION OF IRON-55 IN SOIL AND OTHER SOLID MATRICES

Procedure AP16 (Revision 1)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 4.6.5 Dissolve the precipitate by adding 10 drops of concentrated HF and swirl the solution.	Possible chemical burn Possible radiological hazard	Work in the hood, wear safety glasses with side shields, laboratory coat, and acid resistant gloves.
STEP 4.6.7 Add 15 mL of Ultima Gold LLT scintillation cocktail and shake vigorously	Possible chemical hazard Possible breakage hazard	Wear safety glasses with side shields, laboratory coat and acid resistant gloves.
STEP 5.1.1 Add 2.0 mL of Fe carrier and 10 mL of water to a centrifuge tube.	Possible chemical exposure	Wear safety glasses with side shields, laboratory coat and acid resistant gloves.
STEP 5.1.2 Add concentrated $\text{NH}_4(\text{OH})$ dropwise to precipitate $\text{Fe}(\text{OH})_3$. Add 5 more drops to ensure complete precipitation.	Possible chemical burn Possible radiological hazard	Work in the hood, wear safety glasses with side shields, laboratory coat, and acid resistant gloves.
STEP 5.1.5 Dissolve the precipitate by adding 10 drops of concentrated HF and swirl the solution.	Possible fume hazard (steam and acid) Possible heat exposure	Work in the hood, use large tongs, and wear safety glasses with side shields, laboratory coat and acid resistant gloves.
STEP 5.1.7 Add 15 mL of Ultima Gold LLT scintillation cocktail and shake vigorously.	Possible chemical hazard Possible breakage hazard	Wear safety glasses with side shields, laboratory coat and acid resistant gloves.
STEP 5.2.1 Add 2.0 mL of Fe carrier and 10 mL of water to a centrifuge tube.	Possible chemical exposure	Wear safety glasses with side shields, laboratory coat and acid resistant gloves.
STEP 5.2.2 Add enough Fe-55 standard to the centrifuge tube to give the desired counting statistics.	Possible radiological hazard	Wear safety glasses with side shields, laboratory coat, and acid resistant gloves.

JOB HAZARD ANALYSIS

**SCAR-40031
ESSAP LABS**

DETERMINATION OF IRON-55 IN SOIL AND OTHER SOLID MATRICES

Procedure AP16 (Revision 1)

Given: Good Laboratory Practices

JOB STEP	JOB HAZARD	HAZARD CONTROL
STEP 5.2.3 Add concentrated NH ₄ (OH) dropwise to precipitate Fe(OH) ₃ . Add 5 more drops to ensure complete precipitation.	Possible chemical burn Possible radiological hazard	Work in the hood, wear safety glasses with side shields, laboratory coat, and acid resistant gloves.
STEP 5.2.6 Dissolve the precipitate by adding 10 drops of concentrated HF and swirl the solution.	Possible fume hazard (steam and acid) Possible heat exposure	Work in the hood, use large tongs, and wear safety glasses with side shields, laboratory coat and acid resistant gloves.
STEP 5.2.8 Add 15 mL of Ultima Gold LLT scintillation cocktail and shake vigorously.	Possible chemical hazard Possible breakage hazard	Wear safety glasses with side shields, laboratory coat and acid resistant gloves.

JOB HAZARD ANALYSIS

**SCAR-40009
ESSAP COUNT
ROOM OPERATIONS**

Procedures CP1-4 (Revision 12)

ACTIVITY	HAZARD	CONTROL
All activities, sample handling.	Possible radiological hazard	Follow <u>ALL</u> posted signs and labeling. Wear the appropriate dosimetry.
Operation of Low Background counter	Possible Extremity or digit injury.	Do not place hands on sample changer while in operation. Use sample changer cover.
Operation of Alpha Spec and Gamma systems.	Possible electrical shock Trip hazard. Possible Extremity or digit injury.	Insure Voltage supplies are turned off before dismantling. Route all cabling appropriately. Keep hands clear of Lead shields when closing.
Filling Dewar	Possible hazard from Liquid Nitrogen	Wear PPE provided and Follow filling directions.