

Draft Crow Butte Sampling Plan, March 15, 2011

Type and Location	Analytes	Instrumentation	Frequency/Duration	LLD(s)/DQOs	References/Notes
<b>Air Monitoring Stations</b> Perimeter (existing) - AM-1, AM-2, AM-3, AM-4, AM-5, AM-6 and AM-8  Plant to Perimeter (new) - AM-22 (injection spill), AM-23 (production spill), AM-24 (near plant), AM-25 (near plant) (see Figures 1 and 2)	Gamma	Landauer InLight OSL with aluminum oxide detector. 1mrem to 1 rem range, 1 meter above ground level.	Quarterly for one year	1 mrem	Also used for isotopic analysis
	Particulate- <sup>Nat</sup> U, <sup>226</sup> Ra, <sup>230</sup> Th, <sup>210</sup> Pb	Eberline RAS-1 (or equivalent) regulated air pump, Type A/E glass fiber filter paper, 30-40 l/min	Quarterly composites of weekly samples for one year	<sup>Nat</sup> U – 1x10 <sup>-16</sup> , <sup>226</sup> Ra – 1x10 <sup>-16</sup> , <sup>230</sup> Th – 1x10 <sup>-16</sup> , <sup>210</sup> Pb – 1x10 <sup>-15</sup> uCi/mL	
	Radon	Radtrak <sup>®</sup> Type DRNF	Semiannual for one year	2x10 <sup>-10</sup> uCi/mL	
<b>Well House (exterior)</b> WH-9, WH-17, WH-47, WH-50 (see Figures 1 and 2)	Gamma	Landauer InLight OSL with aluminum oxide detector. 1mrem to 1 rem range, 1 meter above ground level.	Quarterly for one year	1 mrem	
	Radon	RadTrak <sup>®</sup> Type DRNF	Semiannual for one year	2x10 <sup>-10</sup> uCi/mL	
<b>Well House Radon Daughters (interior)</b> WH-9, WH-17, WH-47, WH-50 (see Figures 1 and 2)	Radon Daughters	Lapel samplers, SKC Aircheck XR5000 Sampling Pump (or equivalent) with a flow of 5 to 5000 ml/minute	5-minute grab on monthly basis for one year	0.033 WL	Modified Kusnetz
	Radon	Radtrak <sup>®</sup> Type DRNF	Semiannual for one year	2x10 <sup>-10</sup> uCi/mL	
<b>Near Plant (exterior)</b> 1-TE, 2-TE, 3-TE, 4-TE, (radon and gamma) (see Figure 2)	Gamma	Landauer InLight OSL with aluminum oxide detector. 1mrem to 1 rem range, 1 meter above ground level.	Quarterly for one year	1 mrem	
	Radon	Radtrak <sup>®</sup> Type DRNF	Semiannual for one year	2x10 <sup>-10</sup> uCi/mL	
<b>In-Plant Isotopic Analysis</b> 1-IST, 2-IST, 3-IST, 4-IST, 5-IST, 6-IST (see Figure 3)	Particulate- <sup>Nat</sup> U, <sup>226</sup> Ra, <sup>230</sup> Th, <sup>210</sup> Pb	RADECO Model HD-29A or equivalent, glass fiber filter paper	Semiannual for one year	<sup>Nat</sup> U – 1x10 <sup>-16</sup> , <sup>226</sup> Ra – 1x10 <sup>-16</sup> , <sup>230</sup> Th – 1x10 <sup>-16</sup> , <sup>210</sup> Pb – 1x10 <sup>-15</sup> uCi/mL	
<b>In-Plant Radon Daughters</b> 1-R, 2-R, 3-R, 4-R, 5-R, 6-R, 7-R, 8-R, 9-R, 10-R, 11-R, 12-R, 13-RE, 13-RM, 13-RW (see Figure 3)	Radon Daughters	Lapel samplers, SKC Aircheck XR5000 Sampling Pump (or equivalent) with a flow of 5 to 5000 ml/minute	5-minute grab on monthly basis for one year	0.033 WL	Modified Kusnetz
<b>In-Plant Airborne Area Samples</b> 1-A, 2-A, 3-A, 4-A, 5-A, 6-A, 7-A, 8-A (see Figure 3)	Long-lived Gross α	Eberline RAS-1 (or equivalent) regulated air pump, Type A/E glass fiber filter paper, 30-40 l/min	Minimum of 90 minutes	4.8x10 <sup>-11</sup> uCi/mL - 10% of the Cameco process-specific DAC.	

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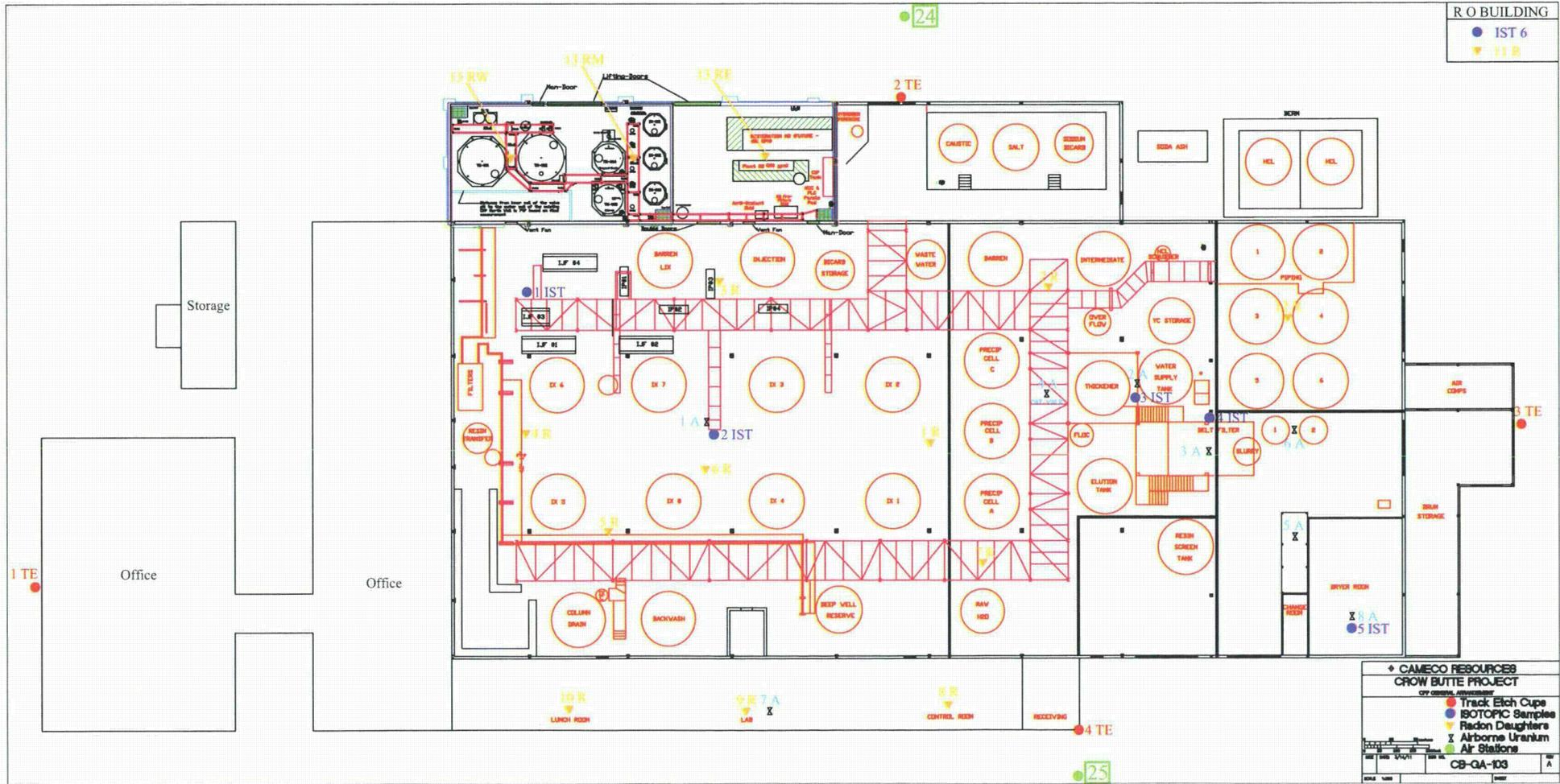
Type and Location	Analytes	Instrumentation	Frequency/Duration	LLD(s)/DQOs	References/Notes
<b><math>\alpha/\beta/\gamma</math> Campaign for Dose Evaluation</b> (Same locations as quarterly gamma surveys, see Attachment 1)	$\alpha$	Total surface activity Ludlum Model 2241 scaler or Model 177 Ratemeter with Model 43-65 or Model 43-5 or equivalent	Quarterly for six months	100 d/m-100 cm <sup>2</sup> (10% of the release limit)	
	$\beta\gamma$	Portable GM survey meter with $\beta/\gamma$ probe. Ludlum Model 3 Survey meter or equivalent, with Ludlum 44-38 probe, 44-9 probe or equivalent.	Quarterly for six months	500 d/m-100 cm <sup>2</sup> dpm/100 cm <sup>2</sup> (50% of the removable contamination limit)	
	Removable $\beta$ (swipes)	Ludlum Model 3030 alpha/beta counter	Where $\beta$ is present	200 d/m-100 cm <sup>2</sup>	
<b><math>\alpha/\beta/\gamma</math> Campaign for Personal Contamination</b>	Total alpha and total beta	Model 43-5 or 43-65 alpha detector with Model 177 ratemeter or equivalent, and model 44-9 beta detector with Model 3 ratemeter or equivalent.	2 week evaluation, >80% of all personal contamination surveys performed	100 d/m-100 cm <sup>2</sup> for alpha and 500 d/m-100 cm <sup>2</sup> for beta/gamma	
<b><math>\alpha/\beta/\gamma</math> Campaign for Contamination Control</b>	Total alpha and beta	Same as above	Free releases for next 20 trucks and next 20 pieces of equipment	Same as above	
	Removable alpha and beta	Model 3030 alpha/beta sample counter	Where $\alpha$ and/or $\beta$ contamination is detected in excess of the removable contamination limit based on survey meter measurements.		

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Objective	Purpose for Data	Buildup	Decision Rule
<b>Evaluate Dose to Public</b>			
Vendors	Validate that dose is <100mrem/year	Particulate- AM-24, AM-25 Radon- 1-TE, 2-TE, 3-TE, 4-TE, AM-24, AM-25 Gamma- 1-TE, 2-TE, 3-TE, 4-TE, AM-24, AM-25	If dose is validated at well less than 100mrem/year, no further action. If potential exists to exceed limit, evaluate alternative assumptions and estimation methods, and/or propose monitoring.
Vendors	Demonstrate dose constraint rule (<10 mrem/yr), 10 CFR 20.1101(d)	Same as above.	If dose is validated at well less than 10mrem/year, no further action. If potential exists to exceed limit, evaluate alternative assumptions and estimation methods, and/or propose monitoring
<b>Evaluate Occupational Dose</b>			
Office Workers	Demonstrate adequacy of existing program by validating <10% (10 CFR 20.1502(a)(1))	Recent data collection effort for pregnant office worker will be tabulated and provided, and supported by the data collected for unbadged Lab Workers (immediately below).	If dose is well less than 10% of the allowable, no further action. If potential exists to exceed 10% of the allowable, evaluate alternative assumptions and estimation methods, and/or propose monitoring
Lab Workers (unbadged)	Demonstrate adequacy of existing program by validating <10% (10 CFR 20.1502(a)(1))	Airborne uranium- 7-A Radon daughters- 9-R, 10-R) Gamma - data from badged lab worker	If dose is well less than 10% of the allowable, no further action. If potential exists to exceed 10% of the allowable, evaluate alternative assumptions and estimation methods, and/or propose monitoring
Well field Workers (badged)	Demonstrate that current program consistently overestimates dose	Particulate – AM-2, AM-5, AM-22, AM-23 Radon- AM-2, AM-5, AM-22, AM-23 Gamma – badges Radon daughters- WH-9, WH-17, WH-47, WH-50	If the current program consistently overestimates dose, no further action. If potential exists that current monitoring/estimates may underestimate dose, evaluate alternative assumptions and estimation methods, and/or propose monitoring
Well field Construction (badged)	Demonstrate that current program consistently overestimates dose	Particulate – AM-2, AM-5, AM-16, AM-17 Radon – AM-2, AM-5, AM-16, AM-17, WH-9, WH-17, WH-47, WH-50 Gamma - badges	If the current program consistently overestimates dose, no further action. If potential exists that current monitoring/estimates may underestimate dose, evaluate alternative assumptions and estimation methods, and/or propose monitoring
α/β/γ implications to all workers	Demonstrate that current program consistently overestimates dose	α/β/γ Campaign for Dose Evaluation	If the current program adequately assesses the contribution attributable to in-growth of β-emitting isotopes, no action. If potential exists that current monitoring/estimates may underestimate contribution attributable to in-growth of β-emitting isotopes, evaluate alternative assumptions and estimation methods, and/or propose monitoring

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Objective	Purpose for Data	Buildup	Decision Rule
<b>Evaluate <math>\alpha/\beta/\gamma</math> Implications to Contamination Control Program</b>			
Personal Contamination	Demonstrate that the current program adequately assesses the contribution to surface activity attributable to in-growth of short-lived $\beta/\gamma$ emitters	$\alpha/\beta/\gamma$ Campaign for Personal Contamination	If the current program adequately assesses the contribution to dose attributable to in-growth of $\beta$ -emitting isotopes, no action. If potential exists that current monitoring/estimates may underestimate contribution attributable to in-growth of $\beta$ -emitting isotopes evaluate alternative assumptions and estimation methods, and/or propose monitoring.
Free Release	Demonstrate that the current program adequately assesses the contribution to surface activity attributable to in-growth of short-lived $\beta/\gamma$ emitters	$\alpha/\beta/\gamma$ Campaign for Contamination Control	If the current program adequately assesses the contribution to surface activity attributable to in-growth of $\beta$ -emitting isotopes, no action. If potential exists that current monitoring/estimates may underestimate contribution to surface activity attributable to in-growth of $\beta$ -emitting isotopes evaluate alternative assumptions, correction factors and estimation methods, and/or propose monitoring.
<b>Mixed DAC - Isotopic Analysis</b>			
In-plant	Demonstrate applicability of <10%/30% 10 CFR Part 20. 1204(g)(2)	Particulate: 1-IST, 2-IST, 3-IST, 4-IST, 5-IST, 6-IST	If the concentrations of other uranium decay products are known and contribute well less than 10% individually, or 30% total, no action. If potential exists that other decay products could contribute 10% individually or 30% total to the dose, evaluate alternative assumptions, estimation methods, and/or monitoring.
Plant to Perimeter	" "	Particulate: AM-22, AM-23, AM-24, AM-25	If the concentrations of other uranium decay products are known and contribute well less than 10% individually or 30% total to the dose, no action. If potential exists that other decay products are near or above 10% individually or 30% total, evaluate alternative assumptions, estimation methods, and/or monitoring.
Lab	" "	Particulate: Estimated based upon results from in-plant isotopic, above.	If the concentrations of other uranium decay products are known and contribute well less than 10% individually or 30% total to the dose, no action. If potential exists that other decay products are near or above 10% individually or 30% total, evaluate alternative assumptions, estimation methods, and/or monitoring.
Perimeter	" "	Particulate: AM-1, AM-2, AM-3, AM-4, AM-5, AM-6, AM-8	If the concentrations of other uranium decay products are known and contribute well less than 10% individually or 30% total to the dose, no action. If potential exists that other decay products are near or above 10% individually or 30% total, evaluate alternative assumptions, estimation methods, and/or monitoring.



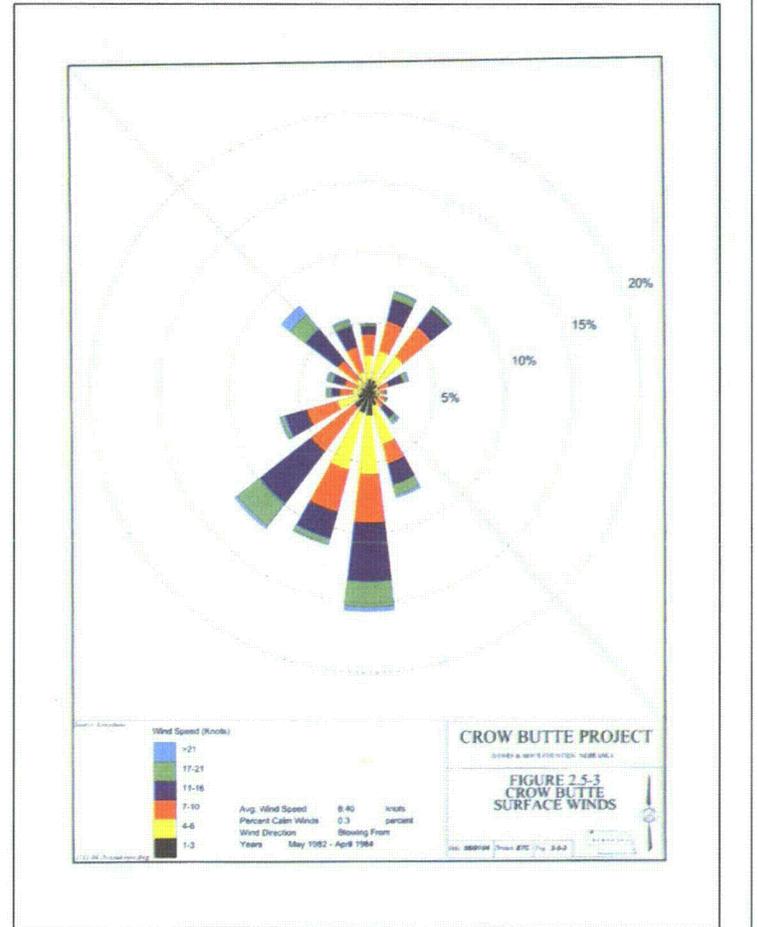
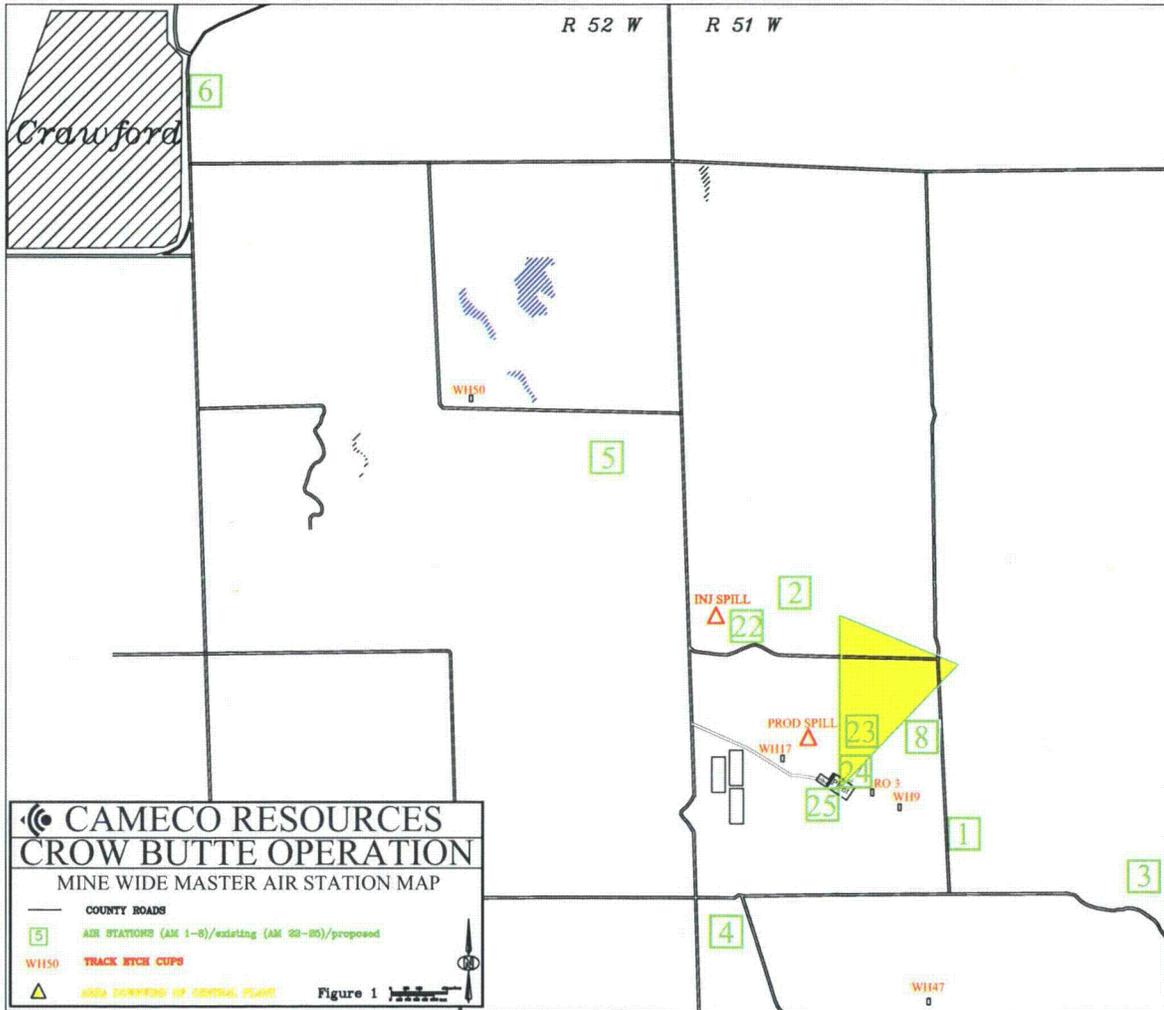
R.O. BUILDING

- IST 6
- ▼ IIR

♦ CAMECO RESOURCES  
 CROW BUTTE PROJECT  
 CIV. OPER. MAINTENANCE

- Track Etch Cups
- ISOTOPIC Samples
- Radon Daughters
- ✕ Airborne Uranium
- Air Stations

CB-GA-103



# CAMECO RESOURCES CROW BUTTE OPERATION

MINE WIDE MASTER AIR STATION MAP

	CBO ROADS
	COUNTY ROADS
	AIR STATIONS (AM 1-8)/Existing (AM 22-25)/Proposed
	WH50 TRACK ETCH CUPS
	AREA DOWNWIND OF CENTRAL PLANT



Figure 2

