HPIP 4.40

TEDE ALARA EVALUATION

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OWNER GROUP:	Radiation Protection

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1.0 PURPOSE

1.1 This procedure establishes the methods and practices to be used to perform a TEDE ALARA evaluation.

1.2 This procedure applies to all plant activities that generate airborne radioactivity.

2.0 DISCUSSION

2.1 Radiation protection practices have long emphasized avoiding unnecessary exposures. This principle, now referred to as ALARA, means making every effort to maintain radiation dose as low as reasonably achievable. As a licensee of the NRC, we are required to implement a radiation protection program consisting of procedures and engineering controls to achieve occupational radiation dose that is ALARA.

2.2 When a specific ALARA evaluation is performed to justify the use or nonuse of respirators, the evaluation should consider the following:

2.2.1 The use of process and engineering controls, filtered ventilation systems and decontamination before the use of respiratory protection equipment;

2.2.2 Control of access, limitation of exposure time and the use of other types of exposure controls before the use of respiratory protection equipment;

2.2.3 The estimated benefit. The evaluation should show that the TEDE for the job will be ALARA, i.e., the internal dose avoided by using the respiratory protection equipment is likely to be greater than any additional external dose that may result from the use of respiratory protection equipment from respirator-induced inefficiency and other factors.

2.3 When application of engineering controls to keep radioactive material in air below values that constitute an Airborne Radioactivity Area is **NOT** practical, then other controls shall be implemented to maintain the total effective dose equivalent (TEDE) ALARA. The use of a respiratory device with a lower protection factor (PF) than the peak concentration may be selected to be consistent with TEDE ALARA

2.4 When the TEDE ALARA evaluation results do not show a clear, obvious indication of whether or not the use of a respirator is ALARA, professional judgment may be used as to whether or not to assign a respirator.

2.5 Terms used in this procedure:

ALARA - The operating principle of radiological protection that states that measures are to be implemented to keep radiation dose and intakes "as low as reasonably achievable."

Total Effective Dose Equivalent, TEDE - The sum of the deep-dose equivalent (for external exposures) and the Committed Effective Dose Equivalent (for internal exposures).

Deep-Dose Equivalent, DDE - The dose equivalent at a tissue depth of 1 cm (1000 mg/cm^2).

Dervived Air Concentration, DAC - The concentration of a given radionuclide in air, which, if breathed by the reference man for a working year of 2,000 hours under conditions of light work, results in an intake of one ALI.

3.0 RESPONSIBILITIES

None

4.0 PROCEDURE

4.1 A TEDE ALARA evaluation shall be done whenever the use of respiratory protection equipment is considered for the protection of personnel against airborne radioactive material or when the airborne contamination concentration will exceed 25 percent of a DAC. The evaluation should be documented using PBF-4230a.

NOTE: A TEDE ALARA evaluation does not need to be done before requiring the use of respiratory protection equipment as a precautionary measure when there is a large uncertainty about the magnitude of the projected concentrations of airborne radioactive material to which workers will be exposed (e.g., a new job with significant airborne contamination potential, but with no history of previous similar jobs). This is regardless of the magnitude of the projected external and internal dose.

4.2 To do the evaluation perform the following using PBF-4230a:

NOTE: For unknown mixtures of radionuclides, the PBNP specific DAC values, as given in HPIP 3.52, shall be used.

4.2.1 Describe the work to be performed. Highlight the work activities that may disturb contaminated surfaces and the manner by which the surfaces are disturbed. Include the time that the maximum exposed individual is expected to be in the area of concern. List expected dose rates, contamination levels and average ambient concentration of radioactive material in work place air (or the estimated average). The air concentration values should be expressed as fraction or percent of DAC. The values should be based on historical data or may be estimated using Tables 1 through 4 for beta/gamma contamination and Tables 5 through 8 for alpha contamination.

4.2.2 Describe the environmental conditions including elevated temperature and noise conditions and impacts on personnel safety.

4.2.3 Describe the process and engineering controls that will be used.

4.2.4 Describe the protective equipment and clothing, including the respirator, to be used and their effects on worker efficiency. Describe the comfort level of the worker regarding the use of the respirator.

4.2.5 Describe potential post-work negative impacts. Include the effects of personnel contaminations and skin dose assessments, portal monitor alarms, etc.

4.2.6 Calculate the dose that will be received not using respiratory protection equipment.

4.2.7 Calculate the dose that will be received using respiratory protection equipment. Respirator protection factors are listed in the legend at the bottom of Tables 1 through 8. If the impact of respirator protection equipment use on worker productivity is not known, assume that work time is increased by fifteen percent[1].

4.2.8 If the total dose using a respirator is less than or equal to the total dose not using a respirator, then the use of respiratory protection equipment is warranted. For instances where the above condition is not met, respirator use may still be warranted due to the benefits provided by nonradiological factors. An example is the benefit of an air-supplied suit that provides cooling.

4.2.9 Complete the TEDE ALARA form and submit to RP Supervision for review.

4.3 Voluntary Use Respirators

If the TEDE ALARA evaluation determines respiratory protection is not warranted, but the workers want some device, a dust mask (or filtering facepiece) may be used by the individual(s). Dust masks can be obtained at Ready Stores for this purpose.

5.0 REFERENCES

5.1 PBF-4230a, TEDE ALARA Evaluation

5.2 NP 4.2.1, ALARA Program

5.3 HPIP 4.57, Respirator Selection

6.0 BASES

B-1 Regulatory Guide 8.15, Acceptable Programs for Respiratory Protection, Revision 1, October 1999.

TABLE 1
Inspection Only - No Ongoing Work
(walk-thru and/or visual examination only)
Potential Beta/Gamma Airborne Hazard as a Function of Working Environment

Loose Surface Contamination (LSC)		Effective DAC Fraction			
(dpm/100 sq. cm.)	(mrad/h)	Confined Area	Normal Vent	Neg. Flow	Glovebox
1.00E+02	1.00E-03	0.000	0.000	0.000	0.000
2.50E+02	2.50E-03	0.000	0.000	0.000	0.000
5.00E+02	5.00E-03	0.000	0.000	0.000	0.000
1.00E+03	1.00E-02	0.000	0.000	0.000	0.000
2.50E+03	2.50E-02	0.001	0.000	0.000	0.000
5.00E+03	5.00E-02	0.001	0.000	0.000	0.000
1.00E+04	1.00E-01	0.002	0.000	0.000	0.000
2.50E+04	2.50E-01	0.006	0.001	0.000	0.000
5.00E+04	5.00E-01	0.011	0.001	0.000	0.000
7.50E+04	7.50E-01	0.017	0.002	0.000	0.000
1.00E+05	1.00E+00	0.023	0.002	0.000	0.000
1.50E+05	1.50E+00	0.034	0.003	0.000	0.000
2.00E+05	2.00E+00	0.045	0.005	0.000	0.000
2.50E+05	2.50E+00	0.056	0.006	0.001	0.000
3.00E+05	3.00E+00	0.068	0.007	0.001	0.000
4.00E+05	4.00E+00	0.090	0.009	0.001	0.000
5.00E+05	5.00E+00	0.113	0.011	0.001	0.000
7.50E+05	7.50E+00	0.169	0.017	0.002	0.000
1.00E+06	1.00E+01	0.225	0.023	0.002	0.000
2.00E+06	2.00E+01	0.450	0.045	0.005	0.000
3.00E+06	3.00E+01	0.675	0.068	0.007	0.001
5.00E+06	5.00E+01	1.125	0.113	0.011	0.001
7.50E+06	7.50E+01	1.688	0.169	0.017	0.002
1.00E+07	1.00E+02	2.250	0.225	0.023	0.002
2.00E+07	2.00E+02	4.500	0.450	0.045	0.005
4.00E+07	4.00E+02	9.000	0.900	0.090	0.009
6.00E+07	6.00E+02	13.500	1.350	0.135	0.014
8.00E+07	8.00E+02	18.000	1.800	0.180	0.018
1.00E+08	1.00E+03	22.500	2.250	0.225	0.023
2.00E+08	2.00E+03	45.000	4.500	0.450	0.045

Legend:

	< 1 DAC
	> 1 DAC and < 50 DAC (PF Neg. Press. Resp./PAPR = 50)
	> 50 DAC and < 1000 DAC (PF Airline/Hood = 1000)
	> 1000 DAC and < 10000 DAC (PF SCBA = 10000)
	> 10000 DAC (>PF of Resp. Protection; Special Considerations)

TABLE 2
Wet Decon/Routine Maintenance
(wet surface wipedown, routine maintenance)
Potential Beta/Gamma Airborne Hazard as a Function of Working Environment

Loose Surface Contamination (LSC)		Effective DAC Fraction			
(dpm/100 sq. cm.)	(mrad/h)	Confined Area	Normal Vent	Neg. Flow	Glovebox
1.00E+02	1.00E-03	0.000	0.000	0.000	0.000
2.50E+02	2.50E-03	0.001	0.000	0.000	0.000
5.00E+02	5.00E-03	0.001	0.000	0.000	0.000
1.00E+03	1.00E-02	0.002	0.000	0.000	0.000
2.50E+03	2.50E-02	0.006	0.001	0.000	0.000
5.00E+03	5.00E-02	0.011	0.001	0.000	0.000
1.00E+04	1.00E-01	0.023	0.002	0.000	0.000
2.50E+04	2.50E-01	0.056	0.006	0.001	0.000
5.00E+04	5.00E-01	0.113	0.011	0.001	0.000
7.50E+04	7.50E-01	0.169	0.017	0.002	0.000
1.00E+05	1.00E+00	0.225	0.023	0.002	0.000
1.50E+05	1.50E+00	0.338	0.034	0.003	0.000
2.00E+05	2.00E+00	0.450	0.045	0.005	0.000
2.50E+05	2.50E+00	0.563	0.056	0.006	0.001
3.00E+05	3.00E+00	0.675	0.068	0.007	0.001
4.00E+05	4.00E+00	0.900	0.090	0.009	0.001
5.00E+05	5.00E+00	1.125	0.113	0.011	0.001
7.50E+05	7.50E+00	1.688	0.169	0.017	0.002
1.00E+06	1.00E+01	2.250	0.225	0.023	0.002
2.00E+06	2.00E+01	4.500	0.450	0.045	0.005
3.00E+06	3.00E+01	6.750	0.675	0.068	0.007
5.00E+06	5.00E+01	11.250	1.125	0.113	0.011
7.50E+06	7.50E+01	16.875	1.688	0.169	0.017
1.00E+07	1.00E+02	22.500	2.250	0.225	0.023
2.00E+07	2.00E+02	45.000	4.500	0.450	0.045
4.00E+07	4.00E+02	90.000	9.000	0.900	0.090
6.00E+07	6.00E+02	135.000	13.500	1.350	0.135
8.00E+07	8.00E+02	180.000	18.000	1.800	0.180
1.00E+08	1.00E+03	225.000	22.500	2.250	0.225
2.00E+08	2.00E+03	450.000	45.000	4.500	0.450

Legend:

	< 1 DAC
	> 1 DAC and < 50 DAC (PF Neg. Press. Resp./PAPR = 50)
	> 50 DAC and < 1000 DAC (PF Airline/Hood = 1000)
	> 1000 DAC and < 10000 DAC (PF SCBA = 10000)
	> 10000 DAC (>PF of Resp. Protection; Special Considerations)

TABLE 3
Abrasive or Dry Surface Decon
(sweeping, scrubbing)
Potential Beta/Gamma Airborne Hazard as a Function of Working Environment

Loose Surface Contamination (LSC)		Effective DAC Fraction			
(dpm/100 sq. cm.)	(mrad/h)	Confined Area	Normal Vent	Neg. Flow	Glovebox
1.00E+02	1.00E-03	0.002	0.000	0.000	0.000
2.50E+02	2.50E-03	0.006	0.001	0.000	0.000
5.00E+02	5.00E-03	0.011	0.001	0.000	0.000
1.00E+03	1.00E-02	0.023	0.002	0.000	0.000
2.50E+03	2.50E-02	0.056	0.006	0.001	0.000
5.00E+03	5.00E-02	0.113	0.011	0.001	0.000
1.00E+04	1.00E-01	0.225	0.023	0.002	0.000
2.50E+04	2.50E-01	0.563	0.056	0.006	0.001
5.00E+04	5.00E-01	1.125	0.113	0.011	0.001
7.50E+04	7.50E-01	1.688	0.169	0.017	0.002
1.00E+05	1.00E+00	2.250	0.225	0.023	0.002
1.50E+05	1.50E+00	3.375	0.338	0.034	0.003
2.00E+05	2.00E+00	4.500	0.450	0.045	0.005
2.50E+05	2.50E+00	5.625	0.563	0.056	0.006
3.00E+05	3.00E+00	6.750	0.675	0.068	0.007
4.00E+05	4.00E+00	9.000	0.900	0.090	0.009
5.00E+05	5.00E+00	11.250	1.125	0.113	0.011
7.50E+05	7.50E+00	16.875	1.688	0.169	0.017
1.00E+06	1.00E+01	22.500	2.250	0.225	0.023
2.00E+06	2.00E+01	45.000	4.500	0.450	0.045
3.00E+06	3.00E+01	67.500	6.750	0.675	0.068
5.00E+06	5.00E+01	112.500	11.250	1.125	0.113
7.50E+06	7.50E+01	168.750	16.875	1.688	0.169
1.00E+07	1.00E+02	225.000	22.500	2.250	0.225
2.00E+07	2.00E+02	450.000	45.000	4.500	0.450
4.00E+07	4.00E+02	900.000	90.000	9.000	0.900
6.00E+07	6.00E+02	1350.000	135.000	13.500	1.350
8.00E+07	8.00E+02	1800.000	180.000	18.000	1.800
1.00E+08	1.00E+03	2250.000	225.000	22.500	2.250
2.00E+08	2.00E+03	4500.000	450.000	45.000	4.500

Legend:

	< 1 DAC
	> 1 DAC and < 50 DAC (PF Neg. Press. Resp./PAPR = 50)
	> 50 DAC and < 1000 DAC (PF Airline/Hood = 1000)
	> 1000 DAC and < 10000 DAC (PF SCBA = 10000)
	> 10000 DAC (>PF of Resp. Protection; Special Considerations)

TABLE 4
Grinding/Welding
(aggressive mechanical disturbance)
Potential Beta/Gamma Airborne Hazard as a Function of Working Environment

Loose Surface Contamination (LSC)		Effective DAC Fraction			
(dpm/100 sq. cm.)	(mrad/h)	Confined Area	Normal Vent	Neg. Flow	Glovebox
1.00E+02	1.00E-03	0.225	0.023	0.002	0.000
2.50E+02	2.50E-03	0.563	0.056	0.006	0.001
5.00E+02	5.00E-03	1.125	0.113	0.011	0.001
1.00E+03	1.00E-02	2.250	0.225	0.023	0.002
2.50E+03	2.50E-02	5.625	0.563	0.056	0.006
5.00E+03	5.00E-02	11.250	1.125	0.113	0.011
1.00E+04	1.00E-01	22.500	2.250	0.225	0.023
2.50E+04	2.50E-01	56.250	5.625	0.563	0.056
5.00E+04	5.00E-01	112.500	11.250	1.125	0.113
7.50E+04	7.50E-01	168.750	16.875	1.688	0.169
1.00E+05	1.00E+00	225.000	22.500	2.250	0.225
1.50E+05	1.50E+00	337.500	33.750	3.375	0.338
2.00E+05	2.00E+00	450.000	45.000	4.500	0.450
2.50E+05	2.50E+00	562.500	56.250	5.625	0.563
3.00E+05	3.00E+00	675.000	67.500	6.750	0.675
4.00E+05	4.00E+00	900.000	90.000	9.000	0.900
5.00E+05	5.00E+00	1125	112.500	11.250	1.125
7.50E+05	7.50E+00	1687.5	168.750	16.875	1.688
1.00E+06	1.00E+01	2250	225.000	22.500	2.250
2.00E+06	2.00E+01	4500	450.000	45.000	4.500
3.00E+06	3.00E+01	6750	675.000	67.500	6.750
5.00E+06	5.00E+01	11250	1125	112.500	11.250
7.50E+06	7.50E+01	16875	1687.5	168.750	16.875
1.00E+07	1.00E+02	22500	2250	225.000	22.500
2.00E+07	2.00E+02	45000	4500	450.000	45.000
4.00E+07	4.00E+02	90000	9000	900.000	90.000
6.00E+07	6.00E+02	135000	13500	1350	135.000
8.00E+07	8.00E+02	180000	18000	1800	180.000
1.00E+08	1.00E+03	225000	22500	2250	225.000
2.00E+08	2.00E+03	450000	45000	4500	450.000

Legend:

	< 1 DAC
	> 1 DAC and < 50 DAC (PF Neg. Press. Resp./PAPR = 50)
	> 50 DAC and < 1000 DAC (PF Airline/Hood = 1000)
	> 1000 DAC and < 10000 DAC (PF SCBA = 10000)
	> 10000 DAC (>PF of Resp. Protection; Special Considerations)

TABLE 5
Inspection Only - No Ongoing Work
(walk-thru and/or visual examination only)
Potential Alpha Airborne Hazard as a Function of Working Environment

Loose Surface Contamination (LSC)		Effective DAC Fraction			
(dpm/100 sq. cm.)	(mrad/h)	Confined Area	Normal Vent	Neg. Flow	Glovebox
1.00E+02	1.00E-03	0.015	0.002	0.000	0.000
2.50E+02	2.50E-03	0.038	0.004	0.000	0.000
5.00E+02	5.00E-03	0.075	0.008	0.001	0.000
1.00E+03	1.00E-02	0.150	0.015	0.002	0.000
2.50E+03	2.50E-02	0.375	0.038	0.004	0.000
5.00E+03	5.00E-02	0.750	0.075	0.008	0.001
1.00E+04	1.00E-01	1.500	0.150	0.015	0.002
2.50E+04	2.50E-01	3.750	0.375	0.038	0.004
5.00E+04	5.00E-01	7.500	0.750	0.075	0.008
7.50E+04	7.50E-01	11.25	1.125	0.113	0.011
1.00E+05	1.00E+00	15	1.500	0.150	0.015
1.50E+05	1.50E+00	23	2.250	0.225	0.023
2.00E+05	2.00E+00	30	3.000	0.300	0.030
2.50E+05	2.50E+00	38	3.750	0.375	0.038
3.00E+05	3.00E+00	45	4.500	0.450	0.045
4.00E+05	4.00E+00	60	6.000	0.600	0.060
5.00E+05	5.00E+00	75	7.500	0.750	0.075
7.50E+05	7.50E+00	113	11.25	1.125	0.113
1.00E+06	1.00E+01	150	15	1.500	0.150
2.00E+06	2.00E+01	300	30	3.000	0.300
3.00E+06	3.00E+01	450	45	4.500	0.450
5.00E+06	5.00E+01	750	75	7.500	0.750
7.50E+06	7.50E+01	1125	113	11.25	1.125
1.00E+07	1.00E+02	1500	150	15	1.500
2.00E+07	2.00E+02	3000	300	30	3
4.00E+07	4.00E+02	6000	600	60	6
6.00E+07	6.00E+02	9000	900	90	9
8.00E+07	8.00E+02	12000	1200	120	12
1.00E+08	1.00E+03	15000	1500	150	15
2.00E+08	2.00E+03	30000	3000	300	30

Legend:

	< 1 DAC
	> 1 DAC and < 50 DAC (PF Neg. Press. Resp./PAPR = 50)
	> 50 DAC and < 1000 DAC (PF Airline/Hood = 1000)
	> 1000 DAC and < 10000 DAC (PF SCBA = 10000)
	> 10000 DAC (>PF of Resp. Protection; Special Considerations)

TABLE 6
Wet Decon/Routine Maintenance
(wet surface wipedown, routine maintenance)
Potential Alpha Airborne Hazard as a Function of Working Environment

Loose Surface Contamination (LSC)		Effective DAC Fraction			
(dpm/100 sq. cm.)	(mrad/h)	Confined Area	Normal Vent	Neg. Flow	Glovebox
1.00E+02	1.00E-03	0.150	0.015	0.002	0.000
2.50E+02	2.50E-03	0.375	0.038	0.004	0.000
5.00E+02	5.00E-03	0.750	0.075	0.008	0.001
1.00E+03	1.00E-02	1.500	0.150	0.015	0.002
2.50E+03	2.50E-02	3.750	0.375	0.038	0.004
5.00E+03	5.00E-02	7.500	0.750	0.075	0.008
1.00E+04	1.00E-01	15	1.500	0.150	0.015
2.50E+04	2.50E-01	38	3.750	0.375	0.038
5.00E+04	5.00E-01	75	7.500	0.750	0.075
7.50E+04	7.50E-01	113	11.25	1.125	0.113
1.00E+05	1.00E+00	150	15	1.500	0.150
1.50E+05	1.50E+00	225	23	2.250	0.225
2.00E+05	2.00E+00	300	30	3.000	0.300
2.50E+05	2.50E+00	375	38	3.750	0.375
3.00E+05	3.00E+00	450	45	4.500	0.450
4.00E+05	4.00E+00	600	60	6.000	0.600
5.00E+05	5.00E+00	750	75	7.500	0.750
7.50E+05	7.50E+00	1125	113	11.25	1.125
1.00E+06	1.00E+01	1500	150	15	1.500
2.00E+06	2.00E+01	3000	300	30	3.000
3.00E+06	3.00E+01	4500	450	45	4.500
5.00E+06	5.00E+01	7500	750	75	7.500
7.50E+06	7.50E+01	11250	1125	113	11.25
1.00E+07	1.00E+02	15000	1500	150	15
2.00E+07	2.00E+02	30000	3000	300	30
4.00E+07	4.00E+02	60000	6000	600	60
6.00E+07	6.00E+02	90000	9000	900	90
8.00E+07	8.00E+02	120000	12000	1200	120
1.00E+08	1.00E+03	150000	15000	1500	150
2.00E+08	2.00E+03	300000	30000	3000	300

Legend:

	< 1 DAC
	> 1 DAC and < 50 DAC (PF Neg. Press. Resp./PAPR = 50)
	> 50 DAC and < 1000 DAC (PF Airline/Hood = 1000)
	> 1000 DAC and < 10000 DAC (PF SCBA = 10000)
	> 10000 DAC (>PF of Resp. Protection; Special Considerations)

TABLE 7
Abrasive or Dry Surface Decon
(sweeping, scrubbing)
Potential Alpha Airborne Hazard as a Function of Working Environment

Loose Surface Contamination (LSC)		Effective DAC Fraction			
(dpm/100 sq. cm.)	(mrad/h)	Confined Area	Normal Vent	Neg. Flow	Glovebox
1.00E+02	1.00E-03	1.500	0.150	0.015	0.002
2.50E+02	2.50E-03	3.750	0.375	0.038	0.004
5.00E+02	5.00E-03	7.500	0.750	0.075	0.008
1.00E+03	1.00E-02	15	1.500	0.150	0.015
2.50E+03	2.50E-02	37	3.750	0.375	0.038
5.00E+03	5.00E-02	75	7.500	0.750	0.075
1.00E+04	1.00E-01	150	15	1.500	0.150
2.50E+04	2.50E-01	375	38	3.750	0.375
5.00E+04	5.00E-01	750	75	7.500	0.750
7.50E+04	7.50E-01	1125	113	11.250	1.125
1.00E+05	1.00E+00	1500	150	15	1.500
1.50E+05	1.50E+00	2250	225	23	2.250
2.00E+05	2.00E+00	3000	300	30	3.000
2.50E+05	2.50E+00	3750	375	38	3.750
3.00E+05	3.00E+00	4500	450	45	4.500
4.00E+05	4.00E+00	6000	600	60	6.000
5.00E+05	5.00E+00	7500	750	75	7.500
7.50E+05	7.50E+00	11250	1125	113	11.250
1.00E+06	1.00E+01	15000	1500	150	15
2.00E+06	2.00E+01	30000	3000	300	30
3.00E+06	3.00E+01	45000	4500	450	45
5.00E+06	5.00E+01	75000	7500	750	75
7.50E+06	7.50E+01	112500	11250	1125	113
1.00E+07	1.00E+02	150000	15000	1500	150
2.00E+07	2.00E+02	300000	30000	3000	300
4.00E+07	4.00E+02	600000	60000	6000	600
6.00E+07	6.00E+02	900000	90000	9000	900
8.00E+07	8.00E+02	1200000	120000	12000	1200
1.00E+08	1.00E+03	1500000	150000	15000	1500
2.00E+08	2.00E+03	3000000	300000	30000	3000

Legend:

	< 1 DAC
	> 1 DAC and < 50 DAC (PF Neg. Press. Resp./PAPR = 50)
	> 50 DAC and < 1000 DAC (PF Airline/Hood = 1000)
	> 1000 DAC and < 10000 DAC (PF SCBA = 10000)
	> 10000 DAC (>PF of Resp. Protection; Special Considerations)

TABLE 8
Grinding/Welding
(aggressive mechanical disturbance)
Potential Alpha Airborne Hazard as a Function of Working Environment

Loose Surface Contamination (LSC)		Effective DAC Fraction			
(dpm/100 sq. cm.)	(mrad/h)	Confined Area	Normal Vent	Neg. Flow	Glovebox
1.00E+02	1.00E-03	150	15	2	0
2.50E+02	2.50E-03	375	38	4	0
5.00E+02	5.00E-03	750	75	8	1
1.00E+03	1.00E-02	1500	150	15	2
2.50E+03	2.50E-02	3750	375	38	4
5.00E+03	5.00E-02	7500	750	75	8
1.00E+04	1.00E-01	15000	1500	150	15
2.50E+04	2.50E-01	37500	3750	375	38
5.00E+04	5.00E-01	75000	7500	750	75
7.50E+04	7.50E-01	112500	11250	1125	113
1.00E+05	1.00E+00	150000	15000	1500	150
1.50E+05	1.50E+00	225000	22500	2250	225
2.00E+05	2.00E+00	300000	30000	3000	300
2.50E+05	2.50E+00	375000	37500	3750	375
3.00E+05	3.00E+00	450000	45000	4500	450
4.00E+05	4.00E+00	600000	60000	6000	600
5.00E+05	5.00E+00	750000	75000	7500	750
7.50E+05	7.50E+00	1125000	112500	11250	1125
1.00E+06	1.00E+01	1500000	150000	15000	1500
2.00E+06	2.00E+01	3000000	300000	30000	3000
3.00E+06	3.00E+01	4500000	450000	45000	4500
5.00E+06	5.00E+01	7500000	750000	75000	7500
7.50E+06	7.50E+01	11250000	1125000	112500	11250
1.00E+07	1.00E+02	15000000	1500000	150000	15000
2.00E+07	2.00E+02	30000000	3000000	300000	30000
4.00E+07	4.00E+02	60000000	6000000	600000	60000
6.00E+07	6.00E+02	90000000	9000000	900000	90000
8.00E+07	8.00E+02	120000000	12000000	1200000	120000
1.00E+08	1.00E+03	150000000	15000000	1500000	150000
2.00E+08	2.00E+03	300000000	30000000	3000000	300000

Legend:

	< 1 DAC
	> 1 DAC and < 50 DAC (PF Neg. Press. Resp./PAPR = 50)
	> 50 DAC and < 1000 DAC (PF Airline/Hood = 1000)
	> 1000 DAC and < 10000 DAC (PF SCBA = 10000)
	> 10000 DAC (>PF of Resp. Protection; Special Considerations)