TABLE D-1. DETAILED AIR EMISSIONS FROM AIRCRAFT USED FOR INTERCONTINENTAL MISSIONS SUPPORTING ACTIVITIES AT THE SOUTH POLE DURING YEARS 1 - 8 of PROJECT ICECUBE (Baseline Conditions)

Characteristic Pollutant	Intercontinental Flights		Additional Idling Time (hr) [3]	Emission Rates [4]			Emissions (kg/year)			
	Number of Missions [1]	Flight Hours below 60°S [2]		LTO (kg/LTO)	Idling (kg/hr)	Flight (kg/hr)	LTO	Additional Idling	Cruise Flight	Total
Aircraft: LC-130 (4 Engine Turboprop, Engine Manufacturer: Detroit Diesel Allison Division of General Motors, Model T56)										
Sulfur Oxides	48	360	0	0.73	0.8	3	35	0	1,080	**1,115**
Nitrogen Oxides	48	360	0	4.35	4	24.6	209	0	8,856	**9,065**
Carbon Monoxide	48	360	0	14.68	31.6	7.4	705	0	2,664	**3,369**
Exhaust Hydrocarbons	48	360	0	9.2	20.8	1.2	442	0	432	**874**
Particulates	48	360	0	1.98	2.8	6.2	95	0	2,232	**2,327**
Aircraft: C-141 (4 Engine Turbofan, Engine Manufacturer: Pratt & Whitney, Model TF33)										
Sulfur Oxides	26	130	0	1.36	N/A	12.4	35	0	1,612	**1,647**
Nitrogen Oxides	26	130	0	11.59	N/A	124.8	301	0	16,224	**16,525**
Carbon Monoxide	26	130	0	64.71	N/A	42.8	1,682	0	5,564	**7,246**
Exhaust Hydrocarbons	26	130	0	63.4	N/A	15.8	1,648	0	2,054	**3,702**
Particulates	26	130	0	19.65	N/A	120.6	511	0	15,678	**16,189**
Aircraft: C-17 (2 Engine Turbofan, Engine Manufacturer: Pratt & Whitney, Model F117-PW-100)										
Sulfur Oxides	6	30	0	1.36	N/A	12.4	8	0	372	**380**
Nitrogen Oxides	6	30	0	40.1	N/A	472.4	241	0	14,172	**14,413**
Carbon Monoxide	6	30	0	25.64	N/A	12.0	154	0	360	**514**
Exhaust Hydrocarbons	6	30	0	2.3	N/A	0.96	14	0	29	**43**
Particulates	6	30	0	2.11	N/A	22.8	13	0	684	**697**

NOTES:
N/A = Not Applicable. NA = Not Available.
[1] Intercontinental missions comprise one round trip to Antarctica and have one landing/takeoff (LTO) cycle below 60°S.
[2] Intercontinental flight hours represent number of flight hours below 60°S; assumed to be 50 percent of the total flight hours.
[3] Represents extra aircraft idling at Antarctic field sites. Routine aircraft idling is included in LTO emissions.
[4] Presented in Table 4-10 of the *2002 Permit Amendments* (RPSC, 2002).

TABLE D-3. DETAILED ANNUAL AIR EMISSIONS FROM AIRCRAFT USED FOR INTERCONTINENTAL MISSIONS SUPPORTING PROJECT ICECUBE (Years 1 - 8)

Characteristic Pollutant	Missions per year [1]	Flight Hours below 60^0S	Additional Idling Time (hr) [2]	Emission Rates [2] LTO (kg/LTO)	Idling (kg/hr)	Flight (kg/hr)	Emissions (kg/year) LTO	Additional Idling	Cruise Flight	Total
Aircraft: C-141 (4 Engine Turbofan, Engine Manufacturer: Pratt & Whitney, Model TF33) [3]										
Sulfur Oxides	13	65	0	1.36	N/A	12.4	18	0	806	**824**
Nitrogen Oxides	13	65	0	11.59	N/A	124.8	151	0	8,112	**8,263**
Carbon Monoxide	13	65	0	64.71	N/A	42.8	841	0	2,782	**3,623**
Exhaust Hydrocarbons	13	65	0	63.4	N/A	15.8	824	0	1,027	**1,851**
Particulates	13	65	0	19.65	N/A	120.6	255	0	7,839	**8,094**

NOTES:
N/A = Not Applicable. NA = Not Available.
[1] Intercontinental missions comprise one round trip to Antarctica and have one landing/takeoff (LTO) cycle below 60^oS; Intracontinental flights have two LTO cycles below 60^oS.
[2] Presented in Table 4-10 of the *2002 Permit Amendments* (RPSC, 2002).
[3] All flights projected to occur in Year 1. Flights may be delayed and some cargo may be transported by C-17 aircraft, which have decreased emission rates (see Table E-1)

TABLE D-2. DETAILED ANNUAL AIR EMISSIONS FROM AIRCRAFT USED FOR INTRACONTINENTAL MISSIONS SUPPORTING ACTIVITIES AT THE SOUTH POLE DURING YEARS 1 - 8 of PROJECT ICECUBE (Baseline Conditions)

Characteristic Pollutant	Missions per year [1]	Flight Hours below 60^0S	Additional Idling Time (hr) [3]	Emission Rates [4] LTO (kg/LTO)	Idling (kg/hr)	Flight (kg/hr)	Emissions (kg/year) LTO	Additional Idling	Cruise Flight	Total
Aircraft: LC-130 (4 Engine Turboprop, Engine Manufacturer: Detroit Diesel Allison Division of General Motors, Model T56)										
Year 1										
Sulfur Oxides	300	1,725	300	0.73	0.8	3	438	240	5,175	**5,853**
Nitrogen Oxides	300	1,725	300	4.35	4	24.6	2,610	1,200	42,435	**46,245**
Carbon Monoxide	300	1,725	300	14.68	31.6	7.4	8,808	9,480	12,765	**31,053**
Exhaust Hydrocarbons	300	1,725	300	9.2	20.8	1.2	5,520	6,240	2,070	**13,830**
Particulates	300	1,725	300	1.98	2.8	6.2	1,188	840	10,695	**12,723**
Year 2										
Sulfur Oxides	250	1,438	250	0.73	0.8	3	365	200	4,313	**4,878**
Nitrogen Oxides	250	1,438	250	4.35	4	24.6	2,175	1,000	35,363	**38,538**
Carbon Monoxide	250	1,438	250	14.68	31.6	7.4	7,340	7,900	10,638	**25,878**
Exhaust Hydrocarbons	250	1,438	250	9.2	20.8	1.2	4,600	5,200	1,725	**11,525**
Particulates	250	1,438	250	1.98	2.8	6.2	990	700	8,913	**10,603**
Year 3										
Sulfur Oxides	241	1,386	241	0.73	0.8	3	352	193	4,157	**4,702**
Nitrogen Oxides	241	1,386	241	4.35	4	24.6	2,097	964	34,089	**37,150**
Carbon Monoxide	241	1,386	241	14.68	31.6	7.4	7,076	7,616	10,255	**24,946**
Exhaust Hydrocarbons	241	1,386	241	9.2	20.8	1.2	4,434	5,013	1,663	**11,110**
Particulates	241	1,386	241	1.98	2.8	6.2	954	675	8,592	**10,221**
Year 4										
Sulfur Oxides	235	1,351	235	0.73	0.8	3	343	188	4,054	**4,585**
Nitrogen Oxides	235	1,351	235	4.35	4	24.6	2,045	940	33,241	**36,225**
Carbon Monoxide	235	1,351	235	14.68	31.6	7.4	6,900	7,426	9,999	**24,325**
Exhaust Hydrocarbons	235	1,351	235	9.2	20.8	1.2	4,324	4,888	1,622	**10,834**
Particulates	235	1,351	235	1.98	2.8	6.2	931	658	8,378	**9,966**
Year 5										
Sulfur Oxides	228	1,311	228	0.73	0.8	3	333	182	3,933	**4,448**
Nitrogen Oxides	228	1,311	228	4.35	4	24.6	1,984	912	32,251	**35,146**
Carbon Monoxide	228	1,311	228	14.68	31.6	7.4	6,694	7,205	9,701	**23,600**
Exhaust Hydrocarbons	228	1,311	228	9.2	20.8	1.2	4,195	4,742	1,573	**10,511**
Particulates	228	1,311	228	1.98	2.8	6.2	903	638	8,128	**9,669**
Year 6										
Sulfur Oxides	219	1,259	219	0.73	0.8	3	320	175	3,778	**4,273**
Nitrogen Oxides	219	1,259	219	4.35	4	24.6	1,905	876	30,978	**33,759**
Carbon Monoxide	219	1,259	219	14.68	31.6	7.4	6,430	6,920	9,318	**22,669**
Exhaust Hydrocarbons	219	1,259	219	9.2	20.8	1.2	4,030	4,555	1,511	**10,096**
Particulates	219	1,259	219	1.98	2.8	6.2	867	613	7,807	**9,288**
Year 7										
Sulfur Oxides	227	1,305	227	0.73	0.8	3	331	182	3,916	**4,429**
Nitrogen Oxides	227	1,305	227	4.35	4	24.6	1,975	908	32,109	**34,992**
Carbon Monoxide	227	1,305	227	14.68	31.6	7.4	6,665	7,173	9,659	**23,497**
Exhaust Hydrocarbons	227	1,305	227	9.2	20.8	1.2	4,177	4,722	1,566	**10,465**
Particulates	227	1,305	227	1.98	2.8	6.2	899	636	8,093	**9,627**
Year 8										
Sulfur Oxides	186	1,070	186	0.73	0.8	3	272	149	3,209	**3,629**
Nitrogen Oxides	186	1,070	186	4.35	4	24.6	1,618	744	26,310	**28,672**
Carbon Monoxide	186	1,070	186	14.68	31.6	7.4	5,461	5,878	7,914	**19,253**
Exhaust Hydrocarbons	186	1,070	186	9.2	20.8	1.2	3,422	3,869	1,283	**8,575**
Particulates	186	1,070	186	1.98	2.8	6.2	737	521	6,631	**7,888**

NOTES:

N/A = Not Applicable. NA = Not Available.

[1] Intercontinental missions comprise one round trip to Antarctica and have one landing/takeoff (LTO) cycle below 6C°S; Intracontinental flights have two LTO cycles below 60oS.

[2] Intercontinental flight hours represent number of flight hours below 60^oS; assumed to be 50 percent of the total flight hours.

[3] Represents extra aircraft idling at the South Pole, assumed to be 1.0 hours per mission. Routine aircraft idling is included in LTO emissions.

[4] Presented in Table 4-10 of the *2002 Permit Amendments* (RPSC, 2002).

TABLE D-4. DETAILED ANNUAL AIR EMISSIONS FROM AIRCRAFT USED FOR INTRACONTINENTAL MISSIONS SUPPORTING PROJECT ICE CUBE (years 1 - 8)

Characteristic Pollutant	Missions per year [1]	Flight Hours below 60^0S	Additional Idling Time (hr) [3]	Emission Rates [4] LTO (kg/LTO)	Idling (kg/hr)	Flight (kg/hr)	Emissions (kg/year) LTO	Additional Idling	Cruise Flight	Total
Aircraft: LC-130 (4 Engine Turboprop, Engine Manufacturer: Detroit Diesel Allison Division of General Motors, Model T56)										
Year 1										
Sulfur Oxides	40	230	40	0.73	0.8	3	58	32	690	**780**
Nitrogen Oxides	40	230	40	4.35	4	24.6	348	160	5,658	**6,166**
Carbon Monoxide	40	230	40	14.68	31.6	7.4	1,174	1,264	1,702	**4,140**
Exhaust Hydrocarbons	40	230	40	9.2	20.8	1.2	736	832	276	**1,844**
Particulates	40	230	40	1.98	2.8	6.2	158	112	1,426	**1,696**
Year 2										
Sulfur Oxides	55	316	55	0.73	0.8	3	80	44	949	**1,073**
Nitrogen Oxides	55	316	55	4.35	4	24.6	479	220	7,780	**8,478**
Carbon Monoxide	55	316	55	14.68	31.6	7.4	1,615	1,738	2,340	**5,693**
Exhaust Hydrocarbons	55	316	55	9.2	20.8	1.2	1,012	1,144	380	**2,536**
Particulates	55	316	55	1.98	2.8	6.2	218	154	1,961	**2,333**
Year 3										
Sulfur Oxides	52	299	52	0.73	0.8	3	76	42	897	**1,015**
Nitrogen Oxides	52	299	52	4.35	4	24.6	452	208	7,355	**8,016**
Carbon Monoxide	52	299	52	14.68	31.6	7.4	1,527	1,643	2,213	**5,383**
Exhaust Hydrocarbons	52	299	52	9.2	20.8	1.2	957	1,082	359	**2,397**
Particulates	52	299	52	1.98	2.8	6.2	206	146	1,854	**2,205**
Year 4										
Sulfur Oxides	58	334	58	0.73	0.8	3	85	46	1,001	**1,132**
Nitrogen Oxides	58	334	58	4.35	4	24.6	505	232	8,204	**8,941**
Carbon Monoxide	58	334	58	14.68	31.6	7.4	1,703	1,833	2,468	**6,004**
Exhaust Hydrocarbons	58	334	58	9.2	20.8	1.2	1,067	1,206	400	**2,674**
Particulates	58	334	58	1.98	2.8	6.2	230	162	2,068	**2,460**
Year 5										
Sulfur Oxides	60	345	60	0.73	0.8	3	88	48	1,035	**1,171**
Nitrogen Oxides	60	345	60	4.35	4	24.6	522	240	8,487	**9,249**
Carbon Monoxide	60	345	60	14.68	31.6	7.4	1,762	1,896	2,553	**6,211**
Exhaust Hydrocarbons	60	345	60	9.2	20.8	1.2	1,104	1,248	414	**2,766**
Particulates	60	345	60	1.98	2.8	6.2	238	168	2,139	**2,545**
Year 6										
Sulfur Oxides	60	345	60	0.73	0.8	3	88	48	1,035	**1,171**
Nitrogen Oxides	60	345	60	4.35	4	24.6	522	240	8,487	**9,249**
Carbon Monoxide	60	345	60	14.68	31.6	7.4	1,762	1,896	2,553	**6,211**
Exhaust Hydrocarbons	60	345	60	9.2	20.8	1.2	1,104	1,248	414	**2,766**
Particulates	60	345	60	1.98	2.8	6.2	238	168	2,139	**2,545**
Year 7										
Sulfur Oxides	46	265	46	0.73	0.8	3	67	37	794	**897**
Nitrogen Oxides	46	265	46	4.35	4	24.6	400	184	6,507	**7,091**
Carbon Monoxide	46	265	46	14.68	31.6	7.4	1,351	1,454	1,957	**4,761**
Exhaust Hydrocarbons	46	265	46	9.2	20.8	1.2	846	957	317	**2,121**
Particulates	46	265	46	1.98	2.8	6.2	182	129	1,640	**1,951**
Year 8										
Sulfur Oxides	4	23	4	0.73	0.8	3	6	3	69	**78**
Nitrogen Oxides	4	23	4	4.35	4	24.6	35	16	566	**617**
Carbon Monoxide	4	23	4	14.68	31.6	7.4	117	126	170	**414**
Exhaust Hydrocarbons	4	23	4	9.2	20.8	1.2	74	83	28	**184**
Particulates	4	23	4	1.98	2.8	6.2	16	11	143	**170**

NOTES:
N/A = Not Applicable. NA = Not Available.
[1] Intercontinental missions comprise one round trip to Antarctica and have one landing/takeoff (LTO) cycle below 60°S; Intracontinental flights have two LTO cycles below 60°S.
[2] Intercontinental flight hours represent number of flight hours below 60°S; assumed to be 50 percent of the total flight hours.
[3] Represents extra aircraft idling at the South Pole, assumed to be 1.0 hours per mission. Routine aircraft idling is included in LTO emissions.
[4] Presented in Table 4-10 of the *2002 Permit Amendments* (RPSC, 2002).