



TECHNICAL MEMORANDUM

INFORMATION REQUEST #2 – EU 1-12 AND 29-34

PREPARED FOR: Enric Fernandez, Donlin Gold

PREPARED BY: Kevin Lewis, Air Sciences

PROJECT NO.: 281-22B-1

DATE: March 22, 2022

This memorandum provides the information requested by Mr. Dave Jones of the Alaska Department of Environmental Conservation (ADEC) on February 23 and March 15, 2022, regarding Donlin Gold Project's Construction Permit AQ0934CPT02 Application.

Table of Contents

1.0 Introduction	2
2.0 Generators EU 1-12 and 29-34.....	2
2.1 ADEC Request Item 1	2
2.2 Item 1 Response	2
3.0 Capital Recovery Factor Interest Rate	4
4.0 References	4

Tables

Table 1. DPF Cost Effectiveness	3
---------------------------------------	---

Appendices

Appendix A – BACT Cost Calculations

Appendix B – Cost analysis workbook and the memorandum reference documents

1.0 Introduction

Per ADEC’s request, diesel particulate filters (DPF) for the Wärtsilä dual fuel generators (EU 1-12; 17,076 ekW) and the emergency diesel generators (EU 29-30; 600 ekW and EU 31-34; 1,500 ekW) have been re-evaluated. The results are summarized as follows:

- DPF are not commercially available for EU 1-12.
- DPF is not cost effective for EU 29-34 at over \$100,000 per ton of particulate matter (PM) removed.

Discussions of the above results are provided in the following sections of this memorandum.

2.0 Generators EU 1-12 and 29-34

2.1 ADEC Request Item 1

Request:

Information Request Regarding the Large Engine Generators (including limited use engines) EUs 1 – 12 & 29 – 34

1. Please provide the Department with BACT analyses for diesel particulate filters for the primary engines EUs 1 – 12 and the limited use engines rated at 600 and 1,500 ekW (EUs 29 – 34). For these analyses please:

- Provide the analyses in Microsoft Excel format using new cost estimates.
- Use the methodology from the most recent EPA Air Pollution Control Cost Manual, available on the following website: <https://www.epa.gov/economic-and-cost-analysis-air-pollution-regulations/cost-reports-and-guidance-air-pollution>.
- Use an appropriate equipment life for the Capital Recovery Factor (CRF) portion of the analyses and justify if a shorter equipment life is warranted.
- Use the current bank prime loan interest rate for the CRF portion of the analyses available here: <https://www.federalreserve.gov/releases/h15/>.

2.2 Item 1 Response

The manufacture of EU 1 - 12, Wärtsilä, was contacted to determine the availability of DPF for these large engines. Wärtsilä confirmed that, “[t]here are no commercially available Diesel Particulate Filters for large, medium speed engines such as the units proposed for the Donlin Gold project” (Whitney, C. 2022).

For the smaller engines, EU 29-34, DPF is commercially available. Cost effectiveness calculations of installing DPF on EU 29-34 are provided in Appendix A and summarized in Table 1. The Excel workbook of these calculation is available for download via the link provided in Appendix B.

The cost effectiveness calculations for EU 29–34 are based on the following:

- The most recent EPA Air Pollution Control Cost Manual (EPA 2017). Applicable cost factors provided in this manual were taken from:
 - Section 1 – Introduction, Chapter 2 – Cost Estimation: Concepts and Methodology, Table 2.4 Cost Ranges for Freight, Sales Tax, and Instrumentation
 - Section 6 – Particulate Matter Controls, Chapter 1 – Baghouses and Filters, Table 1.10 Capital Costs for Fabric Filter System
 - Section 6 – Particulate Matter Controls, Chapter 1 – Baghouses and Filters, Table 1.11 Annual Costs for Fabric Filter System
- A maximum DPF control efficiency for filterable PM of 90 percent (EPA 2010)
- A maximum life expectancy for DPF of 10 years (EPA 2010)
- The Donlin Gold Project borrowing interest rate of eight percent (Annett, K. 2022)
- The average equipment cost of \$43.5 per ekW provided by a DPF vendor (Moffat, W. 2022)
- An operating schedule for the emergency generators of 500 hours per year (Seitz, J. 1995)

Several of the cost factors provided in Section 6, Chapter 1 for filters were assumed to be zero because the DPF is typically delivered as a prefabricated unit.

Table 1. DPF Cost Effectiveness

EU ID	Engine Tier	Engine Rating (ekW)	Total Capital Investment (\$)	Annual Cost (\$/yr)	PM Reduced (ton/yr)	Cost Effectiveness (\$/ton)
29-30	Tier 2	600	\$45,923	\$9,431	0.074	\$126,749
31-34	Tier 2	1,500	\$114,807	\$22,452	0.186	\$120,700

At the high costs shown in Table 1, DPF is not considered cost effective for the emergency generators.

3.0 Capital Recovery Factor Interest Rate

During the March 15, 2022, meeting Mr. Dave Jones of ADEC requested additional details regarding the Donlin Gold Project borrowing interest rate of eight percent. This additional information is summarized below:

- Cost of equity = (risk free rate, 2%) + (market rate, 4%) * (stock volatility, 1.5) = 8% (Annett, K. 2022)

4.0 References

- Annett, K. 2022. "FW: ADEC BACT RFI." Email from K. Annett, Barrick, to E. Fernandez , Donlin Gold., March 15.
- BLS. 2020. "Occupational Employment and Wage Statistics; 49-000." *May 2020 National Occupational Employment and Wage Estimates*. U.S. Bureau of Labor and Statistics (BLS), May. Accessed March 21, 2022. https://www.bls.gov/oes/current/oes_nat.htm#49-0000.
- EPA. 2010. "Technical Bulletin - Diesel Particulate Filter General Information." *EPA-420-F-10-029*. U.S. Environmental Protection Agency (EPA), May. Accessed March 21, 2022. <https://www.epa.gov/sites/default/files/2016-03/documents/420f10029.pdf>.
- . 2017. "EPA Air Pollution Control Cost Manual." *Section 1, Chapter 2, Cost Estimation: Concepts and Methodology*. U.S. Environmental Protection Agency (EPA), November. Accessed March 18, 2022. https://www.epa.gov/sites/default/files/2017-12/documents/epacmcostestimationmethodchapter_7thedition_2017.pdf.
- Moffat, W. 2022. "RE: DPF." Email from W. Moffat, Nett Technologies Inc., to K. Lewis, Air Sciences Inc., March 21.
- Seitz, J. 1995. "Calculating Potential to Emit (PTE) for Emergency Generators." John S. Seitz, Director, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, September 6. Accessed March 2, 2022. <https://www.epa.gov/sites/default/files/2015-08/documents/emgen.pdf>.
- Whitney, C. 2022. "RE: Donlin Gold Project." Email from C. Whitney, Wartsila North America, to K. Lewis Air Science Inc., March 15.

Appendix A – BACT Cost Calculations

AIR SCIENCES INC.		Project Title		By	
		Donlin Gold		K. Lewis	
		Project No		Page of Sheet	
AIR EMISSION CALCULATIONS		281-22B-1		12EU29-34	
		Subject:		Date:	
		DPF Cost Effectiveness		March 22, 2022	

Diesel Particulate Filter Cost		EU 29-30: Black Start Generator BEDG1&2			
Cost Item		Cost	Comment		
Direct Cost					
Purchase Equipment Costs					
Vendor Price (\$/ekW)	600 ekW	\$43.50	(Moffat, W. 2022)		
Equipment Cost		\$26,100			
Freight	0.05	\$1,305	EPA Cost Manual, Sec 1, Ch 2, Table 2.4, 11/2017 (Typical value).		
Sales Tax	0	\$0	No sales tax in Alaska		
Instrumentation	0.1	\$2,610	EPA Cost Manual, Sec 1, Ch 2, Table 2.4, 11/2017 (Typical value).		
Purchase equipment cost		\$30,015			
Direct installation costs					
Foundation and supports	0	\$0	Assumed negligible - prefabricated unit		
Handling and erection	0	\$0	Assumed negligible - prefabricated unit		
Electrical	0	\$0	Assumed negligible - prefabricated unit		
Piping	0.01	\$300	EPA Cost Manual, Sec 6, Ch 1, Table 1.10 (Fabric Filter System).		
Insulation for ductwork	0.07	\$2,101	EPA Cost Manual, Sec 6, Ch 1, Table 1.10 (Fabric Filter System).		
Painting	0	\$0	Assumed negligible - prefabricated unit		
Direct installation cost		\$2,401			
Site preparation		\$0 Assumed negligible - prefabricated unit			
Facilities and buildings		\$0 Assumed negligible - prefabricated unit			
Total Direct Cost		\$32,416			
Indirect Costs (installation)					
Engineering	0.1	\$3,002	EPA Cost Manual, Sec 6, Ch 1, Table 1.10 (Fabric Filter System).		
Construction and field expenses	0.2	\$6,003	EPA Cost Manual, Sec 6, Ch 1, Table 1.10 (Fabric Filter System).		
Contractor fees	0.1	\$3,002	EPA Cost Manual, Sec 6, Ch 1, Table 1.10 (Fabric Filter System).		
Start-up	0.01	\$300	EPA Cost Manual, Sec 6, Ch 1, Table 1.10 (Fabric Filter System).		
Performance test	0.01	\$300	EPA Cost Manual, Sec 6, Ch 1, Table 1.10 (Fabric Filter System).		
Contingencies	0.03	\$900	EPA Cost Manual, Sec 6, Ch 1, Table 1.10 (Fabric Filter System).		
Total Indirect Cost		\$13,507			
Total Capital Investment		\$45,923			
Direct Annual Costs					
Operating labor	0 hr/yr	\$0 Assumed negligible - prefabricated unit			
Maintenance					
Labor	10 hr/yr	\$23.44	\$234 (EPA 2010) (BLS 2020) Cleaning every 6-12 months (5 hr, ea.).		
Material	100%	\$234	EPA Cost Manual, Sec 6, Ch 1, Table 1.11 (Fabric Filter System).		
Total Direct Annual Cost		\$469			
Indirect Annual Costs					
Overhead	60%	\$281	EPA Cost Manual, Sec 6, Ch 1, Table 1.11 (Fabric Filter System).		
Administrative charges	2%	\$918	EPA Cost Manual, Sec 6, Ch 1, Table 1.11 (Fabric Filter System).		
Property Tax	1%	\$459	EPA Cost Manual, Sec 6, Ch 1, Table 1.11 (Fabric Filter System).		
Insurance	1%	\$459	EPA Cost Manual, Sec 6, Ch 1, Table 1.11 (Fabric Filter System).		
Capital recovery	14.9%	\$6,844	10 yr life	(EPA 2010) Replace every 5-10 years	8% (Annett, K. 2022)
Total Indirect Annual Costs		\$8,962			
Total Annual Cost		\$9,431			
Filterable PM emissions	0.25 g/kWh	500 hr/yr	=	0.083 ton/yr	90% control = 0.074 ton/yr (EPA 2010)
Conversions					
453.592 g/lb	2,000 lb/ton	Cost effectiveness	=	\$126,749 per ton PM	

AIR SCIENCES INC.		Project Title		By	
		Donlin Gold		K. Lewis	
		Project No		Page of Sheet	
AIR EMISSION CALCULATIONS		281-22B-1		2 2 EU29-34	
		Subject:		Date:	
		DPF Cost Effectiveness		March 22, 2022	

Diesel Particulate Filter Cost		EU 31-34: Camp Site Emergency Generator CEDG1-4			
Cost Item		Cost	Comment		
<u>Direct Cost</u>					
Purchase Equipment Costs					
Vendor Price (\$/ekW)	1500 ekW	\$43.50	(Moffat, W. 2022)		
Equipment Cost		\$65,250			
Freight	0.05	\$3,263	EPA Cost Manual, Sec 1, Ch 2, Table 2.4, 11/2017 (Typical value).		
Sales Tax	0	\$0	No sales tax in Alaska		
Instrumentation	0.1	\$6,525	EPA Cost Manual, Sec 1, Ch 2, Table 2.4, 11/2017 (Typical value).		
Purchase equipment cost		\$75,038			
Direct installation costs					
Foundation and supports	0	\$0	Assumed negligible - prefabricated unit		
Handling and erection	0	\$0	Assumed negligible - prefabricated unit		
Electrical	0	\$0	Assumed negligible - prefabricated unit		
Piping	0.01	\$750	EPA Cost Manual, Sec 6, Ch 1, Table 1.10 (Fabric Filter System).		
Insulation for ductwork	0.07	\$5,253	EPA Cost Manual, Sec 6, Ch 1, Table 1.10 (Fabric Filter System).		
Painting	0	\$0	Assumed negligible - prefabricated unit		
Direct installation cost		\$6,003			
Site preparation					
		\$0	Assumed negligible - prefabricated unit		
Facilities and buildings					
		\$0	Assumed negligible - prefabricated unit		
Total Direct Cost		\$81,041			
<u>Indirect Costs (installation)</u>					
Engineering	0.1	\$7,504	EPA Cost Manual, Sec 6, Ch 1, Table 1.10 (Fabric Filter System).		
Construction and field expenses	0.2	\$15,008	EPA Cost Manual, Sec 6, Ch 1, Table 1.10 (Fabric Filter System).		
Contractor fees	0.1	\$7,504	EPA Cost Manual, Sec 6, Ch 1, Table 1.10 (Fabric Filter System).		
Start-up	0.01	\$750	EPA Cost Manual, Sec 6, Ch 1, Table 1.10 (Fabric Filter System).		
Performance test	0.01	\$750	EPA Cost Manual, Sec 6, Ch 1, Table 1.10 (Fabric Filter System).		
Contingencies	0.03	\$2,251	EPA Cost Manual, Sec 6, Ch 1, Table 1.10 (Fabric Filter System).		
Total Indirect Cost		\$33,767			
Total Capital Investment		\$114,807			
<u>Direct Annual Costs</u>					
Operating labor	0 hr/yr	\$0	Assumed negligible - prefabricated unit		
Maintenance					
Labor	10 hr/yr	\$23.44	\$234 (EPA 2010) (BLS 2020) Cleaning every 6-12 months (5 hr, ea.).		
Material	100%	\$234	EPA Cost Manual, Sec 6, Ch 1, Table 1.11 (Fabric Filter System).		
Total Direct Annual Cost		\$469			
<u>Indirect Annual Costs</u>					
Overhead	60%	\$281	EPA Cost Manual, Sec 6, Ch 1, Table 1.11 (Fabric Filter System).		
Administrative charges	2%	\$2,296	EPA Cost Manual, Sec 6, Ch 1, Table 1.11 (Fabric Filter System).		
Property Tax	1%	\$1,148	EPA Cost Manual, Sec 6, Ch 1, Table 1.11 (Fabric Filter System).		
Insurance	1%	\$1,148	EPA Cost Manual, Sec 6, Ch 1, Table 1.11 (Fabric Filter System).		
Capital recovery	14.9%	\$17,110	10 yr life	(EPA 2010) Replace every 5-10 years	8% (Annett, K. 2022)
Total Indirect Annual Costs		\$21,983			
Total Annual Cost		\$22,452			
Filterable PM emissions	0.25 g/kWh	500 hr/yr	=	0.207 ton/yr	90% control (EPA 2010) = 0.186 ton/yr
Cost effectiveness		=	\$120,700 per ton PM		

Appendix B – Cost analysis workbook and the memorandum reference documents

The cost analysis workbooks for EU 1-12 and 29-34, and the reference documents for this memorandum are available for download via the following link:

<https://ftps.airsci.com/?ShareToken=E92E64247A1804358BCED57408D2B4B61F209D89>