March 31, 2026

Katie Woodstock, Senior Energy Advisor

Government of Yukon – Department of Energy, Mines, and Resources
Whitehorse, Yukon

Dear Ms. Woodstock:

**RE: ATCO Electric Yukon (AEY) Final Report for the Renewable Diesel Trial in Watson Lake**

Please find enclosed the final report on AEY's renewable diesel trial at the Watson Lake power plant, conducted in 2025 under the Transfer Payment Agreement (TPA) with the Yukon Government (YG). It provides further information to the interim report submitted on October 15, 2025.

Thank you for your support in conducting this trial at AEY's facility. Please let us know if any additional information is required.

Sincerely,

**Kyle Rolling**
Generation Supervisor

ATCO Electric
YUKON

# ATCO Electric Yukon

## Renewable Diesel Trial – Watson Lake Power Plant

## Final Report

March 31, 2026

### Executive Summary


In 2025, ATCO Electric Yukon (AEY) conducted a renewable diesel trial at the Watson Lake power plant under a Transfer Payment Agreement (TPA) with the Yukon Government, designed so eligible incremental trial costs would not be recovered from ratepayers. The trial evaluated the operational, cost, supply-chain, and emissions implications of using hydrotreated renewable diesel (HDRD) in remote, diesel-fired electricity generation.

Overall, HDRD was used safely in AEY's diesel generators when operated within OEM specifications and at temperatures above freezing, with no equipment damage or abnormal maintenance observed during the trial. However, HDRD's lower energy content and higher delivered cost increased fuel cost per unit of electricity generated relative to ultra-low sulfur diesel (ULSD).

With respect to emissions, current Canadian guidance – aligned with the GHG Protocol – results in HDRD blends providing material reductions in Scope 1 emissions due to the treatment of biogenic carbon. These reductions reflect accounting methodology rather than any decrease in physical stack emissions. AEY identified no change to Criteria Air Contaminants (CAC) emissions under current Yukon Government reporting requirements.

From a utility perspective – where service must be safe, reliable, and cost-effective – broader adoption of HDRD would require further assessment of cold-weather performance, storage/integration needs, long-term reliability impacts, and a path to address higher costs within a regulated rate-making framework.

## 1. Introduction and Purpose

This report provides the findings from the renewable diesel trial conducted at AEY's Watson Lake power plant in 2025. The trial was designed to assess the operational, cost, supply-chain, and emissions implications of using renewable diesel in remote diesel-fired electricity generation.

Specifically, the trial involved testing two HDRD blends – 99.9% and 20% – each for approximately 500hr operating periods. Testing was conducted in the late summer and early fall of 2025 to avoid potential cold-weather and cloud point limitations associated with HDRD fuel.

## 2. Facility and Equipment Overview

### *Facility*

The trial was conducted at AEY's prime power plant in Watson Lake, Yukon which supplies electricity to the microgrid serving Upper Liard, Lower Post, and Watson Lake.

Diesel generation is used at the plant because the equipment and fuel are cost-effective and well suited to remote operations, offering proven reliability and on-site storage capability (i.e., stable, safe, and energy-dense fuel that can be easily stored).

The site includes six diesel generator sets (gensets). Each genset in Watson Lake averages >3,000hrs per year and generally can be expected to have a lifespan of >100,000hrs. Genset dispatch is automated, with units sharing load as required. The plant typically generates over 15 million kWh per year.

AEY typically receives ULSD from distribution points in Edmonton, in accordance with a competitive tender for fuel supply. Depending on the grid load and associated fuel consumption, B-train deliveries can occur as frequently as every two to three days. Fuel is stored in two, 80,000L storage tanks, connected to supply and return manifolds. During summer operations, an air-cooled heat exchanger reduces the temperature of return fuel to the tanks to remain within engine tolerances.

### *Trial Equipment*

For this trial, Unit #1 was selected due to its reliability and proximity to the tank laydown area. Unit #1 is a Caterpillar 3512 diesel genset (1045 ekW 2400 V), purchased in 2020. As of June 2025, it had accumulated 13,280 operating hours, including approximately 500 hours since its March 2025 top-end overhaul. The unit's average annual runtime is approximately 3,150 hours.

Unit #1 was prioritized in the dispatch (i.e. top of stacking order) or operated manually to ensure it was in continuous service during the trial.

*HDRD Supply and Setup*

The HDRD trial volumes were competitively tendered. Two bids were received, and the supply contract was awarded based on price to the successful bidder (the Supplier).

Supply was delivered via B-trains from Calgary and was stored in a rental 61,000 L double wall tank, sized to receive the entire delivery volume. Rental hoses connected the tank to Unit #1's supply and return lines. AEY installed:

- Volumetric fuel meters (Flomec EGM) on supply and return lines
- Fine mesh strainers to protect the instrument
- A Fluidwell F127 differential flow computer
- A GE RX3i PLC card for SCADA monitoring
- A 10-micron bag filter (Parker CBC1D2T)

## 3. Trial Design, Phases, and Baseline

The HDRD trial was conducted in the late summer and early fall of 2025 to avoid potential cold-weather and cloud point limitations associated with HDRD fuel. A ULSD phase followed for a baseline assessment. Dates for each phase follows:

| Dates | Fuel Type |
|---|---|
| July 25 – Aug 21 | 99.9% HDRD |
| Aug 29 – Sep 25 | 20% HDRD |
| Nov 14 – Dec 11 | ULSD |

Before and after each phase, AEY completed oil changes, oil sampling and analysis, along with a technician inspection. During the HDRD trial period, a borescope visual exam was carried out to assess the condition of the equipment before moving on to the next phase. AEY has a maintenance contract for these services, which includes support from technical experts (such as engineers). While no issues were identified during the trial, extended operation would provide greater confidence in long-term equipment performance and reliability.

*Operational factors: 99.9% HDRD Trial Run*

- The local operator responsible for monitoring the equipment was unavailable for part of the trial period. To maintain reliability and proceed with the trial, AEY made temporary changes for approximately half the trial run:
  - Unit #1 was placed under manual control.
  - Two additional units were operated alongside Unit #1 to provide sufficient spinning reserve, reducing the risk of a grid outage.
  - Automation reduced the load factor on each genset, lowering overall fuel efficiency.

*Operational factors: 20% HDRD Trial Run*

- The trial included 2,823 L of 99.9% HDRD, blended into the rental tank at delivery, which remained as residual inventory after the first phase.
- The trial was interrupted twice due to low inventory and associated low fuel pressure. The operator temporarily shut the equipment down to avoid potential outages from unintended equipment shutdowns, waiting on delivery.
  - The Supplier advised that seasonal HDRD production and distribution from their upstream supplier ended on September 12, 2025, due to a lack of demand in colder weather when cloud point is a concern.

## 4. Operational Results and Observations

### *Mechanical Observations*

No issues related to engine condition, fuel quality, or equipment damage were observed during the trial. A representative condition report, completed following each trial phase, is provided in Appendix A. AEY operated in accordance with OEM guidance on biofuels (Caterpillar SEBU6251-29, 2022) and consulted the local dealer representative on to confirm HDRD operating limits and to identify potential risks.

### *Average Daily Loading*

AEY generally operates diesel generators within a 50-85% loading range of each unit's nameplate capacity and target an average of 70%. Loading fluctuates seasonally and throughout any given day and is shared amongst multiple generators dispatched. Loading and dispatch is automated in Watson Lake to ensure 1) equipment is operated within OEM recommendations for "prime duty"[1] 2) equipment is operated within its best fuel efficiency range (see appendix B), 3) to avoid "wet stacking"[2], and 4) to manage spinning reserve.

Average daily loading on Unit #1 for each trial phase is shown in the following chart:

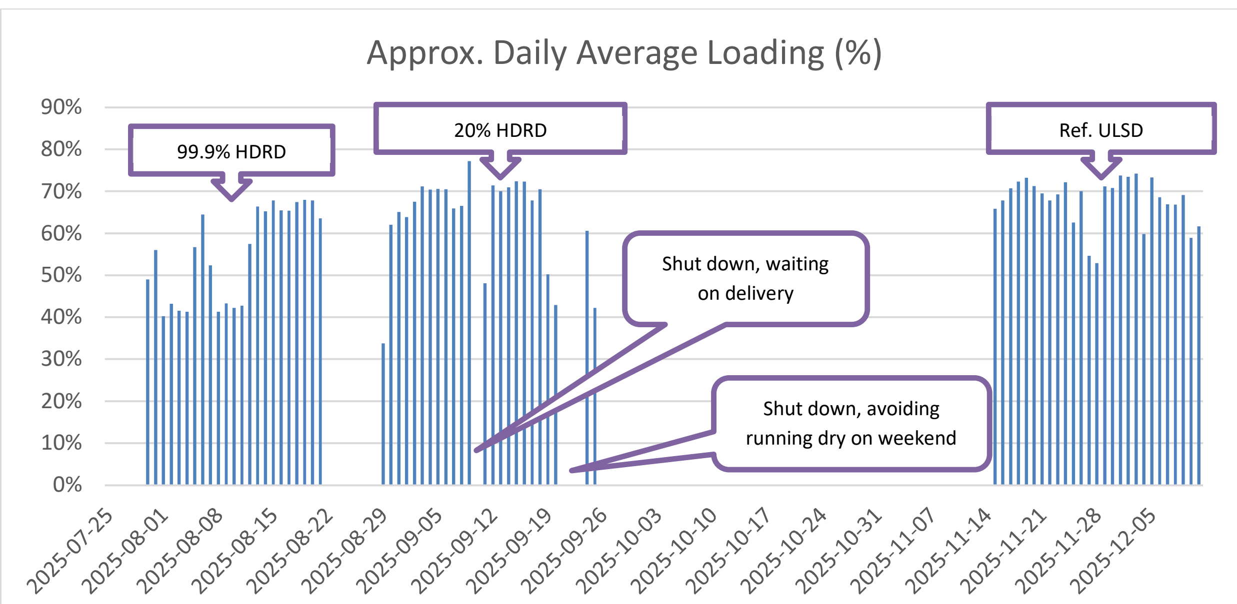


**Chart 1.** Time period of the trial showing each phase, interruptions, and equipment loading.

[1] Understanding Generator Set Rankings. Accessed from: https://www.cat.com/en_US/by-industry/electric-power/Articles/White-papers/understanding-generator-set-ratings.html
[2] Wet Stacking Prevention Technologies for Cat® 3500 Diesel Generator Sets. Accessed from: https://www.cat.com/en_US/by-industry/electric-power/Articles/White-papers/wet-stacking-prevention-technologies-for-cat-3500-diesel-generator-sets.html

### *Generator Output and Efficiency*

A reduction in engine output of up to 10% was expected due to lower fuel density[3]. For a comparable assessment of fuel efficiency during each trial run, the Heat Rate, or electrical output per unit of fuel consumed, is calculated and shown against OEM specification for the equivalent engine average loading using ULSD (Refer to Appendix B).

As observed, the HDRD fuel trials indicate lower heat density than ULSD:

| Fuel Type | Runtime (h) | Output (kWh) | Volume (L) | Average Load Factor | Avg. Heat Rate (kWh / L) | Reference Heat Rate adjusted for Load Factor (kWh / L) | Heat Rate Difference (%) |
|---|---|---|---|---|---|---|---|
| 99.9% HDRD | 550 | 297,068 | 90,591 | 51.7% | 3.28 | 3.55 | -8% |
| 20% HDRD | 503 | 365,627 | 99,214 | 69.6% | 3.69 | 3.70 | 0% |
| ULSD | 588 | 430,523 | 108,828 | 70.1% | 3.96 | 3.71 | +7% |

**Table 1.** Overview of generator output and efficiency.

[3] Canada Clean Fuel Regulations, Schedule 2. Accessed from: https://laws-lois.justice.gc.ca/eng/regulations/SOR-2022-140/page-19.html#h-1360785

## 5. Emissions Results

Watson Lake plant emissions are calculated and reported annually to the Government of Canada for air contaminants (NPRI, #31006) and for greenhouse gases (ECCC, #G10877). The facility's CAC emissions are also included in AEY's annual reports to YG, as required under authorization #60-052.

From a direct (on-site) combustion perspective, HDRD performs similarly to ULSD in diesel generators, and stack $CO_2$ emissions per liter are generally comparable. The key difference is how $CO_2$ emissions are classified and reported under Canadian federal reporting requirements[4] and the GHG Protocol[5]. Together, these frameworks form the accounting basis AEY uses for public disclosure of GHG emissions, and Watson Lake's federally reported GHG emissions are also required to be prepared on the same basis.

Under current reporting guidance:

- $CO_2$ from biomass-derived fuels is classified as biogenic $CO_2$ and reported separately, rather than included in Scope 1 totals.
- $CH_4$ and $N_2O$ emissions from combustion remain included in Scope 1.

Reported emissions for Watson Lake are calculated from fuel consumption estimates using standard emission factors and Global Warming Potentials (GWPs). Direct measurement methods (e.g. stack sampling, fuel consumption or exhaust validation testing, or computer-simulated emissions models) were not used for this trial.

| Trial Period Fuel Type | Reported Emissions (Scope 1 total) (tCO2e) | Biogenic $CO_2$ (reported separately) ($tCO_2e$) | ULSD Baseline (same volume) ($tCO_2e$) | Reported Scope 1 reduction* vs ULSD Baseline (%) | Scope 1 Emissions Intensity-Fuel Basis ($KgCO_2e/L$) | Scope 1 Emissions Intensity-Energy Basis ($KgCO_2e/kWh$) |
|---|---|---|---|---|---|---|
| 99.9% HDRD | 0.92 | 242.63 | 243.55 | 99.62 | 0.010 | 0.003 |
| 20% HDRD | 213.54 | 53.20 | 266.74 | 19.94 | 2.152 | 0.584 |
| ULSD | 292.58 | 0.00 | N/A | N/A | 2.688 | 0.680 |

** Note: Reduction (%) compares only the reported Scope 1 total (excluding biogenic $CO_2$) against the ULSD baseline for the same volume – this reflects the reporting convention, not a full life-cycle assessment.*

Published studies suggest renewable diesel can reduce certain CACs (e.g., $NO_x$, $SO_x$, CO, TPM, VOCs) under some conditions; however, Environment and Climate Change Canada's (ECCC) interim recommendation, given the absence of Canadian-published HDRD-specific CAC emission factors for harmonized reporting, is to apply ULSD CACs

[4] Reporting Greenhouse Gas Emissions. Accessed from https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/facility-reporting/reporting.html
[5] GHG Protocol Corporate Standard. Accessed from: https://ghgprotocol.org/

emission factors to avoid under-reporting until regulator-accepted factors are available or stack testing is completed. Considering the observed heat rate for HDRD in comparison to ULSD, the resultant CACs emissions could in fact be higher on a per energy intensity basis. This trial did not evaluate upstream (Scope 3) emissions; full lifecycle carbon intensity of HDRD can vary widely depending on feedstock and production pathway.

## 6. Costs

AEY invoiced YG under the TPA for eligible incremental HDRD trial costs (e.g., setup/removal and the fuel cost differential), with the intent that these incremental costs would not be recovered from ratepayers.

| Invoice | Date | Amount |
|---|---|---|
| A5517 | 2025-09-10 | $88,890.31 |
| A5547 | 2025-12-30 | $62,856.01 |
| **Total** | | **$151,746.32** |

The total invoiced cost was lower than the original estimate. The variance was driven primarily by favourable fuel pricing; discounted rates appear to have reflected the supplier's availability of surplus HDRD volumes outside of contracted commitments. In addition, the second phase of the trial used a 20% HDRD blend, whereas the original budget allowed for up to 50% HDRD for that phase (which has a higher price). These favorable prices are not guaranteed in future procurement cycles and may not be representative of long-term cost expectations.

YG was invoiced for the incremental cost of HDRD compared to ULSD at time of supply. The fuel pricing during the trial was as follows:

| **Date** | 7/7/25 | 8/7/25 | 8/22/25 | 9/6/25 |
|---|---|---|---|---|
| **Volume Delivered (L)** | 53,599 | 39,815 | 49,886 | 46,504 |
| **HDRD Delivered** | 99.9% | 99.9% | 20% | 20% |
| **ULSD Price[6] ($/L)** | 1.16 | 1.11 | 1.15 | 1.16 |
| **HDRD Price[1] ($/L)** | 1.59 | 1.61 | 1.36 | 1.33 |

[6] AEY's ULSD consumption at remote power sites is exempt from 1) federal excise tax, 2) Yukon fuel tax, and 3) federal output-based carbon pricing system. AEY understands this tax status is applicable to HDRD fuel as well. These exemptions provide fuel cost relief for ratepayers in our service area.

## 8. Further Considerations

AEY power production facilities are required to be reliable, redundant, and low cost. HDRD has the potential to reduce reported Scope 1 GHG emissions in AEY's operation. However, to integrate HDRD on an ongoing basis, the following considerations must be addressed:

### *Cloud Point and Seasonality*

- At AEY power generating sites, fuel consumption peaks in the winter due to customer electrical demand for space heating. The Supplier advised AEY that HDRD is unable to be stored and should not be used in this application below -5°C (Refer to Appendix C) due to cloud point concerns. The Supplier's upstream distributor only provides HDRD to the market between April and September due to their own storage limitations.
- Further research and development into cold weather operability of HDRD (and different blends) is required to address its seasonal use constraints, especially in northern, territorial environments. This poses a significant reliability risk that must be resolved to support broader operational use.

### *Infrastructure Integration*

- Temporary rental equipment was used during the Watson Lake trial to mitigate cross contamination issues with ULSD and existing equipment, manage inventory and delivery separately, and ensure adequate material compatibility. To accommodate regular seasonal batch runs or a permanent and recurring supply of HDRD, plant upgrades would be required. This would need engineering design and could be expected to include new tankage and piping along with secondary containment and remote monitoring. At present, due to AEY's economic regulation, upgrade costs would need to be contributed by government.
- Furthermore, the genset selected for the trial was known to be in good condition and up to date on its maintenance. More comprehensive equipment impacts of HDRD on various engines, under a variety of performance and loading characteristics, with longer trial periods would be insightful.

### *Supply Guarantee*

- HDRD production is contracted by distributors at the start of the calendar year. This is the ideal time to tender supply volumes, although actual costs are based on weekly rates at the supply point. Annual or multi-year seasonal commitments need to be defined in advance and sourced competitively to ensure lowest possible rates and cost-effective use of funds.

- As of August 2025, Imperial Oil is producing HDRD at its Strathcona refinery[7]. This is now the largest renewable fuel production facility in Canada and could result in a change in future pricing. This facility is noteworthy, but the overall Western Canadian supply of HDRD does not have the same abundance of distributors and retail locations as ULSD. The variety of suppliers and available storage of ULSD helps mitigate supply risk and reduces on-site inventory obligations, in a logistically challenging territory. Any future or permanent commitment of HDRD volumes at AEY facilities would need the ability to revert to ULSD without complication due to this risk.

***Emissions Reporting***

- Facility GHG emissions 10,000 tCO2e/y or more are required to report to the Government of Canada; Watson Lake has met this threshold for the past decade. If substantially larger volumes of HDRD were used, Watson Lake's reported Scope 1 emissions could fall below the reporting threshold, reducing federal visibility into site-specific emissions. Although AEY's emissions would still be included in ATCO Group's corporate-level reporting, this aggregated disclosure does not provide the facility-specific granularity.

- CAC emission factors or regulator-accepted testing protocols for HDRD use do not exist. These are federal and territorial regulatory frameworks, therefore the use of HDRD could introduce compliance uncertainty with current authorizations and permit obligations. Stack sampling tests and analysis, using a variety of blends, would help validate assumptions and reassure regulators that HDRD performs similarly to ULSD.

- Under the Clean Fuel Regulations (CFR), which replaced the former Renewable Fuels Regulations (RFR), the renewable content of diesel supplied in Canada now averages approximately 2%. The previous RFR exemption for northern remote power generation no longer applies under the CFR, resulting in a need for seasonal use of different renewable fuel blends, with higher blend products in summer and little to no biodiesel in winter. Based on discussions with the Supplier, this requirement is typically met using B5 blends during the summer months, reflecting seasonal constraints related to biodiesel's cold weather performance.

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[7] Imperial now producing renewable diesel at Strathcona refinery. Accessed from: https://www.imperialoil.ca/company/operations/strathcona/renewable-diesel-at-strathcona-refinery

***Ratepayer Cost Recovery***

- HDRD is more expensive per liter, and requires more liters for the same electricity production, than ULSD. As such, if HDRD was incorporated into regular operations, there would be an additional cost burden for rate payers. If there is a desire to pursue consistent or more regular use of HDRD in power generating sites, a variety of funding, regulatory, or subsidy methods would be required. For this trial, a project-specific contribution agreement was a successful administrative tool. However, this would not be effective for creating a multi-year, ongoing plan.
- Using the average incremental fuel price of $0.47/L for 99.9% HDRD and the observed reduction in reported Scope 1 emissions relative to ULSD, the unit cost of GHG emission reduction for AEY to switch fuels was $177/tCO2e. For 20%, HDRD, the smaller emissions benefit resulted in a higher cost of $345/tCO2e[8]. By comparison, in Alberta, the TIER fund price is $95/tCO2e[9], and, in BC, the Output Based Pricing System (OBPS) compliance charge rate is $110/tCO2e[10], in accordance with the Greenhouse Gas Pollution Pricing Act. This indicates that HDRD is a relatively expensive emissions reduction option and should be assessed against other, more cost-effective alternatives.

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[8] This represents only the incremental fuel cost; the capital cost of additional infrastructure integration, or operating cost of incremental maintenance such as treatment or heating, adds further expense.

[9] Defending Alberta industry during U.S. tariffs. Accessed from: https://www.alberta.ca/release.cfm?xID=93283B765EBC5-A9E8-D59B-01C010E7DF9C9D30

[10] B.C. OBPS Program and Reporting Guidance. Accessed from: https://www2.gov.bc.ca/assets/gov/environment/climate-change/ind/obps/guidance/bc_obps_guidance.pdf

## 9. Conclusion

As a regulated utility, AEY has a mandate to provide safe and reliable power at the lowest cost available to its customers. AEY currently relies on ULSD for isolated generating plants in the Yukon.

The Watson Lake renewable diesel trial demonstrated that HDRD can be used safely in AEY's diesel generators when operated within OEM specifications and at temperatures above freezing, with no abnormal maintenance or equipment condition concerns observed during the trial periods. However, HDRD increases fuel cost per unit of electricity generated relative to ULSD due to higher delivered price and lower energy content, and would require additional plant integration measures for routine use. While HDRD can materially reduce reported Scope 1 GHG emissions under current guidance, HDRD-specific CAC emission factors and regulator-accepted reporting frameworks are not yet available.

Based on these results, broader or recurring use of HDRD for remote generation would require: (1) a demonstrated approach to cold-weather operability and winter reliability; (2) a defined procurement and supply strategy that addresses seasonal availability and the ability to revert to ULSD; (3) fit-for-purpose infrastructure design and cost estimates for seasonal or permanent integration; (4) engagement with regulators and, if required, emissions validation (e.g., stack testing); and (5) a funding and cost-recovery mechanism consistent with AEY's regulated framework.

## Appendix A

Finning Condition Report Sep 19 2025 included in the following pages.

# Condition analysis report

**Customer: Yukon Electric Company Limited**

**Date: September, 19 2025**

**Job number: 2480835**

**Unit:WL#1**

**Unit hours: 14,434**

**Component: engine**

**Background information:** ATCO will be running renewable diesel and has requested a preliminary inspection of the cylinder bores and injectors.

Injector 1,3,5,7,9,11

Injector 2,4,6,8,10,12


#1 bore scope


#2 bore scope


#3 bore scope


#4 bore scope


#5 bore scope


#6


#7 bore scope


#8 bore scope


#9 bore scope

FINNING CAT


#10 bore scope


#11 bore scope


#12 bore scope

Valve chart all valves and injectors have been set to spec
Intake: 0.020”
Exhaust: 0.040”
Injectors: 64.34mm

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Valve | | | | Valve | | | |
| Before | After | | | Before | After | | |
| 0.028 | | Intake | | 0.019 | | Intake | |
| 64.42 | | Injector | No. 1 | 64.53 | | Injector | No. 2 |
| 0.036 | | Exhaust | | 0.039 | | Exhaust | |
| Valve | | | | Valve | | | |
| Before | After | | | Before | After | | |
| 0.02 | | Intake | | 0.018 | | Intake | |
| 63.38 | | Injector | No. 3 | 64.44 | | Injector | No. 4 |
| 0.042 | | Exhaust | | 0.039 | | Exhaust | |
| Valve | | | | Valve | | | |
| Before | After | | | Before | After | | |
| 0.015 | | Intake | | 0.013 | | Intake | |
| 64.32 | | Injector | No. 5 | 64.4 | | Injector | No. 6 |
| 0.036 | | Exhaust | | 0.038 | | Exhaust | |
| Valve | | | | Valve | | | |
| Before | After | | | Before | After | | |
| 0.023 | | Intake | | 0.019 | | Intake | |
| 64.45 | | Injector | No. 7 | 64.24 | | Injector | No. 8 |
| 0.04 | | Exhaust | | 0.039 | | Exhaust | |
| Valve | | | | Valve | | | |
| Before | After | | | Before | After | | |
| 0.017 | | Intake | | 0.021 | | Intake | |
| 64.36 | | Injector | No. 9 | 64.41 | | Injector | No. 10 |
| 0.04 | | Exhaust | | 0.038 | | Exhaust | |
| Valve | | | | Valve | | | |
| Before | After | | | Before | After | | |
| 0.015 | | Intake | | 0.017 | | Intake | |
| 64.49 | | Injector | No. 11 | 64.42 | | Injector | No. 12 |
| 0.039 | | Exhaust | | 0.043 | | Exhaust | |

## Comments:

Inspection Summary:
As per ATCO's request to assess the condition of the CAT 3512C engine prior to running it on renewable diesel, a visual inspection of the combustion chambers and injectors was carried out. The inspection involved removal of fuel injectors and borescope evaluation of the cylinder liners.

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Cylinder Liner Condition:
Borescope inspection was completed on all cylinders. Cylinder liners were found to be in good overall condition with consistent crosshatch patterns visible and no scoring, pitting, or signs of abnormal wear.
A minor amount of carbon deposit was observed at the top of the cylinder bores, consistent with normal diesel combustion. No immediate concerns were noted.

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Injector Condition:
All injector tips showed moderate carbon build-up, typical for hours accumulated and fuel type used to date. No damage, melting, or abnormal wear was observed on the tips. No other issues were present at the time of inspection.

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Conclusion:
The engine is in good condition and shows typical wear for service hours. There are no current issues that would prevent the unit from operating on renewable diesel. Recommend documenting fuel changeover and monitoring injector and combustion chamber condition during the early stages of renewable diesel use to assess impact on carbon buildup and combustion characteristics

**Appendix B**

Expected Performance Data for Unit 1 (Source: Caterpillar, Performance Number EM1212)

| Power [kW] | Loading [%] | Brake Specific Fuel Consumption [g/kWh] | Efficiency [%] | Volumetric Fuel Consumption [L/h] | Expected Heat Rate at various Load Factor for ULSD* [kWh/L] |
|---|---|---|---|---|---|
| 1045 | 100% | 206.1 | 40.8 | 270.50 | 3.86 |
| 940.5 | 90% | 207.3 | 40.6 | 244.80 | 3.84 |
| 836 | 80% | 210.5 | 40.0 | 221.40 | 3.78 |
| 783.8 | 75% | 212.6 | 39.6 | 209.90 | 3.73 |
| 731.5 | 70% | 213.8 | 39.4 | 197.40 | 3.71 |
| 627 | 60% | 216.8 | 38.8 | 172.60 | 3.63 |
| 522.5 | 50% | 221.0 | 38.1 | 147.80 | 3.54 |
| 418 | 40% | 227.0 | 37.1 | 123.20 | 3.39 |
| 313.5 | 30% | 236.7 | 35.6 | 98.20 | 3.19 |
| 261.2 | 25% | 244.4 | 34.4 | 85.40 | 3.06 |
| 209 | 20% | 255.7 | 32.9 | 72.30 | 2.89 |
| 104.5 | 10% | 311.5 | 27.0 | 45.10 | 2.32 |

*ULSD heating value 42,780 kJ/kg, density 838.9 g/L

## Appendix C

# Certificate of Analysis

| | | | |
|---|---|---|---|
| PO Number: | Shell RD99C CP CALGARY BC 1 | Order Number: | 1658084 |
| Product: | RD99C | Shipping Date: | 28-Jul-25 |
| Cust. Mat. No: | | Date of Mfg: | 28-Jul-25 |
| Product Code: | 800460 | Qty: | 29,105.635 UG6 |
| Batch # : | 2507280001 | Rail ID: | TILX354201 |
| Carrier: | 0010004477-BNSF RAILWAY COMPANY | | |

**Shipping To:**

SHELL CANADA PRODUCTS
10326 BARLOW TRL SE
CALGARY AB T2C 4K9

**Shipping From:**

[redacted]

| Test Description | Units | Method | Min. | Max. | Results |
|---|---|---|---|---|---|
| DISTILLATION, IBP (°F) | °F | D86 | | | 201 |
| DISTILLATION, 10% (°F) | °F | D86 | | | 537 |
| DISTILLATION, 50% (°F) | °F | D86 | | | 553 |
| DISTILLATION, 90% (°F) | °F | D86 | 540 | 640 | 556 |
| DISTILLATION, EP (°F) | °F | D86 | | | 596 |
| API GRAVITY @ 60°F | | D4052 | | | 47.5 |
| BS & W | %(V) | D2709 | | 0.05 | 0.00 |
| FLASH POINT, PMCC (°F) | °F | D93 | 126 | | 137 |
| VISCOSITY @ 40°C | cSt | D445 | 1.90 | 4.10 | 3.37 |
| CETANE INDEX | | D4737A | 40.0 | | 91.6 |
| CETANE INDEX | | D976 | 40.0 | | 74.5 |
| CLOUD POINT (°F) | °F | D2500 | | 23.0 | 1.0 |
| ASH:** | %(m) | D482 | | 0.100 | 0.001 |
| CARBON:** | %(m) | D524 | | 0.15 | 0.04 |
| CONDUCTIVITY | pS/m | D2624 | 25 | | 246 |
| COPPER CORROSION | | D130 | | 3 | 1A |

Analysis Certified By : Maurice Frey (Printed Name) Laboratory Manager (Title) Lab Signature/Loader

All sales of Products b[redacted]d its subsidiaries and affiliates are subject to the applicable terms and conditions of sale a[redacted]hich are incorporated herein by reference.