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LABORATORY TEST REPORT

Lab. Test Reference #: 202411-TR1766-DEL03
Job Order #: 11-3031-2024J

TDEC-LAB 009
Revision No. 3
Revision Date: 17 May 2021

Company Name	**Delta Grid Power System Corporation**			Address	Amon Compound, Ugong Norte, Pasig City		
Location	**Petron Corporation**	Manufacturer	**Hyundai**		**1997**	Container	**Syringe**
Equip. ID	**Substation U / TR-U1**	Type of Oil	**Mineral**			Syringe S/N	**0570**
KVA Rating	**2300 / 2645**	Oil Temp	**56°C**			Received Date	**November 18, 2024**
Voltage Rating	**4160 / 480**	Preservation	**Sealed with Nitrogen**			Test Date	**November 18 - 28, 2024**
Serial #	**T974292**	AGE (years)	**27**			Release Date	**November 29, 2024**

Dissolved Gas Results - ASTM D 3612

	Limits			Present
Sample Date				**11/14/2024**
Hydrogen	75	(ppm)	H_2	443.5
Methane	90	(ppm)	CH_4	7.1
Ethane	90	(ppm)	C_2H_6	22.9
Ethylene	50	(ppm)	C_2H_4	12.7
Acetylene	1	(ppm)	C_2H_2	0.0
Carbon Monoxide	900	(ppm)	CO	299.7
Carbon Dioxide	10000	(ppm)	CO_2	2,602.0
Nitrogen		(ppm)	N_2	107,055.8
Oxygen		(ppm)	O_2	9,216.7
O2/N2 Ratio				0.086

ANALYSIS AND INTERPRETATION

Table 1 Limits based on IEEE C57.104-2019

- ►**Hydrogen is above limits. Indicates Possible corona.**
- Methane within normal limits
- Ethane within normal limits
- Ethylene within normal limits
- Acetylene within normal limits
- Carbon Monoxide within normal limits
- Carbon Dioxide within normal limits

Duval's Triangle Method indicates:

Fault Code

Triangle 1 Not Applicable
Triangle 4 or 5

Duval's Pentagon Method indicates:

Pentagon 1
Pentagon 2

IEC 60599 Ratio Method indicates:

C_2H_2 / C_2H_4	0.00	code = 0
CH_4 / H_2	0.02	code = 1
C_2H_4 / C_2H_6	0.55	code = 0

►**Partial Discharges of Low Energy density.**

Rogers Ratio Method (present sample) indicates:

C_2H_2 / C_2H_4	0.00	code = 0
CH_4 / H_2	0.02	code = 1
C_2H_4 / C_2H_6	0.55	code = 0

►**Low Energy Arcing (Partial discharge.)**

OIL QUALITY TEST RESULTS (Limits used are based on IEEE C57.106-2015, ≤ 69 kV voltage class)

DESCRIPTION	ASTM/IEC STD	UNITS	LIMITS	VALUE
Sample Date				**11/14/2024**
Water Content	D1533	ppm	35 Max	65.7
Dielectric Breakdown Voltage	D1816, 2mm	kV	40 Min	16.9
Acidity/Neutralization No.	D664	mg KOH/g	0.2 Max	0.0521
Interfacial Tension	D971	dynes/cm	25 Min	13.95
Color/Visual Examination	D1500/1524	-	3.5 Max / Clear	L1.5 / Clear
Oil Power Factor @ 60hz, 25°C	D924	%	0.5 Max	0.02674
Dielectric Constant @ 25°C	D924	-	Ref	-
Volume Resistivity @ 25°C	D1169	Ohm-Meter	Ref	-
Oil Conductivity @ 25°C	D1169	pS/m	Ref	-
Specific Gravity	D1298	kg/liter	0.91 Max	-
Kinematic Viscosity @ 40°C	D445	cSt	12.0 Max	-
Total Sediments	D1698	%	Ref	-
Soluble Sludge	D1698	%	Ref	-
Oxidation Inhibitor Content	D2668	%	0.08 Min	-
Metal Passivator -	-	mg/L	-	-
Particle Count > 5 µm per mL	D6786	µm/mL	1300 Max	-
> 15 µm per mL		µm/mL	160 Max	-
ISO Class		-	-	-
Contamination Level		-	Normal	-
Corrosive Sulfur	D1275B	-	Non-corrosive	-

RECOMMENDATIONS:

Based on Dissolved Gas Analysis Results

CO2/CO ------
DGA Status ► DGA Status 3
Resampling ► Perform DGA confirmation within a month to confirm DGA status
Faults ► Possible partial discharge
Addtl Remarks
► Recommended next sample date: December 14, 2024

Based on Oil Quality Results

► Oil Regeneration / Oil Replacement is recommended to reduce moisture, improve interfacial tension and dielectric strength.

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