# Fluid Analysis Report

|  |  |  |  |
| --- | --- | --- | --- |
| *Equipment* | TRAN 9958464 | *Rated kV* | 69.000 |
| *Serial No.* | 14241295 | *In service* | False |
| *Apparatus type* | TRN | *Spare* | True |
| *Substation* | Speedway | *Tank* | main |
| *Designation* | SW 01 | *Norms used* | TRN\_IEEE\_INC\_69KV |
| *Norms* | TRN\_IEEE\_INC\_69KV | *DGA result* | 1/1 |
| *Fluid type* | OIL | *Fluid condition* | 1/1 |
| *Description* | Transformer | *Moisture code* | 1/1 |
| *Manufacturer* | U. S. TRANSFORMER | *PCB result code* | 0/1 |
| *Model* | 2500 KVA | *Oil test status* | UNREVIEWED |

Gas Analysis

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *Lab Report Number* | 172665-012 | 167845-016 | 162181-016 | 156235-023 | 150688-021 |
| *Sample date* | 2012-10-02 | 2011-12-13 | 2010-12-28 | 2009-12-16 | 2008-12-04 |
| *Fluid temp* | 32 | 32 | 30 | 35 | 25 |
| *Hydrogen (H2)* | 5 | 5 | 7 | 6 | 15 |
| *Methane (CH4)* | 27 | 27 | 30 | 26 | 27 |
| *Ethane (C2H6)* | 21.0 | 23.0 | 22.0 | 19.0 | 17.0 |
| *Ethylene (C2H4)* | 8.0 | 9.0 | 10.0 | 10.0 | 10.0 |
| *Acetylene (C2H2)* | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| *Carbon Monoxide (CO)* | 362 | 389 | 432 | 428 | 531 |
| *Carbon Dioxide (CO2)* | 5136 | 5437 | 5501 | 5251 | 5490 |
| *Oxygen (O2)* | 1857 | 1891 | 1083 | 1138 | 1211 |
| *Nitrogen (N2)* | 81997 | 85942 | 86905 | 82061 | 81648 |
| *Total heat gas* | 56 | 59 | 62 | 55 | 54 |
| *TDCG* | 423 | 453 | 501 | 489 | 600 |
| *Equivalent TCG* | 0.336 | 0.343 | 0.380 | 0.399 | 0.502 |
| *Total partial press* | 91.3 | 95.7 | 97.2 | 89.8 | 93.7 |
| *Est. safe handling limit* | 11.2 | 11.3 | 11.2 | 11.3 | 10.8 |
| *Calculated monitor µL/L* | 70 | 75 | 85 | 83 | 111 |
| *CO2/CO* | 14.188 | 13.977 | 12.734 | 12.269 | 10.339 |
| *Oxygen/Nitrogen (O2/N2)* | 0.023 | 0.022 | 0.012 | 0.014 | 0.015 |
| *NEI-HC* | 0.22 | 0.23 | 0.24 | 0.22 | 0.21 |
| *NEI-CO* | 8.56 | 9.09 | 9.37 | 9.01 | 9.80 |
| *DGA retest days* | 365 | 365 | 365 | 365 | 365 |
| *DGA retest date* | 2013-10-02 | 2012-12-12 | 2011-12-28 | 2010-12-16 | 2009-12-04 |
| *DGA reference days* | 294.0 | 350.0 | 377.0 | 377.0 | 364.0 |
| *DGA result* | 1 | 1 | 1 | 1 | 1 |

*Gas Analysis Remarks*

No anomalies.

*Gas Analysis Summary*

*Variable name* Value Units Description

Carbon Monoxide (CO) 362 µL/L Level alert (high 351).

co\*

Fluid Quality

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *Lab Report Number* | 199452-029 | 192053-032 | 179163-007 | 172665-012 | 159934-009 |
| *Sample date* | 2017-04-22 | 2016-01-21 | 2013-11-21 | 2012-10-02 | 2010-08-10 |
| *Fluid temp* | 27 | 20 | 25 | 32 | 47 |
| *Dielectric breakdown D1816 (1 mm)* | 40.0 | 40.0 | 35.0 | 33.0 | 30.0 |
| *PF at 25 C* | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| *PF at 100 C* | 1.220 | 0.970 | 0.940 | 0.750 | 0.560 |
| *Acid number* | 0.010 | 0.010 | 0.012 | 0.010 | 0.010 |
| *Interfacial tension* | 36.6 | 35.6 | 37.0 | 36.6 | 38.0 |
| *Oxidation inhibitor* | 0.220 | 0.220 | 0.220 | 0.230 | 0.190 |
| *Specific Gravity* | 0.880 | 0.882 | 0.885 | 0.883 | 0.883 |
| *Color* | 2.0 | 2.0 | 2.0 | 2.0 | 1.5 |
| *Oil quality index* | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| *Visual* | CLEAR | CLEAR | CLEAR | CLEAR | CLEAR |
| *Fluid quality retest days* | 365 | 365 | 365 | 365 | 365 |
| *Fluid quality retest date* | 2018-04-22 | 2017-01-20 | 2014-11-21 | 2013-10-02 | 2011-08-10 |
| *Fluid condition* | 1 | 1 | 1 | 1 | 1 |

*Fluid Quality Analysis Remarks*

No oil quality problems were detected.

Moisture Analysis

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *Lab Report Number* | 199452-029 | 192053-032 | 179163-007 | 172665-012 | 159934-009 |
| *Sample date* | 2017-04-22 | 2016-01-21 | 2013-11-21 | 2012-10-02 | 2010-08-10 |
| *Fluid temp* | 27 | 20 | 25 | 32 | 47 |
| *Moisture* | 3 | 7 | 5 | 7 | 14 |
| *Relative saturation* | 4 | 13 | 7 | 8 | 9 |
| *Dew point* | -34 | -21 | -26 | -21 | -8 |
| *Moisture code* | 1 | 1 | 1 | 1 | 1 |

*Moisture Remarks*

The water content of the oil is acceptable.

PCB Analysis

|  |  |
| --- | --- |
| *Lab Report Number* | 138613-011 |
| *Sample date* | 2006-08-16 |
| *Fluid temp* | 33 |
| *Total PCB* | 0.0 |
| *PCB result code* | 1 |

*PCB Remarks*

Not PCB contaminated.

History Graphs and Diagnostic Charts

# Hydrogen (H2)

100



80

60

µL/L

40

20

0

200

150



µL/L

100

50

0

# Methane (CH4)

1996 2001 2006 2011 2016

# Ethane (C2H6)



60

40

µL/L

20

0

1996 2001 2006 2011 2016

# Acetylene (C2H2)

1996 2001 2006 2011 2016

# Ethylene (C2H4)

60



50

40

µL/L

30

20

10

0

1996 2001 2006 2011 2016

# Carbon Monoxide (CO)

3.0



2.5

2.0

µL/L

1.5

1.0

0.5

0.0

1996 2001 2006 2011 2016

600

400



µL/L

200

0

1996 2001 2006 2011 2016

6000



4000

µL/L

2000

0

# Carbon Dioxide (CO2)

20000



15000

µL/L

10000

5000

0

# Oxygen (O2)

1996 2001 2006 2011 2016

# Nitrogen (N2)

1996 2001 2006 2011 2016

# Total heat gas

100000



80000

60000

µL/L

40000

20000

0

1996 2001 2006 2011 2016

# TDCG

60

40



µL/L

20

0

1996 2001 2006 2011 2016

# Equivalent TCG

600



400

µL/L

200

0

1996 2001 2006 2011 2016

# Total partial press

100



80

60

atm

40

20

0

1996 2001 2006 2011 2016

# Calculated monitor µL/L

200



150

µL/L

100

50

0

1996 2001 2006 2011 2016

0.5

0.4



0.3

%

0.2

0.1

0.0

1996 2001 2006 2011 2016

# Est. safe handling limit

12



10

8

6

%

4

2

0

1996 2001 2006 2011 2016

# CO2/CO

15



10

5

0

1996 2001 2006 2011 2016

# Oxygen/Nitrogen (O2/N2)

0.30



0.30



# NEI-HC

0.20 0.20

kJ/kL

0.10 0.10

0.00

1996 2001 2006 2011 2016

# NEI-CO



10

8

kJ/kL

6

4

2

0

1996 2001 2006 2011 2016

# PF at 25 C

0.00

1996 2001 2006 2011 2016

# Dielectric breakdown D1816 (1 mm)

50



40

30

kV

20

10

0

1996 2001 2006 2011 2016 2021

# PF at 100 C

0.4



0.2

0.0

%

-0.2

-0.4

1996 2001 2006 2011 2016 2021

# Acid number

0.20



0.15

mg KOH/g

0.10

0.05

0.00

1996 2001 2006 2011 2016 2021

# Oxidation inhibitor



0.20

0.15

%

0.10

0.05

0.00

1996 2001 2006 2011 2016 2021

1.0

0.5



%

0.0

1996 2001 2006 2011 2016 2021

# Interfacial tension

50



40

30

mN/m

20

10

0

1996 2001 2006 2011 2016 2021

# Specific Gravity



0.8

0.6

0.4

0.2

0.0

1996 2001 2006 2011 2016 2021

2.0



1.5

1.0

0.5

0.0

# Color

0.4



0.3

0.2

0.1

0.0

# Oil quality index

1996 2001 2006 2011 2016 2021

# Moisture

40



30

mg/kg

20

10

0

1996 2001 2006 2011 2016 2021

# Fluid temp

1996 2001 2006 2011 2016 2021

# Relative saturation

30



25

20

15

%

10

5

0

1997 2002 2007 2012 2017 2022

60



50

40

°C

30

20

10

0

1996 2001 2006 2011 2016 2021