Trojan Dry-Out System

Patented Portable Online Transformer Dry-Out System with automatic Filter Regeneration

The Trojan Dry-Out System (TDOS) can be safely connected and left unattended to operate on any energised transformer main tank. The TDOS will provide a safe and cost effective solution for accurate water contamination analysis, water in cellulose reduction and gas from oil removal. With a sound history of reliability and many fail safe features, the TDOS will provide an economical and effective alternative to current methods of drying out transformers, online or offline. The TDOS is compatible with both mineral and FR3 oils.

Features – Asset Management

- **Accurate on-line water contamination Analysis**
- **Understand the real oil / cellulose dielectric risk**
- **Remove water in the insulation cellulose to exact levels**
- **Extend the natural life of the cellulose insulation and the transformer**
- **Reduce operating costs**

Features – using the Trojan

- **Connect to and leave unattended on energised transformers**
- **Automated Commissioning cycle with screen prompting**
- **Analysis Cycle to confirm water contamination levels**
- **Water Removal Cycle with automatic filter regeneration**
- **Long life water removal filters: 18-24 months before change out**
- **Degassing Cycle – low or high vacuum options available**
- **Automated decommissioning cycle at removal**
- **Very easy and safe to use**
- **Low maintenance**

Operators find them simple and very easy to use, with screen and audible prompting and colour coded valves. The large capacity adsorbent water removal filters last up to 2 years with regular regeneration without losing water removal effectiveness. Easy to replace spin on filters are used to remove particle down to very low levels. The oil hoses have a secondary outer hose to further prevent leakage, and return any oil back to the Trojan sump to activate the leak sensor. The Trojan requires minimal maintenance, and has a long proven history of safe, unattended operation.

Commissioning (Set up) Cycle:

After connecting the oil hoses and safety isolation valves to the transformer main tank, plugging in the power supply, the operator selects “Commissioning” on the PLC screen. The Trojan goes through a quick check process before the PLC screen prompts the operator to open the oil valves

on the transformer, allowing the Trojan oil pump to draw oil down both hoses to remove all air. This is followed by a closed circuit process to prepare the Trojan for use. The total commissioning time is less than 20 minutes, and this automated cycle is specifically designed for safe connection to energised transformers. Once commissioned it is ready for operation in the Treatment Cycles

Treatment Cycles

Three optional Treatment Cycles are offered. Hours are entered into the PLC screen by the operator to confirm what they require the Trojan to do. Only the treatment cycles that have hours entered against them are performed (zero hours = no action). The screen example shown below will take the Trojan automatically through 2 days of Analysis, no degassing, and then go into a 24 hour cycle of water removal and automatic filter regeneration. The water removal cycle will continue until the TDOS is stopped.

Analysis Cycle:

The TDOS is fitted with a high quality water in oil relative saturation (relative humidity) sensor to provide accurate transformer water in oil activity Analysis in real time. During the Analysis Cycle, oil is drawn from the transformer and directed past the sensor then returned to the transformer through the final particle filters. Water in oil relative humidity (relative saturation %), water in oil PPM and oil temperature are recorded at 30 minute intervals. This Analysis data allows accurate water in cellulose diagnosis prior to water removal, and allows a real understanding of dielectric risk.

Degassing Cycles (two models available)

Low Vacuum model (LV)

The Trojan LV includes uses a vacuum pump rated to 60 Torr / 80 mbar. During the optional / selectable Degas Cycle the system will remove a high percentage of the dissolved gases from the oil as a general clean up, and to also minimise the occurrence of bubble evolution on wet transformers which can occur during a rapid rise in temperature. Bubble evolution can occur when the oil is cold and the water migrates from the cellulose faster than the oil can adsorb it, and remains as a gas.

High Vacuum model (HV)

The TDOS HV (High Vacuum) model includes an additional, higher capacity vacuum pump (maximum rating of 0.5 Torr) that operates only during the degassing cycle. The HV vacuum pump is sized to progressively reduce gas saturated oil down to low levels by continuously circulating the total oil volume while the transformer remains energised. The oil is not heated by the Trojan and is processed at the temperature received from the transformer.

Note: On both of the degas cycles (LV & HV) the vacuum is only created on the oil within the Trojan vacuum chamber and not on the oil hoses or main tank of the transformer.

Water Removal Cycle:

The Trojan uses large capacity adsorbent filters to store water during filtering. At regular intervals the filters are automatically regenerated (re-died).
During the filter regeneration process the flow of oil from the transformer ceases, and the Trojan is isolated from the transformer. After the regeneration process the Trojan automatically starts filtering the oil in the transformer again and continues the filtering / regeneration process until stopped.

This filter regeneration process is unique to the Trojan Dry-Out System, and is covered by patent.

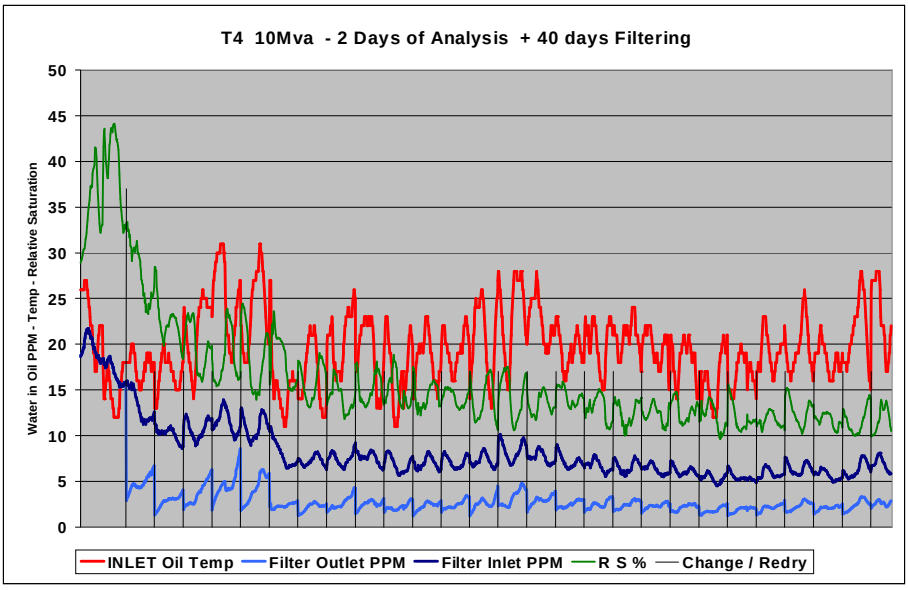
Regenerating the Filters at regular intervals considerably increases water removal efficiency and accelerates the water removal process from the transformer. This provides a very low cost solution to managing water levels in transformers. The water removal Filters are large capacity and will typically only need to be changed every 2 years. The Filters can be regenerated many times without a reduction in effectiveness.

Note: The benefit of the Trojan filter adsorption water removal method rather than the alternative continuous high vacuum systems is that it does not remove the nitrogen blanket from the transformer, disturb the oil DGA, and remove lighter fractions / aromatics from oil altering its chemical qualities.

Decommissioning Cycle:

Before disconnecting the Trojan from the transformer, the operator selects the "Drain System" option on the PLC screen, which takes them through a safe process of returning the oil in the Trojan back into the transformer. The operator is guided through the process with screen prompts.

Example – Analysis and water removal



The transformer in this example was a 10mva 3 phase distribution ONAF with 12,000 litres (3200 US gal) oil. The chart shows 2 days of online Analysis where the oil peaked at 22 ppm at a bottom oil temperature of 27ºC, and

the relative humidity peaked at 44%. The Trojan was set in the 36 hour Water Removal Cycle, and over the 40 days the Filters were regenerated a total of 27 times, removing **4.6** litres (1.25 US gallons) of water from the

transformer insulation. This was the first session of water removal on this transformer the Trojan was removed to allow equilibrium to occur, the returned for re-analysis and more water removal.
The example above shows the water in oil PPM values measured by the water in oil sensor before and after the filters, to demonstrate the water removal efficiency of the Trojan. The filters are not fully saturated before regeneration, creating a strong disequilibrium between the oil and the cellulose insulation, accelerating the migration rate. The filter adsorption / regenerating process provides a very low cost transformer water reduction solution, without altering the DGA.

All of the data in the above graph is stored in the PLC, and accessed (downloaded) from the Trojan either onsite or from a remote location by modem, Ethernet etc. This capability provides Utilities with a powerful tool for assessing the real health of their transformers over various load profiles. Data recorded includes date and time, Inlet oil temperature, Inlet water in oil relative saturation, Inlet oil water in oil PPM and Trojan operating data.

Safety features

- Automated connection to energised transformers
- Energised open / spring closed ball valves at the transformer end of the oil hoses that close on all fault alarms and loss of power, isolating the transformer
- Double skinned oil hoses with leak detection, in conjunction with pressure sensing for irregularities
- Fault alarms can be sent via SCADA, SMS text messages, email
- Large oil containment sump with fast acting oil leak detection switches
- Exterior emergency stop switch
- Fully weatherproof and lockable
- Remote start / stop function and data download

Communication options/ features

- Onsite or remote site data download.
- Trojan Monitor software – allows full control of the Trojan from the office. Stop / start, alter the hours of filtering, or change between the Analysis, Degassing or Filtering cycles. Also view real time water in oil values, etc.
- Hardware and software options available to allow remote data download and operation via Web based Ethernet communication via cellular network

Warranty – Twelve month warranty (excludes consumables; fair wear and tear).

Manual / training - Full operating, safety and maintenance manual is supplied. Training is usually recommended for one day onsite, or as required.

Website

Visit our website www.dryoutsystems.com for more Analysis and water reduction examples.

Contact: contactus@dryoutsystems.com