



**DELTA-X**  
RESEARCH

*Bringing science to risk management*

## Transformer Oil Analyst™ (TOA4)

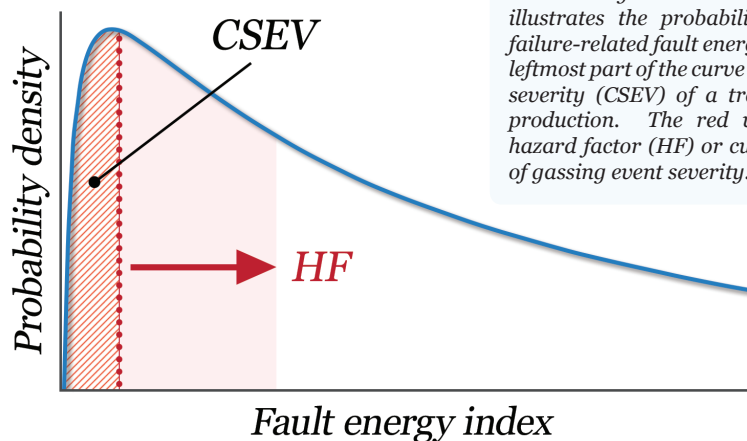
Advanced diagnostic software for insulating fluid test data, including DGA, for high-voltage apparatus

Reliable and safe operation of the electric power grid requires confidence in the state of vital assets – something that is constantly challenged by aging equipment, experienced staff retirement, and budget constraints. Addressing these challenges is required for the best possible maintenance of and capital planning for equipment like power transformers.

### Scientific

With a scientifically sound foundation developed from 25 years of research, TOA4 provides the most correct interpretation of dissolved gas analysis (DGA) data available today. Reliability-based Dissolved Gas Analysis uses real-world reliability data to create an innovative statistical model that correlates fault gas production and transformer failures.

Based on real-world experience and first principles science, TOA4 is a key decision support tool designed to assess the state of high-voltage apparatus and help you make decisions regarding the maintenance, refurbishment and replacement of critical assets with confidence, while optimizing capital budgets.



#### **Reliability-based DGA Model:**

Invented by Dr. James Dukarm, this model illustrates the probability density curve for failure-related fault energy. The area under the leftmost part of the curve represents cumulative severity (CSEV) of a transformer's fault gas production. The red vector represents the hazard factor (HF) or current rate of increase of gassing event severity.

### Easy

TOA4 is easy to access and easy to use, delivering high-quality assessments of insulating oil test data to operations, maintenance, asset managers and enterprise systems. It flags and diagnoses problems quickly, while avoiding false alarms.

### Independent

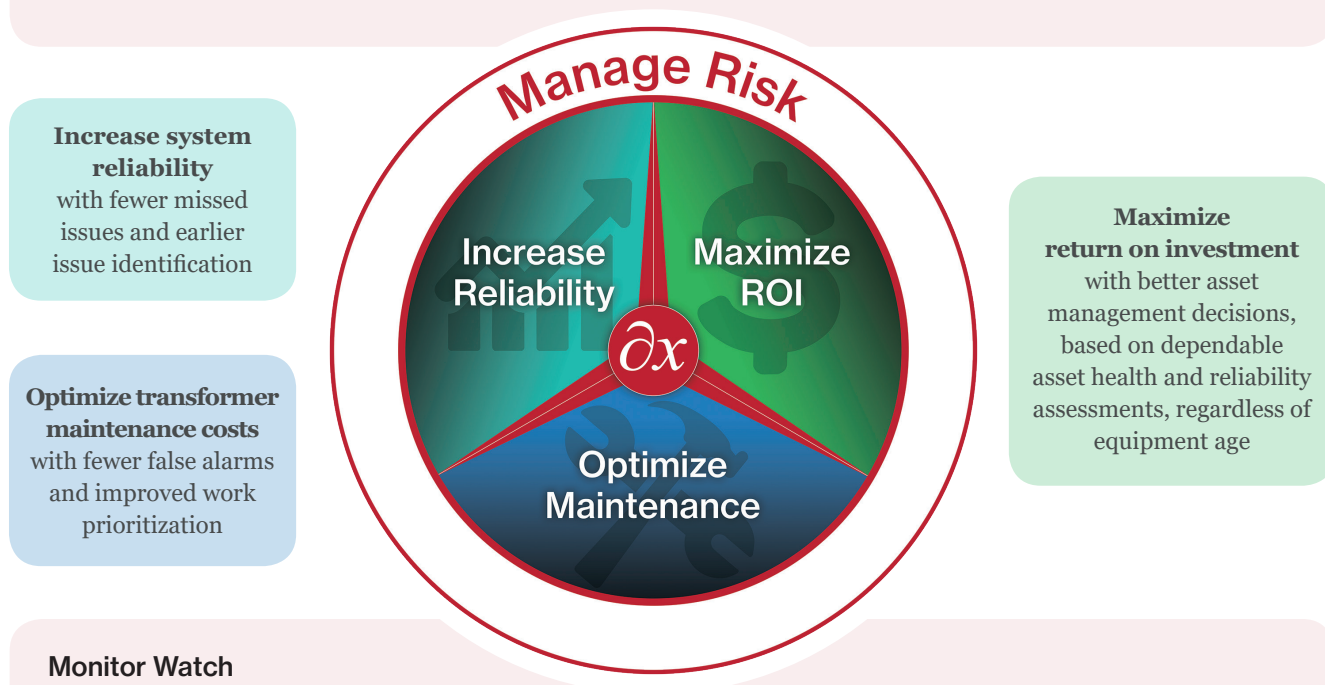
Because Delta-X Research is not affiliated with any hardware manufacturer or service provider, you can trust that TOA4 software is a truly independent decision support tool, supporting data from any lab or online monitoring device.

## Reliability-based DGA: The Most Correct Interpretation of Dissolved Gas Analysis

Utilities have shared their test and reliability data and experiences with us for over 20 years, allowing us to research and develop the most advanced analytics for interpreting insulating fluid test data for transformers and other high-voltage electrical equipment.

TOA4 has been enhanced with an innovative new method called Reliability-based Dissolved Gas Analysis. Rather than using simple limits or setpoints as employed by conventional DGA, Reliability-based DGA identifies and assesses power transformer abnormalities by correlating fault gas production with transformer failures. It is based on a statistical analysis of a large set of real-world transformer reliability data.

By tracking the fault energy index related to dissolved gases, Reliability-based DGA outperforms conventional DGA and assesses transformer gassing behaviour to provide event severity, hazard factor and fault type.



## Monitor Watch

Many utilities and large industrials are turning to online monitoring to safeguard critical assets and ensure plant operations. But online monitoring has challenges, including delivery of far more data than traditional testing, which makes manual screening of raw monitor data impractical.

TOA4's Monitor Watch option manages and interprets online monitoring data from any manufacturer's monitoring device to deliver high-quality DGA status assessments to operations, maintenance, asset managers and enterprise systems in real-time. And because TOA4 handles both lab and monitoring data, it provides consistent information in status and diagnostic reports, regardless of data source.

Monitor Watch produces high-quality status and diagnostic reports with statistical and graphical summaries for high-voltage equipment experts. Conventional DGA applies simple limits to online monitor data, which produces a lot of false alarms. But with Monitor Watch and Reliability-based DGA, key personnel can feel confident that notifications of equipment requiring additional or urgent attention are truly critical events.

Online DGA monitors are sophisticated electronic instruments susceptible to data quality problems. Monitor Watch evaluates the noise level in monitor data output to detect early signs of sensor deterioration or other problems, so staff can ensure that the safeguards are working at their optimal levels.

## Features

- Stores and manages any test data, including
  - Laboratory and online monitor data
  - Raw test data, fluid sample tracking, and equipment nameplates
  - Info to meet compliance requirements for regulators and insurers
- Interprets insulating fluid test data for
  - Dissolved gas analysis (DGA)
  - Oil quality analysis
  - Moisture in oil
  - Furans (including all 5 commonly measured furans)
  - Particle counts and particle statistics
  - Metals and trace elements in oil
  - PCBs in oil
- Automatically processes new test data to generate condition assessment reports ready for review
  - Flags abnormal results
  - Notifies key personnel of equipment requiring attention (for urgent situations or regular activities) according to user-configured diagnostic alerts
- Assesses power transformers, load tap changers and other liquid-filled electrical apparatus
- Supports popular alternative insulating fluids such as esters, less-flammable hydrocarbons, and silicon
- Applies state-of-the-art analytics
  - Offers advanced interpretation with Reliability-based DGA, using innovative statistical analysis of a large set of real-world transformer reliability data, including failure events
  - Provides analysis criteria based on industry standards from IEEE, IEC, and CIGRE
  - Compares conventional DGA results with Reliability-based DGA results
  - Includes Duval triangle diagnosis for transformers and load tap changers
  - Supports new diagnostic methods for tap changers, voltage regulators, and oil circuit breakers
  - Tracks online monitors for deteriorating data quality
- Users can modify or create analysis norms and criteria
- Scales for large & small apparatus fleets
- Various and flexible reporting
  - Supports basic testing, condition assessment, and maintenance tasks
  - Allows fleet equipment comparisons & prioritization with user-configurable lists and alerting functions
  - Indicates newly-received and unreviewed test data
  - Identifies equipment requiring further attention or testing
  - Offers preconfigured graphs to visualize data and results
  - Lets users add write-protected expert comments and recommendations
  - Exports results in PDF format for easy distribution
  - Enables users to download data for spreadsheet analysis or other offline work
- Open & published interfaces
  - Unrestricted data transfers to and from TOA4
  - Easy data extraction to other tools (like Microsoft Excel)
  - Simple integration with enterprise systems with optional application programming interface (API)
  - Secure authorization for safe and unfettered access with no impediments by proprietary lock-ins when you need to move data
- User interface
  - 24 x 365 access via all major web browsers
  - Designed for fast access in office and on mobile devices
  - Multiple pre-defined user roles with tiered access & use privileges
- Web-based service
  - Annual & multi-year subscription terms
  - Base configuration plus optional features
  - No additional server licencing or on-premises server administration
  - No software to install on user computers
  - Updates and bug fixes are automatically broadcast to all users regularly
  - Automatic updates for all users mean zero installation effort

## ***Bringing science to transformer risk management™***

Since 1992, Delta-X Research has invested in the research and development of advanced analytics for assessing the health of high-voltage equipment. Generation, transmission and distribution utilities around the world, as well as leading industrial operations, rely on Delta-X Research to provide key decision support tools for managing their critical assets.

With over half of the largest utilities in the USA as TOA4 subscribers, you join a large community whose combined experience over two decades has been applied to create the most effective and recognized diagnostic tool for assessing and tracking the condition of high-voltage electrical apparatus. With TOA4, you are in good company.



**Delta-X Research Inc.  
Victoria BC Canada**

**[www.deltaxresearch.com](http://www.deltaxresearch.com)**

**Sales: [sales@deltaxresearch.com](mailto:sales@deltaxresearch.com) | +1 250.592.2998  
Inquiries: [info@deltaxresearch.com](mailto:info@deltaxresearch.com)**