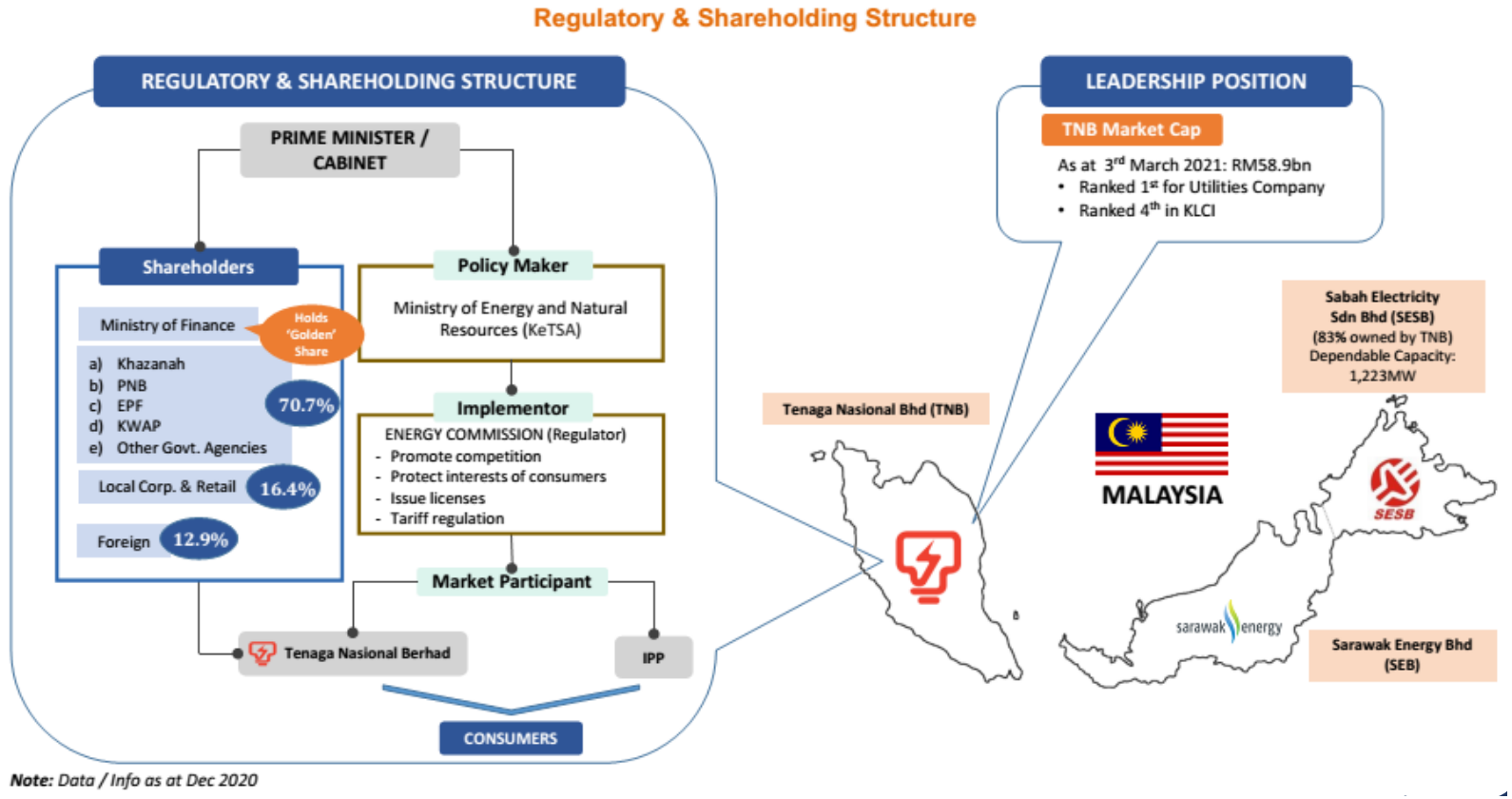
AVEVA PI WORLD

PI DGA – Duval's Triangle as Custom Symbol in PI Vision

AVEVA

INTRODUCTION TO TENAGA NASIONAL

TNB's core activities are in the generation, transmission and distribution of electricity. TNB also engages in other energy-related operations, such as the manufacturing of transformers and the providing of consulting services. The company primarily generates revenue through the sale of electricity in West Malaysia. Its customers are mainly commercial operations, domestic consumers, and large industrial entities



***Note:** Data / Info as at Dec 2020*

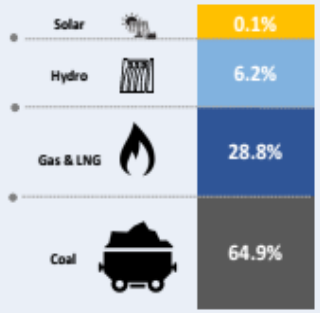
INTRODUCTION TO TENAGA NASIONAL

Regulated & Non-Regulated Business

Core Business

Generation	Grid/Transmission	Distribution Network & Retail
Non-Regulated Business	**Regulated Business**	

TNB Generation Mix:



Installed Capacity:
25,212MW
TNB: 14,561MW @ 57.9%
IPP: 10,854MW @ 42.1%

Generation Market Share:
61.3%

Equivalent Availability Factor (EAF):
87.4%

Note: TNB installed capacity & Market Share are based on gross capacity

Transmission Network Length:
23,964KM

Transmission Substations:
456

Transmission System Minutes:
0.08 mins

Distribution Network Length:
683,008KM

Distribution Substations:
83,467

SAIDI:
45.0mins

Customer Satisfaction Index (CSI):
8.1

Source: TNB Data / Info as at Dec 2020

Non-Core Business

Main Subsidiaries

Non-Regulated Business

Operation & Maintenance (O&M)
- TNB Repair & Maintenance Sdn. Bhd. (REMACO)

Manufacturing
- Tenaga Switchgear Sdn. Bhd.
- Malaysia Transformer Manufacturing Sdn Bhd.
- Tenaga Cables Industries Sdn. Bhd.

Renewables, Energy Efficiency & Other Services
- TNB Renewables Sdn. Bhd.
- GSPARX Sdn. Bhd.
- TNB Energy Services Sdn. Bhd.
- TNB Engineering Corporation Sdn. Bhd.
- Integrax Bhd.
- Allo Technology Sdn. Bhd.

Education & Research
- TNB Integrated Learning Solution Sdn. Bhd. (ILSAS)
- TNB Research
- University Tenaga Nasional (UNITEN)

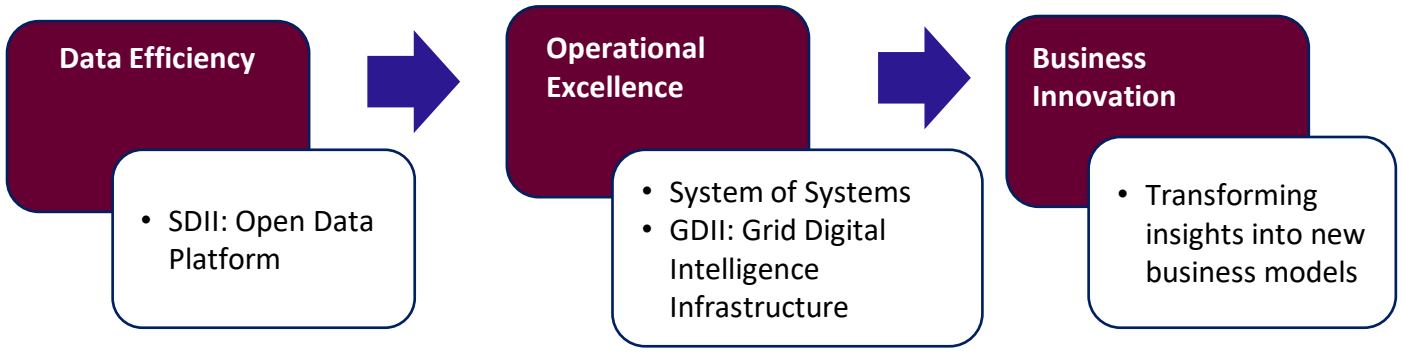
GRID DIGITAL TRANSFORMATION (GDT) INITIATIVE

From Application Centric to Data Centric

SITUATION

- Digital disruption has levelled the playing field allowing the opportunity for existing and new players to start from the same line.
- Digital Transformation is about leveraging innovation, changing mind-sets and leading change.

STRATEGY



DIGITAL TRANSFORMATION CHALLENGE

How to design & implement continuous and sustainable improvement successfully

Set Up Infrastructure and framework to :-

- "Harmonise" and support existing digitalization initiatives
- Harness data to gain insights
- Turning insights into actions to derive value
- Adapt to get the most value out of advancement in digital technology – future proof, extensible, scalable

Inculcate the Outward Digital Mindset

DIGITAL DISRUPTION → DIGITAL TRANSFORMATION → BUSINESS INNOVATION

LEADING BUSINESS BY TRANSFORMING INTO A DIGITAL ENTERPRISE

DIGITAL TRANSFORMATION (GDT) INITIATIVE

GRID Division is committed towards achieving the aspirations of Reimaging TNB and delivering the Grid of the Future (GotF) through Grid Modernization and Grid Digitalization. GRID Digital Transformation roadmaps our strategic journey of Grid Digitalization.

GRID DIGITAL TRANSFORMATION

Leveraging Digital Intelligence, Harnessing In-House expertise Into Operational Excellence

As part of the realization effort, **4 key pillars** have been identified for implementation and execution in order to attain the following outcomes through various initiatives within each pillar

1

INTELLIGENT ASSET MANAGEMENT

Cost Effective & Reliable Assets

$ Improve return on capital and optimize asset reliability

Intelligent Asset Management is about creating a network of smart connected assets giving us intelligence, heighten our state of situational awareness, enabling us make the right decisions and the right strategy to ensure that our assets perform reliably and to its full capability thus realising our investments.

2

DIGITAL EMPOWERED WORKFORCE

Effective Intervention

$ Increase productivity, safety and efficiency of workforce

Effective intervention is about having the right person being at the right place at the right time doing the right thing with the right tools and support. With digital technology, we can equip our workforce with the necessary tools to help them accomplish their tasks in the most efficient and safe manner.

3

FLEXIBLE GRID

Self-Healing, Robust & Flexible Grid

$ Optimize revenue on energy and system reliability

Our assets form the Grid which is the backbone of the power transmission system that our country depends on. With digital technology, we can make our grid robust against failures yet flexible to adapt to changing demands in the energy market. We will use digital technology to ensure we operate the Grid in the most efficient and reliable manner,

4

INSIGHTS AND INNOVATION

Drive Data Centricity, Insights and Innovation

$ Continuous Improvement and Innovation

We need to continuously turn data into insights, insights into innovative solutions, and we need to deploy and scale these solutions into our organization. For this we will need to leverage advanced analytics to build on our internal expertise and experience.

2

DIGITAL EMPOWERED WORKFORCE

Effective Intervention

Increase productivity, safety and efficiency of workforce

Business Challenges

Power Transformer one of the major assets in an Electric Utility

- The Online Monitoring system is a continuous real-time system that monitors the condition of selected critical equipment and provides an alarm indication in the event of sudden failures. This will be beneficial in providing the condition of such equipment in real-time and thus reducing the probability of sudden equipment failures.
- The common Transformer OMS project implementation usually covers end-to-end delivery from site installation work for sensors, data acquisition and transfer process, and a dedicated application based on vendor of choice. By implementing a centralised and integrated OMS module and have all the sensors data stored within the centralised historian, it will converge the silo-monitoring activity, streamline our manpower resources, and increase the sharing of information and data correlation between assets, and our maintenance zones.
- Paradigm shift from age-related maintenance schedules and visual inspections, we are investing in new technologies including remote asset tracking and monitoring, preventive maintenance, condition-based monitoring, and predictive maintenance to drive efficiencies and cut costs.

2

DIGITAL EMPOWERED WORKFORCE

Effective Intervention

Increase productivity, safety and efficiency of workforce

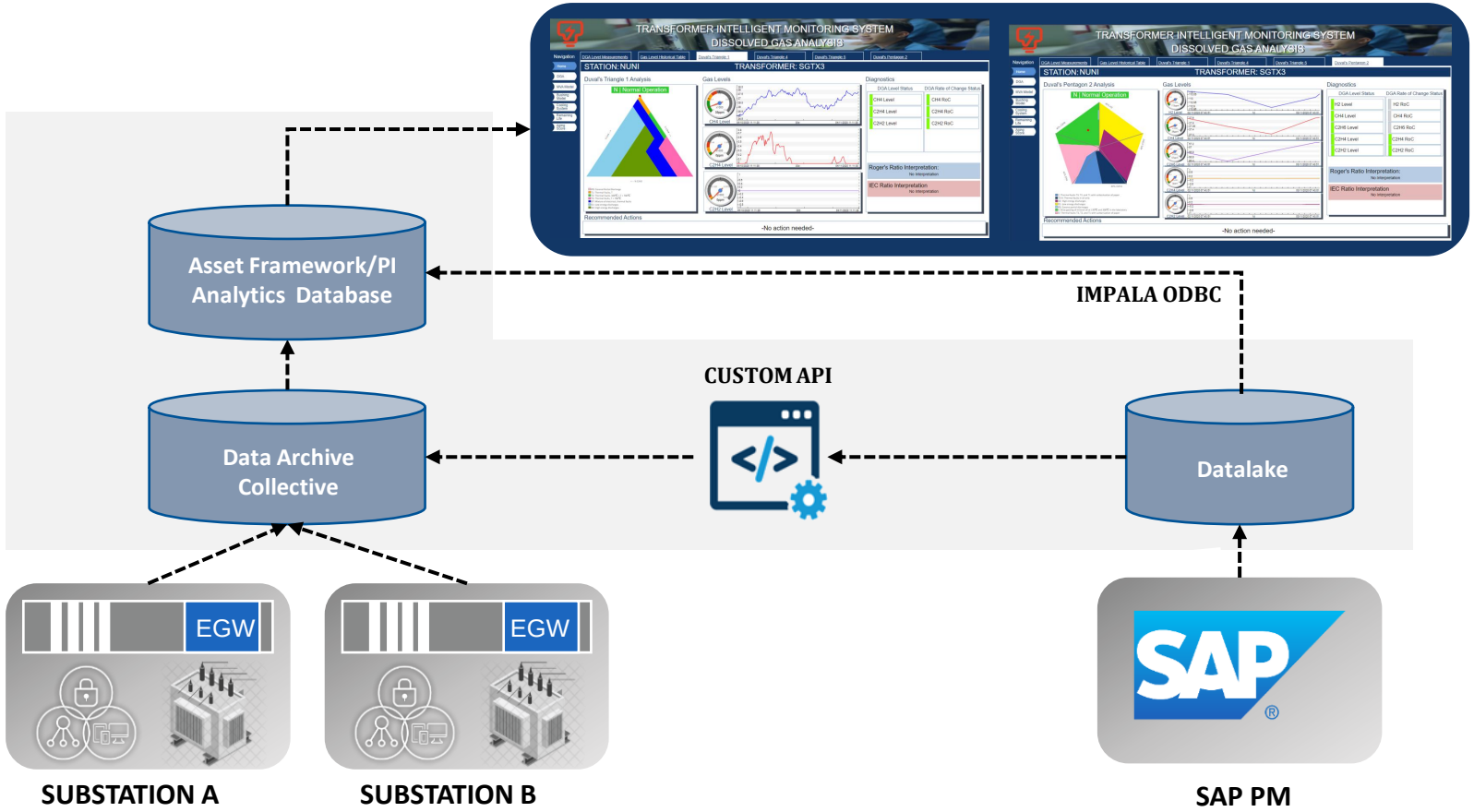
Business Challenges

Consolidating the data centrally for easy access and analysis.

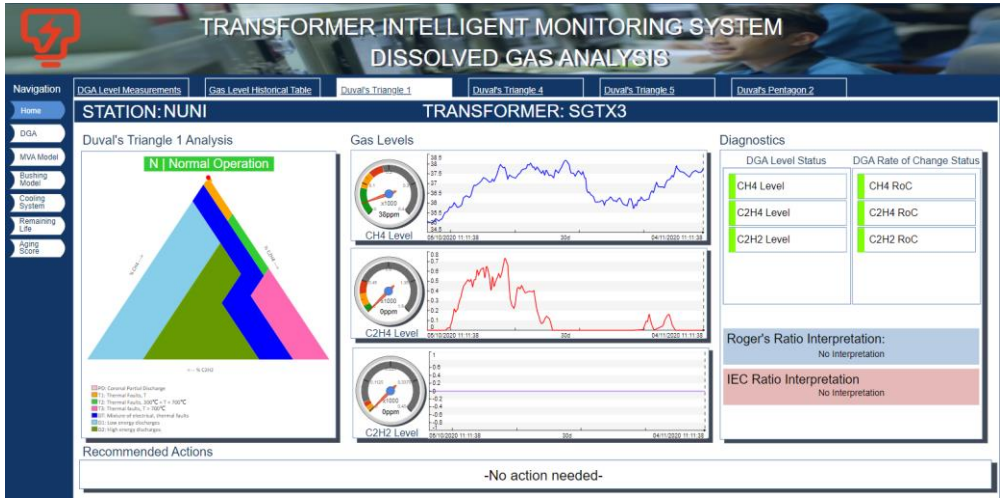
DGA | MVA Model | Bushing Model | Aging Score | Remaining Life

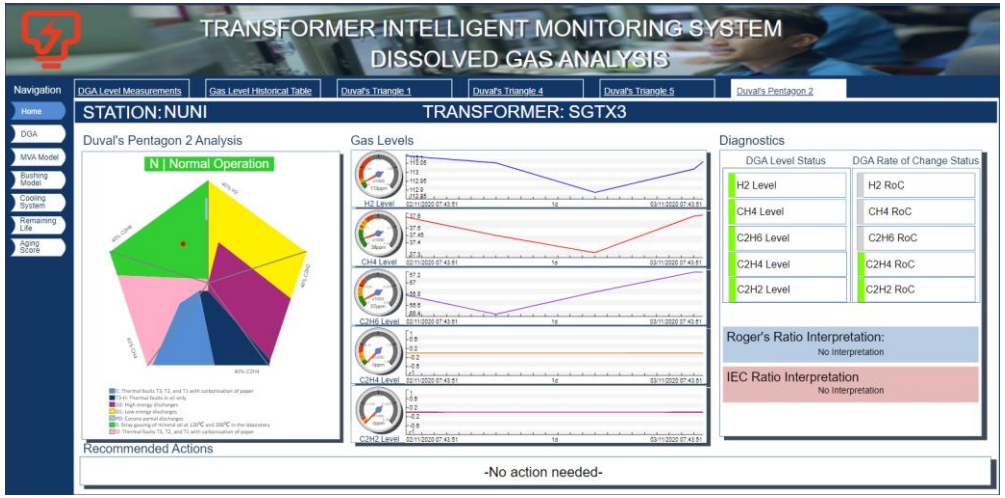
- DGA is considered the best method for determining a transformer's overall condition and is now a universal practice. Advantages of DGA include:
  - Advanced warning of developing faults
  - Status checks on new and repaired units
  - Convenient scheduling of repairs
  - Monitoring of units under potential overload conditions.

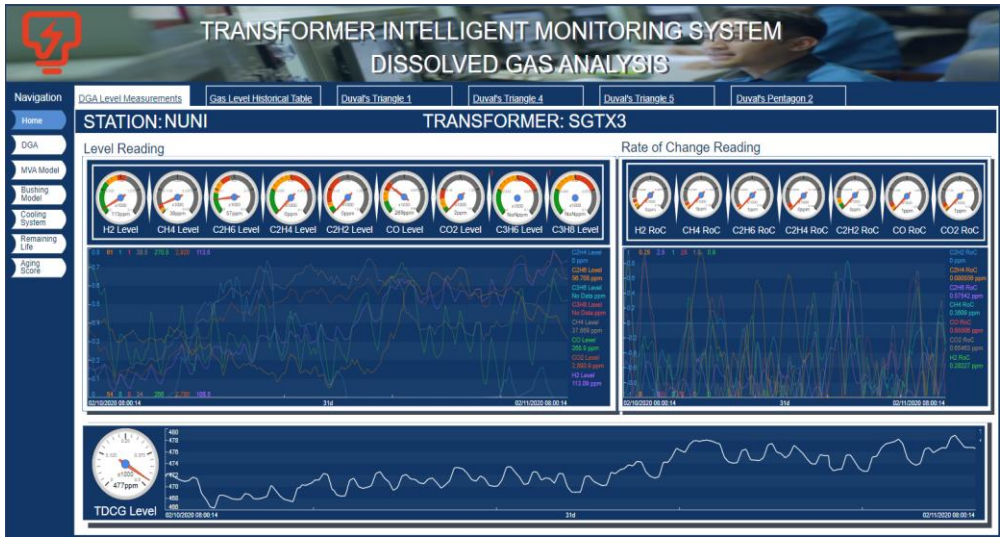
TRANFORMER ONLINE MONITORING SYSTEM ARCHITECTURE FOR TNB



DEPLOYMENT OF CALIBR8 DGA ANALYTICS ENGINE







- Thermal and electrical stresses that occur within normal operating transformers generate hydrocarbon gases that degenerated from Transformer oil which can indicate potential problems within the transformer.
- Dissolved Gas Analysis (DGA) as a method for determining the types of pending or occurring faults within power transformer by determining ratios and proportions of certain gasses produced.

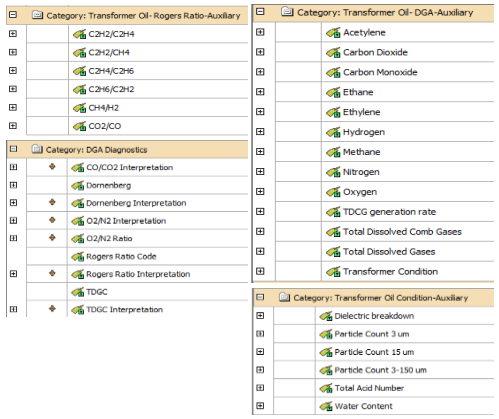
APPLICATION OF THE PI SYSTEM FOR DGA ANALYTICS ENGINE

Connect DGA Analyzer

- Without integration to the DCS
- Via Dell IoT Gateway or Calibr8 Offline Loggers
- Near-real-time to Real-time Data Collection

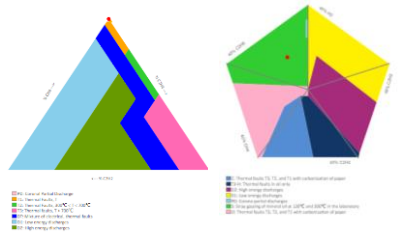
Integrate into the PI Asset Framework

- All Key Gas Ratios and Algorithms was imputed into PI AF

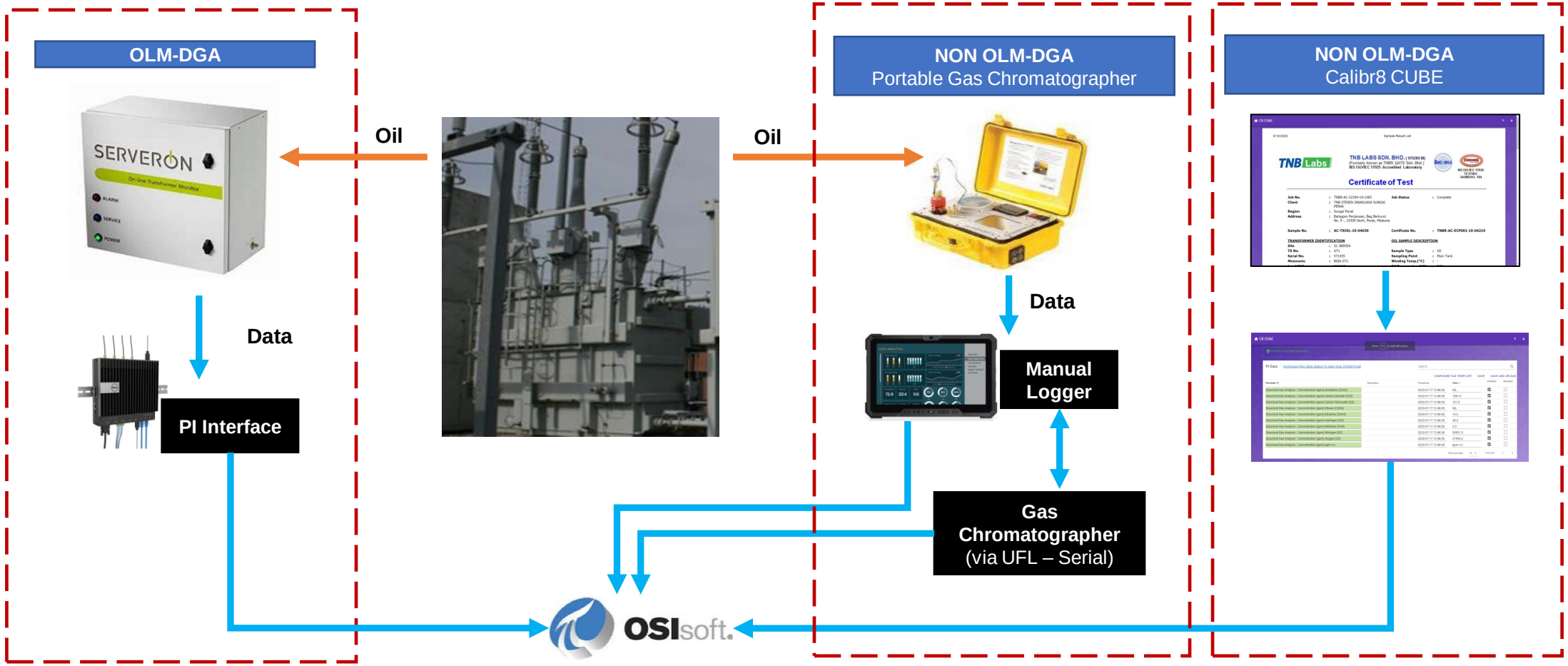


Develop Custom Symbols in PI Vision

- Developed by Calibr8 Systems – Services Provider
  - Duval's Triangle Real time plotting
  - Automated Interpretation and Diagnostics

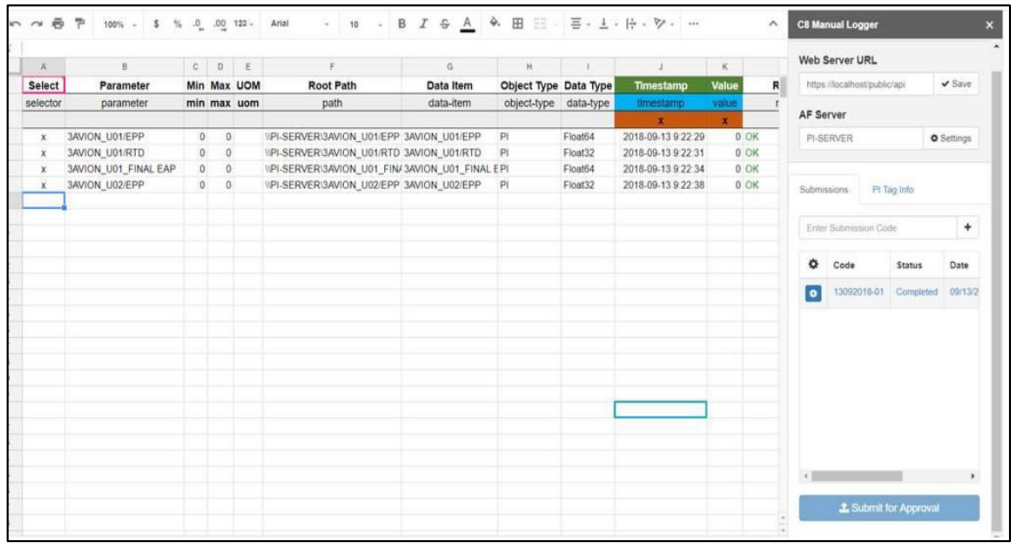


HIGH LEVEL ARCHITECTURE

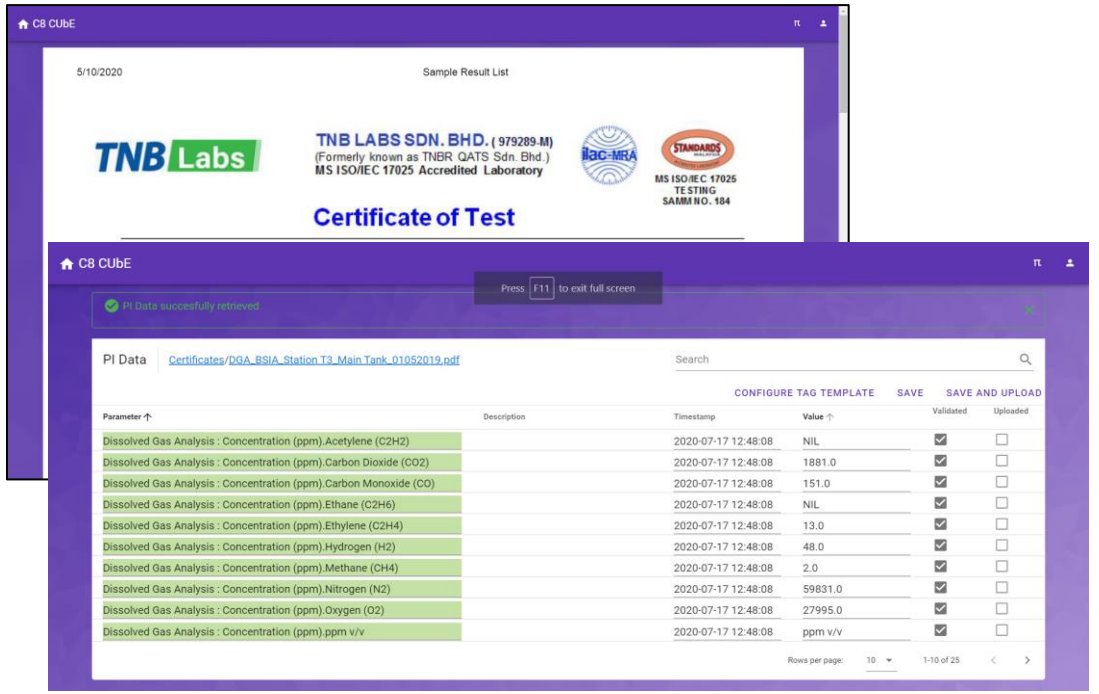


OFFLINE DATA COLLECTORS

Calibr8 Offline Logger: Google Sheet Add-In



Calibr8 CUBE: Certificate Uploader and Batch Extractor



BUSINESS IMPACT

Cost Effective Solution across the Fleet

- *Development by Local Service Provider – Calibr8*

No Dependencies from 3rd Party DGA Provider

Correlation to all data that is being collected

Better Planning for Electrical Assets

Future Proof Solution that will be rolled out across the fleet

- *NO Excuse for Data Collection*
- *Online DGA Integration*
- *Gas Chromatographer (ChemLab) integration – serial port*
  - *PI UFL via IoT Gateway*
- *Manual Data or Batch Inputs*
- *Internal expertise can be a shared resource across*

CUSTOMER SUCCESS STORY

Challenge

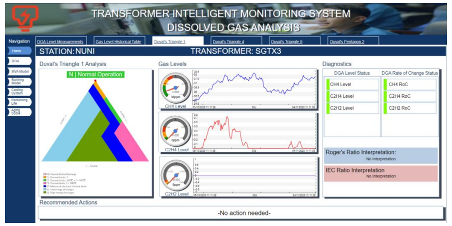
- Manual Analysis of Power Transformer Data
- Full Dependency from 3rd Party
- Reactive Maintenance
- No Real time Visibility
- No Data Correlation

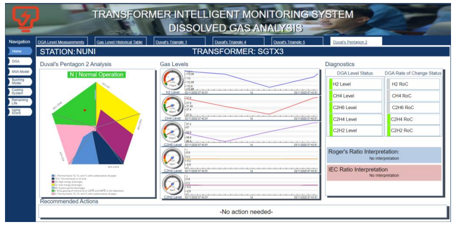
Solution

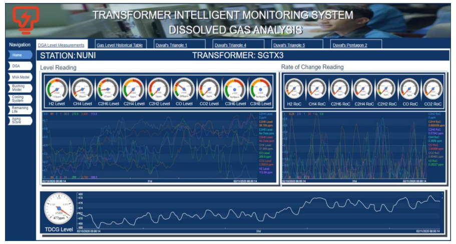
- Integration to PI System
- Development of Online DGA Application with Duval's Triangle and Pentagon
- Future proofing the solution across the Fleet

Benefits

- Internal Expertise that can be used to manage the Transformers across the whole fleet
- Rate of Change Analytics as an Early Warning System
- Real time decision making = better planning
- Saving $$$







“ Duval's Triangle in PI Vision was the key to Management buy-in to roll out the application across the Fleet. ”

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