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

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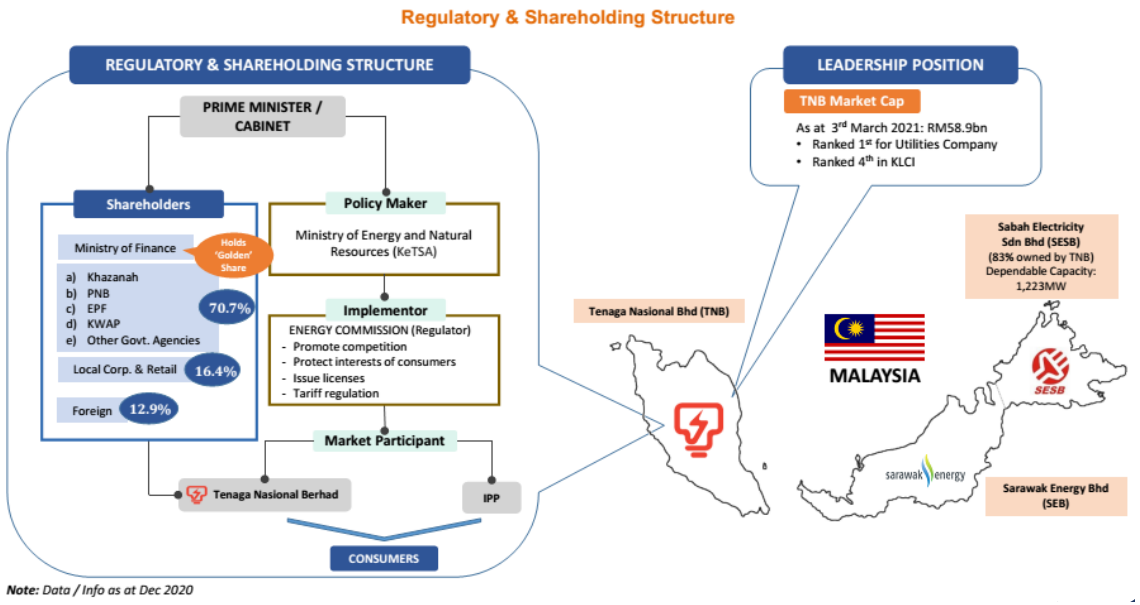
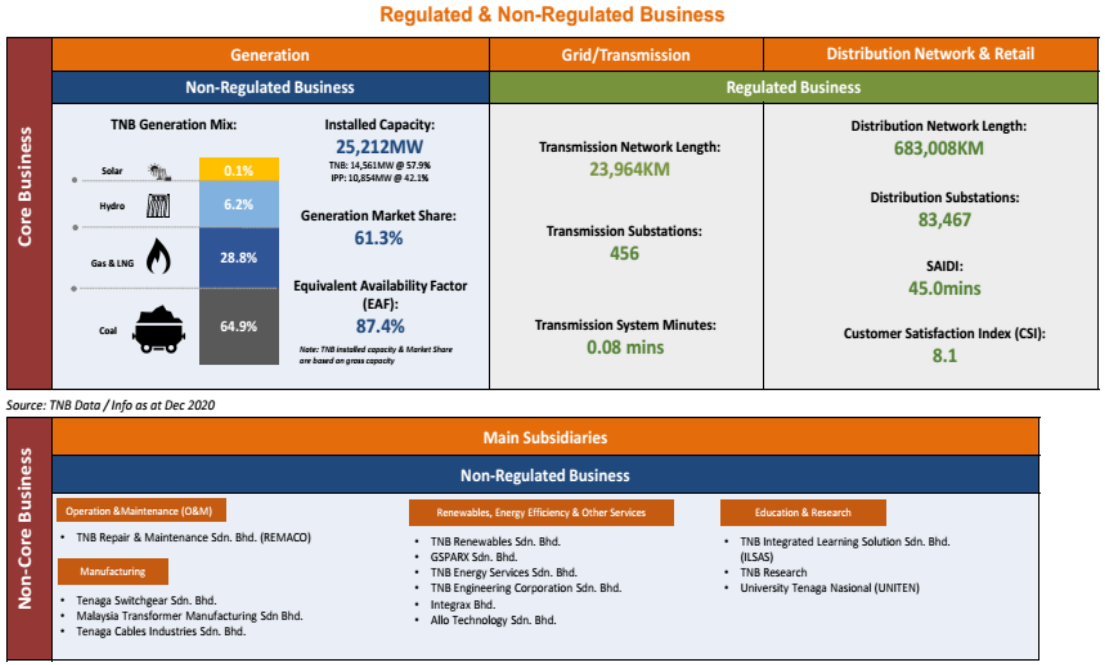
INTRODUCTION TO TENAGA NASIONAL

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



Source: TNB Data / Info as at Dec 2020

GRID DIGITAL TRANSFORMATION (GDT) INITIATIVE

From Application Centric to Data Centric

GRID DIGITAL TRANSFORMATION

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

STRATEGY

Data Efficiency
- SDII: Open Data Platform

Operational Excellence
- System of Systems
- GDII: Grid Digital Intelligence Infrastructure

Business Innovation
- Transforming insights into new business models

SDII *- Substation Digital Intelligence Infrastructure*
GDII *- Grid Digital Intelligence Infrastructure*

DIGITAL DISRUPTION → DIGITAL TRANSFORMATION → BUSINESS INNOVATION
LEADING BUSINESS BY TRANSFORMING INTO A DIGITAL ENTERPRISE

4 KEY DIGITAL PILLARS

1 **INTELLIGENT ASSET MANAGEMENT**
Cost Effective & Reliable Assets
Improve return on capital and optimize asset reliability

2 **DIGITAL EMPOWERED WORKFORCE**
Effective Intervention
Increase productivity, safety and efficiency of workforce

3 **FLEXIBLE GRID**
Self-Healing, Robust & Flexible Grid
Optimize revenue on energy and system reliability

4 **INSIGHTS AND INNOVATION**
Drive Data Centricity, Insights and Innovation
Continuous Improvement and Innovation

1

INTELLIGENT ASSET MANAGEMENT

Cost Effective & Reliable Assets

Improve return on capital and optimize asset reliability

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.

1

INTELLIGENT ASSET MANAGEMENT

Cost Effective & Reliable Assets

Improve return on capital and optimize asset reliability

Business Challenges

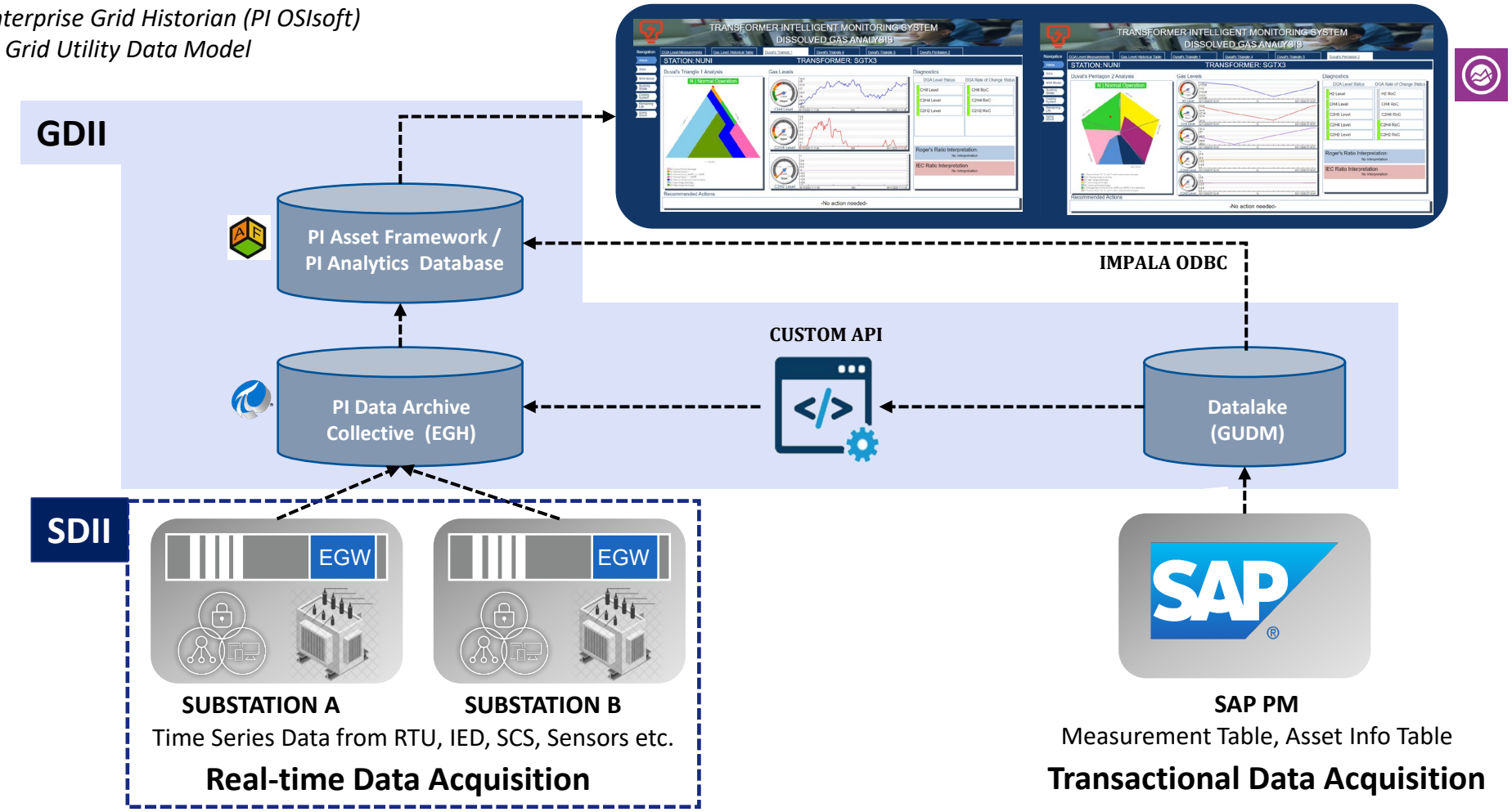
Consolidating the data centrally for easy access and analysis.

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

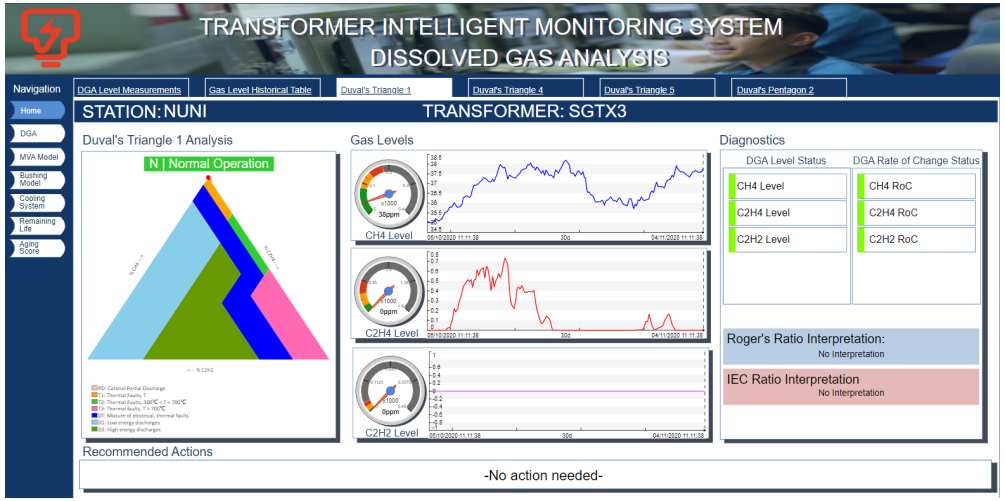
- DGA is considered the best method for determining a transformer's overall condition and is now a universal practice. Advantages of DGA include:
  - Advanced warning of developing faults
  - Status checks on new and repaired units
  - Convenient scheduling of repairs
  - Monitoring of units under potential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

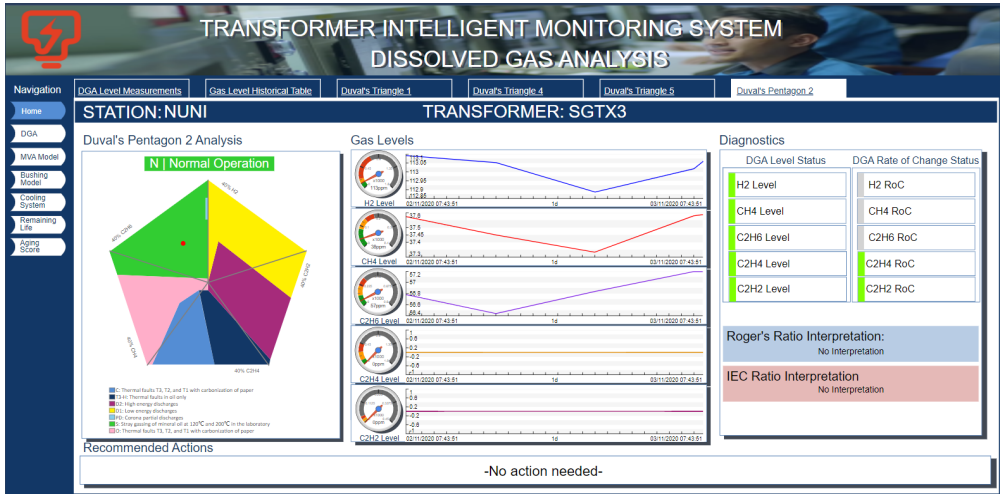
TRANSFORMER ONLINE MONITORING SYSTEM ARCHITECTURE FOR TNB

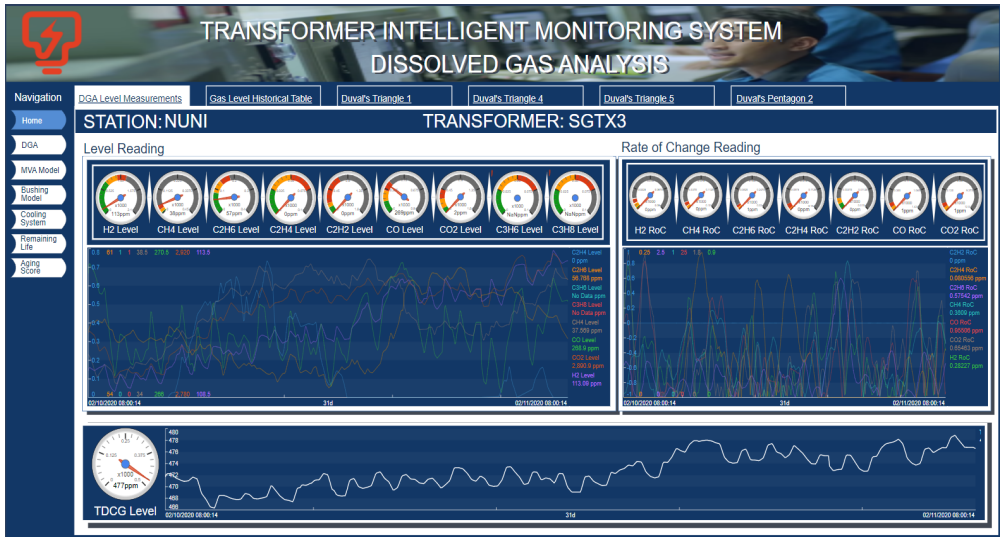
EGW – *Enterprise Gateway*
EGH – *Enterprise Grid Historian (PI OSIsoft)*
GUDM *– Grid Utility Data Model*



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.

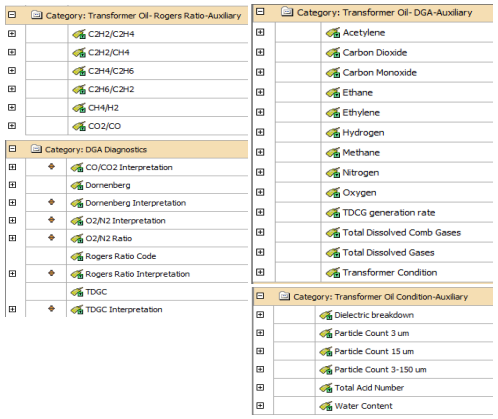
PI System Technologies

Connect DGA Analyzer

- Without integration to the DCS
- Via EGW / IoT Gateway
- Calibr8 Offline Loggers

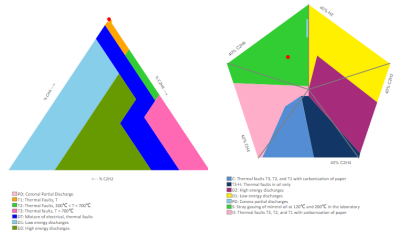
Integrate into the PI Asset Framework

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

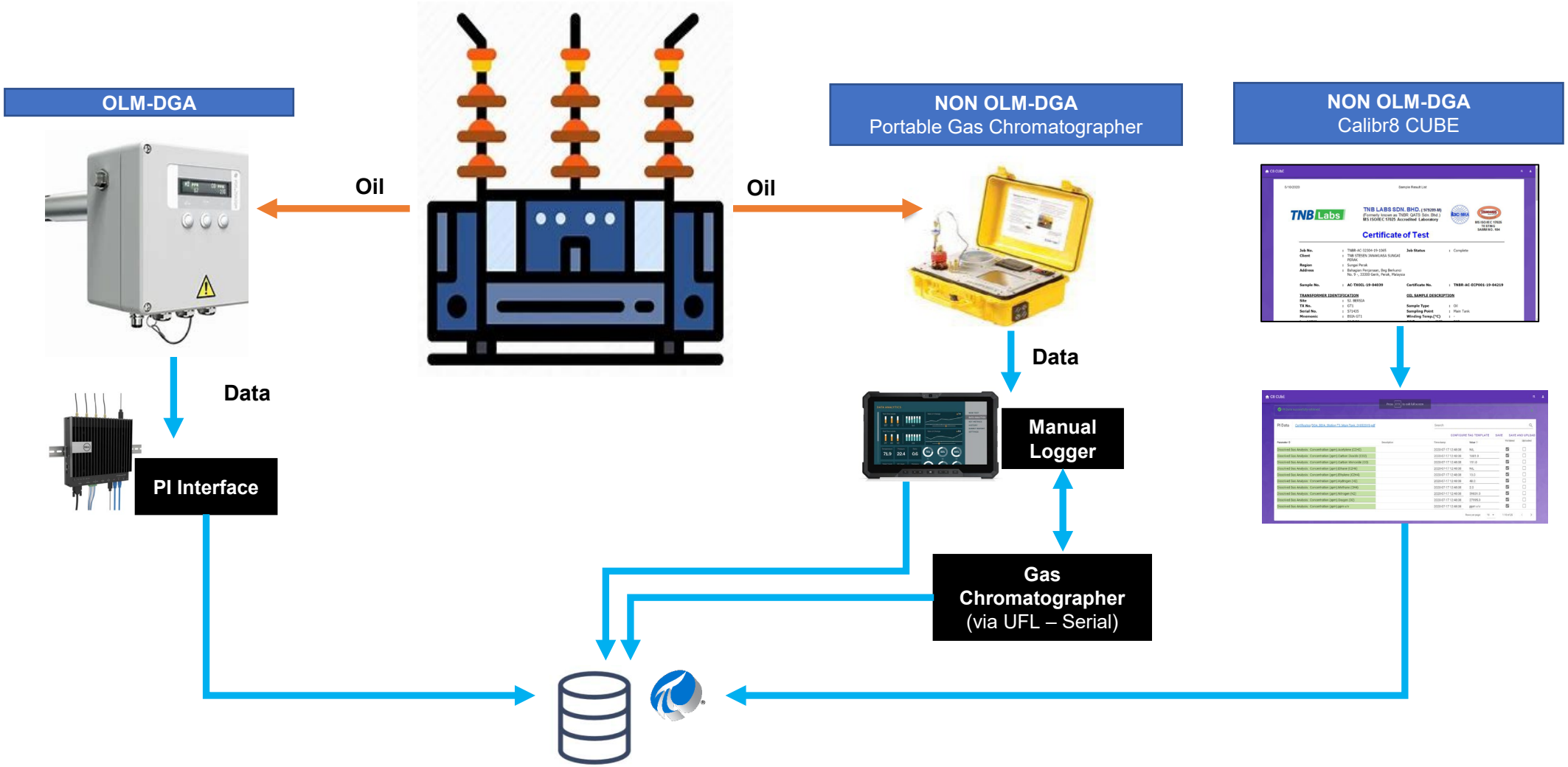


Develop Custom Symbols in PI Vision

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

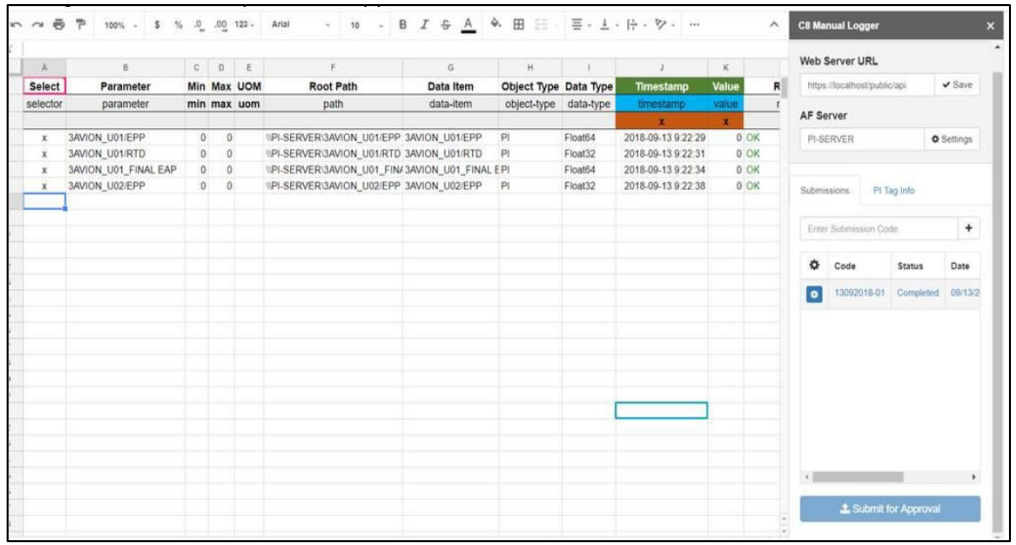


Ways to get the Data



OFFLINE DATA COLLECTORS

Calibr8 Offline Logger: Google Sheet Add-In



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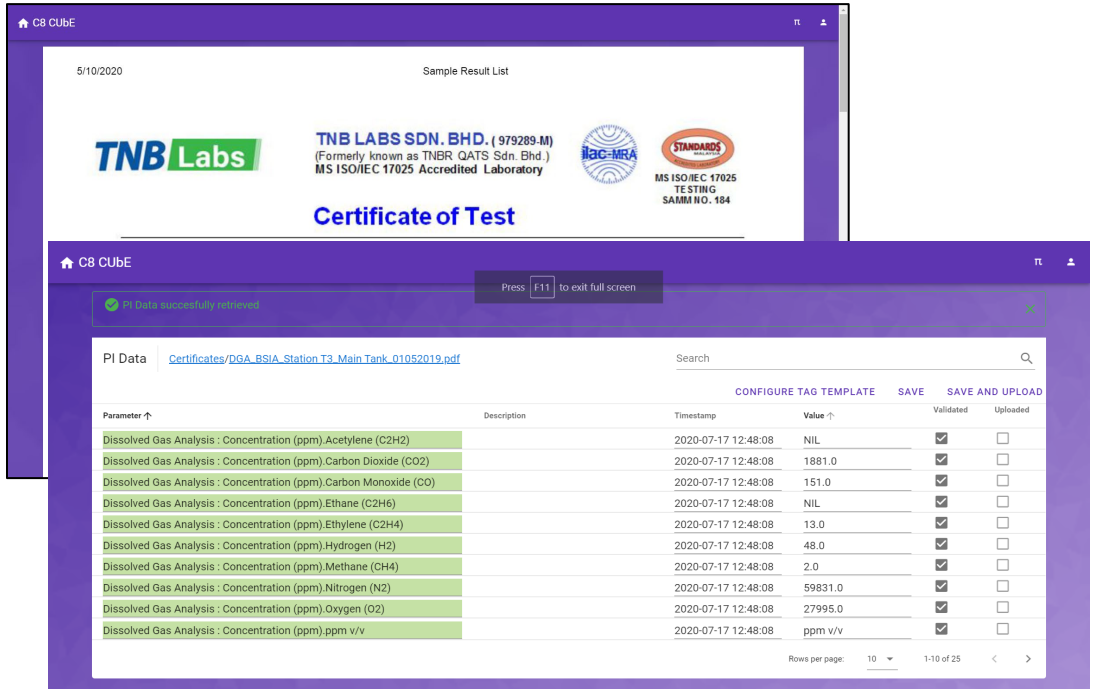
x	3AVION_U01/RTD	0	0		\\PI-SERVER\3AVION_U01/RTD	3AVION_U01/RTD	PI	Float32	2018-09-13 9:22:31	0 OK
x	3AVION_U01_FINAL EAP	0	0		\\PI-SERVER\3AVION_U01_FIN	3AVION_U01_FINAL E	PI	Float64	2018-09-13 9:22:34	0 OK
x	3AVION_U02/EPP	0	0		\\PI-SERVER\3AVION_U02/EPP	3AVION_U02/EPP	PI	Float32	2018-09-13 9:22:38	0 OK

Calibr8 CUBE: Certificate Uploader and Batch Extractor



CUSTOMER SUCCESS STORY

Challenge

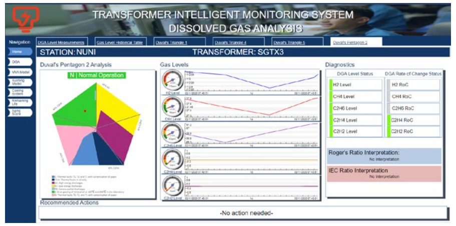
- Manual Analysis of Power Transformer Data
- Full Dependency from 3rd Party
- Reactive Maintenance
- No Real time Visibility
- No Data Correlation

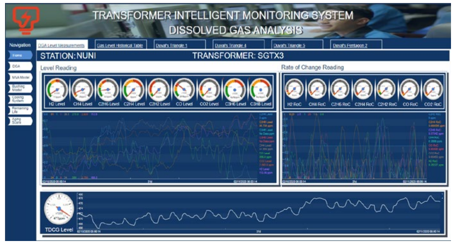
Solution

- 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."**

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

- *DGA*
- *Overload Conditions*
- *Aging Score*
- *MVA Model*

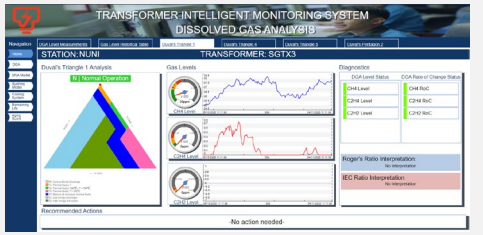
Better Planning for Electrical Assets

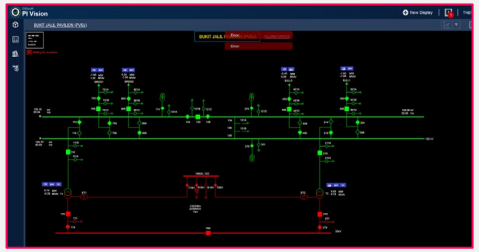
Future Proof Solution that will be rolled out across the fleet

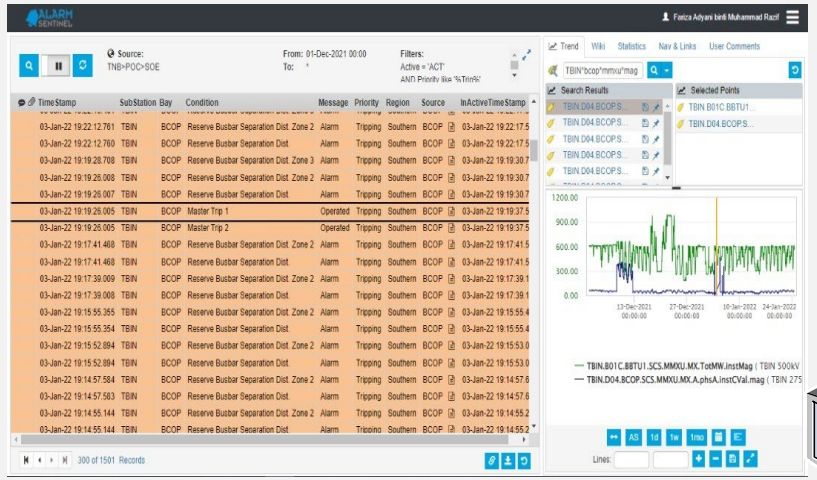
- *NO Excuse for Data Collection*
- *Online DGA Integration*
- *Gas Chromatographer (ChemLab) integration – serial port*
  - *PI UFL via IoT Gateway*
- *Manual Data or Batch Inputs*
- *Internal expertise can be a shared resource across*

IN DISCUSSION - FUTURE ARCHITECTURE

***EGW** – Enterprise Gateway*
***EGH** – Enterprise Grid Historian (PI OSIsoft)*
***GUDM** – Grid Utility Data Model*







PI Vision

GDII

Asset Framework/PI Analytics Database

Data Archive Collective (EGH)

IMPALA ODBC

CUSTOM API

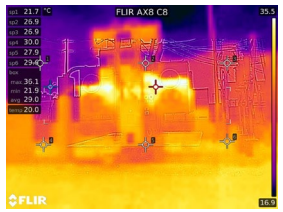
Datalake (GUDM)

Asset Synch

SUBSTATION

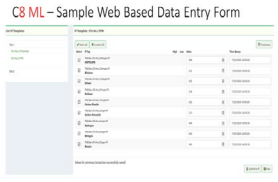
Time Series Data from RTU, IED, SCS, Sensors PMU, etc.

Real-time Data



SUBSTATION

Real Tine Data Values from Thermal Cameras



Manual Loggers

SISCO **COMTRADE**

And Other Data

SAP PM

Measurement Table, Asset Info Table

Transactional Data Acquisition

AVEVA

“EVERYTHING START WITH DATA.”

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Please remember to…

Navigate to this session in the mobile app to complete the survey.

Thank you!

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