NDT Products available

IoT - sensoring

NDT Products available

P.2.1.2 Global standard for sensoring in secondary substations

Code	Name	Description	Use case	Benefits
P.2.1.2	Global standard for sensoring in secondary substations	Global standard for real time sensoring of electrical and non electrical parameters in secondary substations	• Environmental parameters monitoring • LV Breakers monitoring • Transformer monitoring	• Improving predictive maintenance through faults early waring • Increasing of losses detection • Improving MV/LV investment planning

Type	Business impact	Deployment cost	Relevance	Picture
Technical specifications / System / Product	**High** / Medium / Low	**High** / Medium / Low	**High** / Medium / Low	

Development status	Type of action	I&N unit affected	Technical reference
Solution prototyping and validation / Industrialization & System integration / **Roll-out**	**Integration in Enel internal processes** / System integration and deployment / Product deployment in the field	**O&M** / **ND** / **NCO** / HSE / Q&PT / BD / GP	Elsa Russo

NDT Products available

P.2.2.4 Low voltage supervisor (LVS)

Code	Name	Description	Use cases	Benefits
P.2.2.4	Low voltage supervisor (LVS)	Load curve / saturation monitoring of MV/LV transformer through on-line sensoring	• Load curve monitoring • Temperature monitoring • Alert management	• Over heating and over load in MV/LV trafo prediction for maintenance improvements • SAIDI reduction

Type	Business impact	Deployment cost	Relevance	Picture
Technical specifications / System / **Product**	**High** / Medium / Low	High / **Medium** / Low	**High** / Medium / Low	

Development status	Type of action	I&N unit affected	Technical reference
Solution prototyping and validation / Industrialization & System integration / **Roll-out**	Integration in Enel internal processes / System integration and deployment / **Product deployment in the field**	**O&M** / ND / NCO / HSE / Q&PT / BD / GP	Elsa Russo

NDT Products available

P.3.1.2 Open Me / I’m In

Code	Name	Description	Use cases	Benefits
P.3.1.2	Open Me / I’m In	Mobile APP + electronic key to facilitate substation access to workers and management in safety conditions	• Primary substation access control through electronic key • Primary substation access management though a mobile APP	• Increase facilities safety and security, as well as process performance • Reduction of waiting times

Type	Business impact	Deployment cost	Relevance	Picture
Technical specifications / System / **Product**	**High** / Medium / Low	High / **Medium** / Low	**High** / Medium / Low	  

Development status	Type of action	I&N unit affected	Technical reference
Solution prototyping and validation / Industrialization & System integration / **Roll-out**	Integration in Enel internal processes / System integration and deployment / **Product deployment in the field**	**O&M** / ND / NCO / HSE / Q&PT / BD / GP	Elsa Russo

NDT Products under industrialization

Global standard for sensoring in primary substations

Code	Name	Description	Use cases	Benefits
	Global standard for sensoring in primary substations	Global standard for real time sensoring of electrical and non electrical parameters in primary substations	• Environmental parameters monitoring • MV breakers monitoring • Transformer monitoring	• Improving predictive maintenance through faults early waring

Type	Business impact	Deployment cost	Relevance	Picture
Technical specifications / System / Product	**High** / Medium / Low	**High** / Medium / Low	**High** / Medium / Low	

Development status	Ready for roll-out	Type of action	I&N unit affected	Technical reference
Solution prototyping and validation / **Industrialization & System integration** / Roll-out	Q3-Q4 2020	**Integration in Enel internal processes** / System integration and deployment / Product deployment in the field	**O&M** / ND / NCO / HSE / Q&PT / BD / GP	Elsa Russo

NDT Products under industrialization

Predictive maintenance models for secondary substations

Code	Name	Description	Use cases	Benefits
	Predictive maintenance models for secondary substations	Predictive maintenance models for secondary substations through artificial intelligence from IoT sensors	• Partial discharges • Overload in transformers • Anomaly detection	• Improving predictive maintenance from real time and historic data correlation

Type	Business impact	Deployment cost	Relevance	Picture
Technical specifications / **System** / Product	**High** / Medium / Low	High / Medium / **Low**	**High** / Medium / Low	

Development status	Ready for roll-out	Type of action	I&N unit affected	Technical reference	
Solution prototyping and validation / **Industrialization & System integration** / Roll-out	Q4 2020	Integration in Enel internal processes / **System integration and deployment** / Product deployment in the field	**O&M** / ND / NCO / HSE / Q&PT / BD / GP	Elsa Russo	

NDT Products under industrialization

Global standard for thermography inspections

Code	Name	Description	Use cases	Benefits
	Global standard for thermography inspections	Global standard for thermography standards through potable thermocameras	• Secondary substations • LV network	• Early warning of grid anomalies or over loaded assets through thermography inspections

Type	Business impact	Deployment cost	Relevance	Picture
Technical specifications / System / Product	High / **Medium** / Low	High / **Medium** / Low	High / **Medium** / Low	

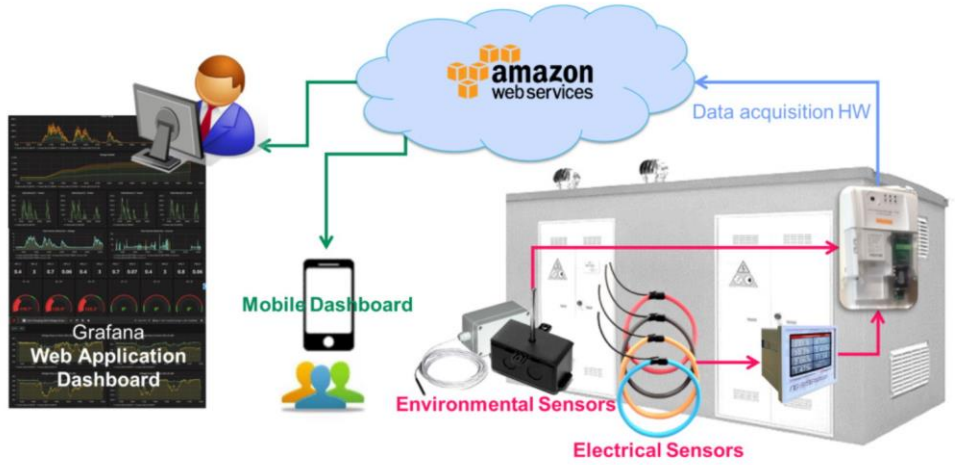
Development status	Ready for roll-out	Type of action	I&N unit affected	Technical reference	
Solution prototyping and validation / **Industrialization & System integration** / Roll-out	Q4 2019	**Integration in Enel internal processes** / System integration and deployment / Product deployment in the field	**O&M** / ND / NCO / HSE / Q&PT / BD / GP	Marco Altigieri	

IoT in secondary Substations

Italy

PoC100 Activities

- ✓ 100 substations enabled
- ✓ Dashboard development:
  - Data visualization
  - Realtime substation status for maintenance
  - Data extractor for analysis
  - Transformer life real-time monitoring (Loss of Life Index)
- ✓ NDT Squad for transformer data analysis "AI over IoT with GE"
- ✓ Ping test for each IP address
- ✓ Check of speed measurement



- ❑ Status: **Completed (dec 2019)**

PoC100 dashboard with substations data:

http://it000001339377.enelint.global:3000/login

User: POC100 (Uppercase)
Password: poc100 (lowercase)

The page can be accessed only on the Enel local network or VPN

IoT in secondary Substations

Italy

PoC25 Retrofit Activities

✓ Retrofit for the PoC100 architecture
✓ Integration in the PoC100 data infrastructure (dashboard visualisation and storage)

❑ Status: **On going**
- 17/25 substations completed
  - 5 Trapani substations retrofit within December
  - 3 Prato substations selection pending

Substations realtime status dashboard
- Healthy system
- Minor transmission delays
- Major transmission delays
- Missing sensor data or substation offline

PoC2020 Activities

✓ Release of the technical specifications
✓ 1 substation installed with NT Italy for the LVS-PoC100 sensors kit integration

❑ Status: **On going**
- Architecture definition

PoC5G Activities

✓ Adaptation of two PoC25 retrofit substations for NT Italy-MISE Prato project
✓ Development of the network infrastructure (5G router ZTE in POC100 Architecture)
✓ Monitoring of the system and verify the proper receiving data
✓ Workshop for results presentation to MISE experts

❑ Status: **Completed**
- Positive results during test period
- Substations then restored to the 4G connection

Loss of Life Index

PoC100 data utilization

IEC 60076-7
Edition 1.0 2005-12
INTERNATIONAL STANDARD

Goal: Implement a model to support MV/LV transformer predictive maintenance from field data

FIELD INPUT
- I1 = Current phase 1
- I2 = Current phase 2
- I3 = Current phase 3
- Ta = Internal substation temperature

MODEL
- Θo = Top-oil temperature (in tank)
- Θh = Hot-spot temperature

OUTPUT
- L = Loss Of Life index

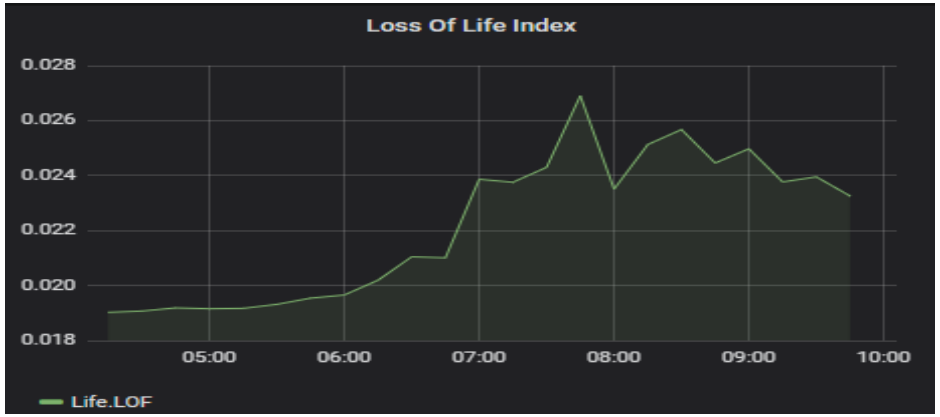
Assumpions:
- Avarage input values (base15 min)
- Calculation frequency: 15 min

Activities:

- ✓ Analisys of the received model
- ✓ Script development to automate calculations

❑ Status:

- **Alpha version: Completed**
  - Same parameters assumed for all POC100 transformers



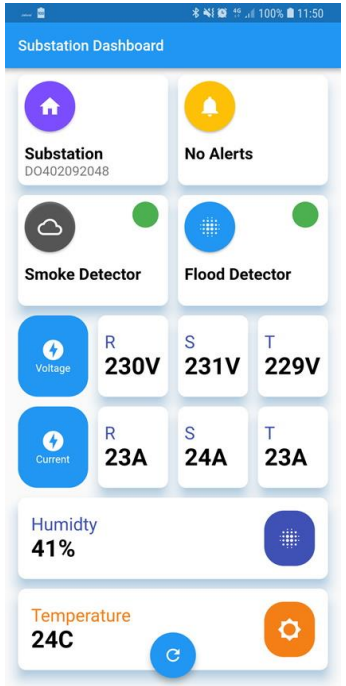
- **On going:**
  - Introduction of specific parameters for each transformer
  - Definition of a limit treshold for the index
  - Implementation of a real-time alert

Bluetooth

New Sensors progress

BLE for Substation Realtime Safety and Access Control

A bluetooth low energy device to enable communications with the field crew smartphones.
Information sent to the operator may include any information collected locally, like substation ID and substation sensors data (electrical and environmental). Operators will receive information from IoT gateway only after proper authentication. This allows them to carry on trouble-shooting activities.
To guarantee the workers' safety, automatic warnings are triggered in case of danger (e.g. crew member entering the substation with voltage presence, flooding or smoke/fire).



Activities:

- ✓ Feasibility study and hardware compliance for low cost device
- ✓ PoC100/PoC2020 architecture compatibility
- ✓ Technical specification for GIN - Field Technologies tender proposal
- ✓ Custom app development for WFM smartphones integrated with MobAuth

❑ Status: **ESP32 board prototype and WFM app completed**

On going:

- Tender proposal results\RDA pending
- RPIzero board prototype development for demo (January 2020)

Prycam

New Sensors progress

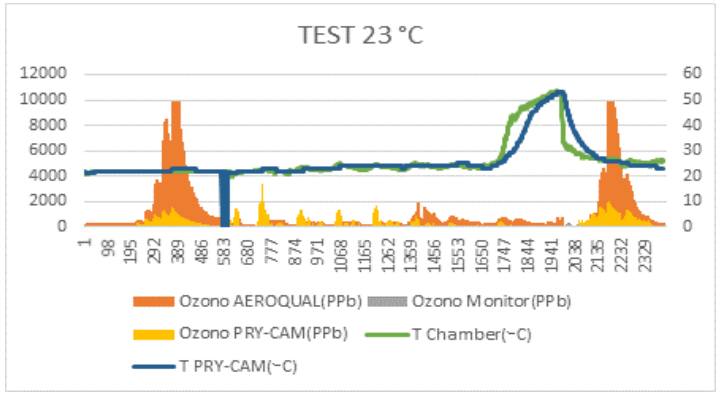
Ozone Sensors: *Monitor Partial Discharge in the secondary substation*

Activities:

✓ Good results received from lab test in a climatic chamber (CESI)

❑ Status: **On going**
- Integration in PoC100 architecture
- Different sensors positioning test in substation
- Validation of the O3 as side indicator of partial discharge

❑ Opportunities:
- Development of a mathematical model for predictive maintenance
- New hardware for extend temperature range and cost optimisation (no display- no push button)



Infrared Sensors: *Monitor temperature variation in the MV/LV transformer*

Activities**:**

✓ Device tested in the laboratory (1 sample)

❑ Status: **To be done**
- Integration in PoC100 architecture
- Finalize characterisation
- Test on field