



SNAM RETE GAS



Real Time Simulation

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Context

Overall Solution

Real Time Simulation



Context

Snam Rete Gas has released in the latter years a Simulation and Optimization solution, based on Liwacom's SIMONE software, initially covering offline calculations.

The solution currently supports main Dispatching business processes and has been recently integrated with the introduction of the Real Time Simulation module.



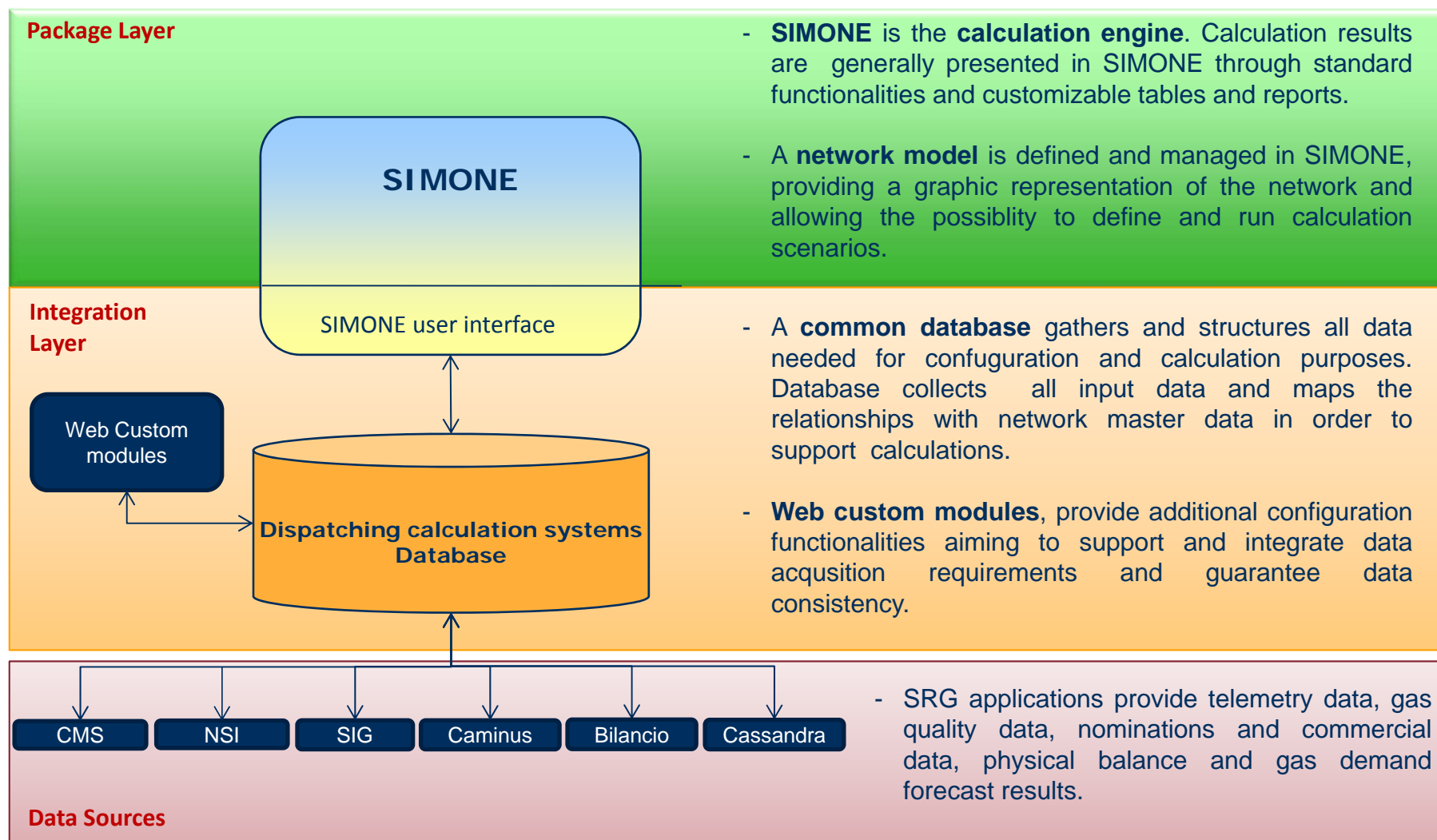
Context

Overall Solution

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Overall solution



Overall solution

Dispatching business processes and supporting functionalities

Simulation and Optimization functionalities currently define **a consolidated solution** supporting the main Dispatching business processes.

Gas transportation planning, maintenance planning, (e.g. network works, inline inspection), **budget of fuel gas consumption** are performed using **network optimization**.

Emergency scenarios definition and management is performed on demand with the support provided by **offline simulation** (both steady state and transient).



Daily gas network management is performed running a **network optimization** aiming to evaluate gas nominations portability on the whole network using Nominations data, telemetry data, current network configuration

Compression stations (CS) monitoring is based on CS optimization (ARGO), which runs on hourly-base aiming to gather results to be used for spot analysis on CS working conditions and verification of working maps.

Overall Solution Results and benefits

- **New calculation features** supporting Dispatching processes with the introduction of steady state and transient simulation
- High **calculation precision** thanks to the possibility of adopting some calculation functionalities useful to represent transportation phenomena and conditions (e.g. Joule -Thompson effect modeling, ...)
- **Improved system usability** in terms of scenario parameters definition and calculation results visualization
- Introduction of a **structured and common Database**, providing data consistency and data monitoring
- Possibility of relating the main Dispatching business processes to SIMONE calculations performed on a **common topology/network model**



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SIMONE

Real Time simulation – main features

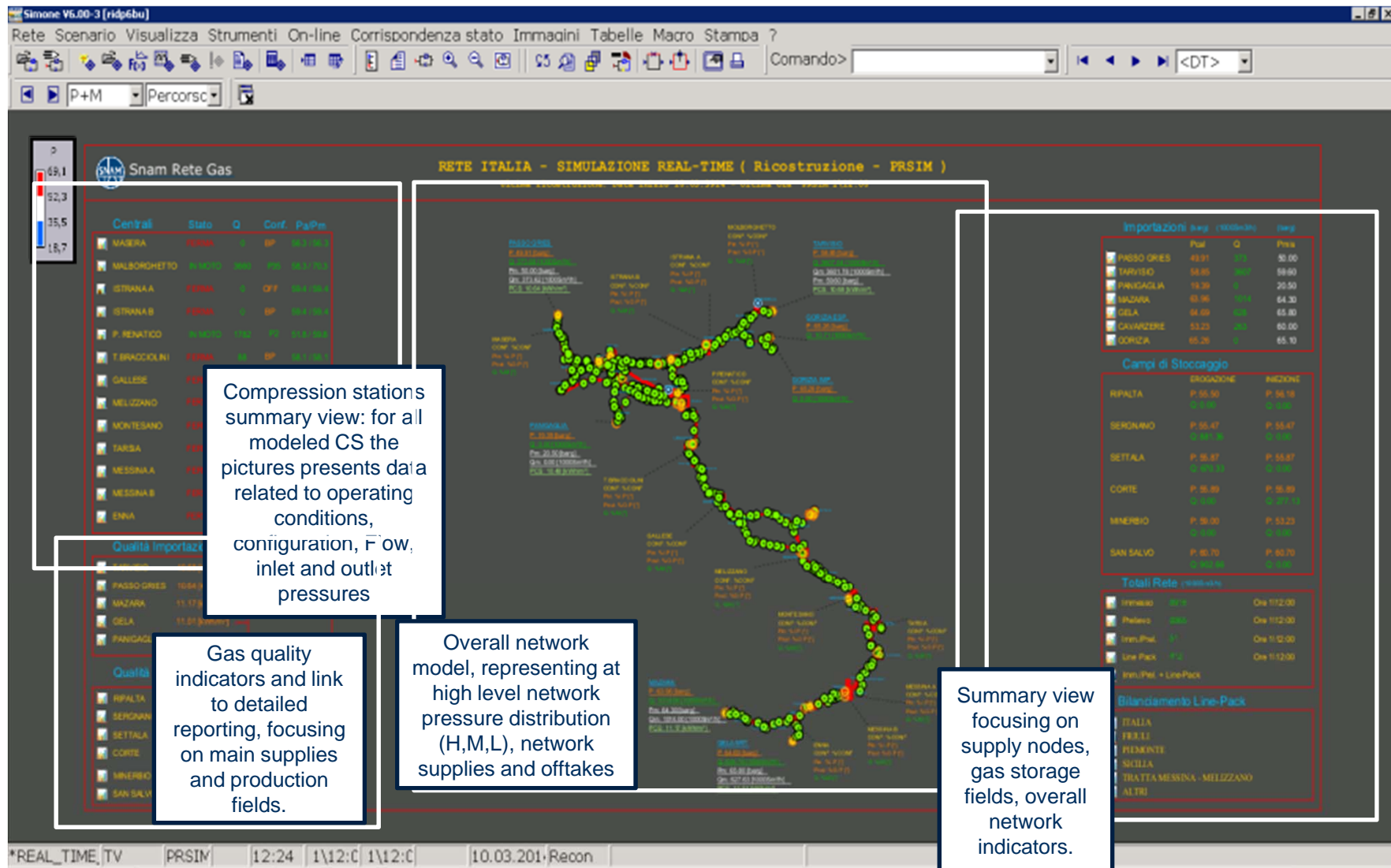
Real Time Simulation performs a current **state reconstruction** of the network, in transient conditions, according to telemetered flows, telemetered pressures and valve signals. Real Time functionalities allow the possibility to proceed with **Look-Ahead** and **What-if** calculations, starting from the reconstructed initial state.

Scenario data used for calculations are basically acquired from Snam Rete Gas current **SCADA** application.



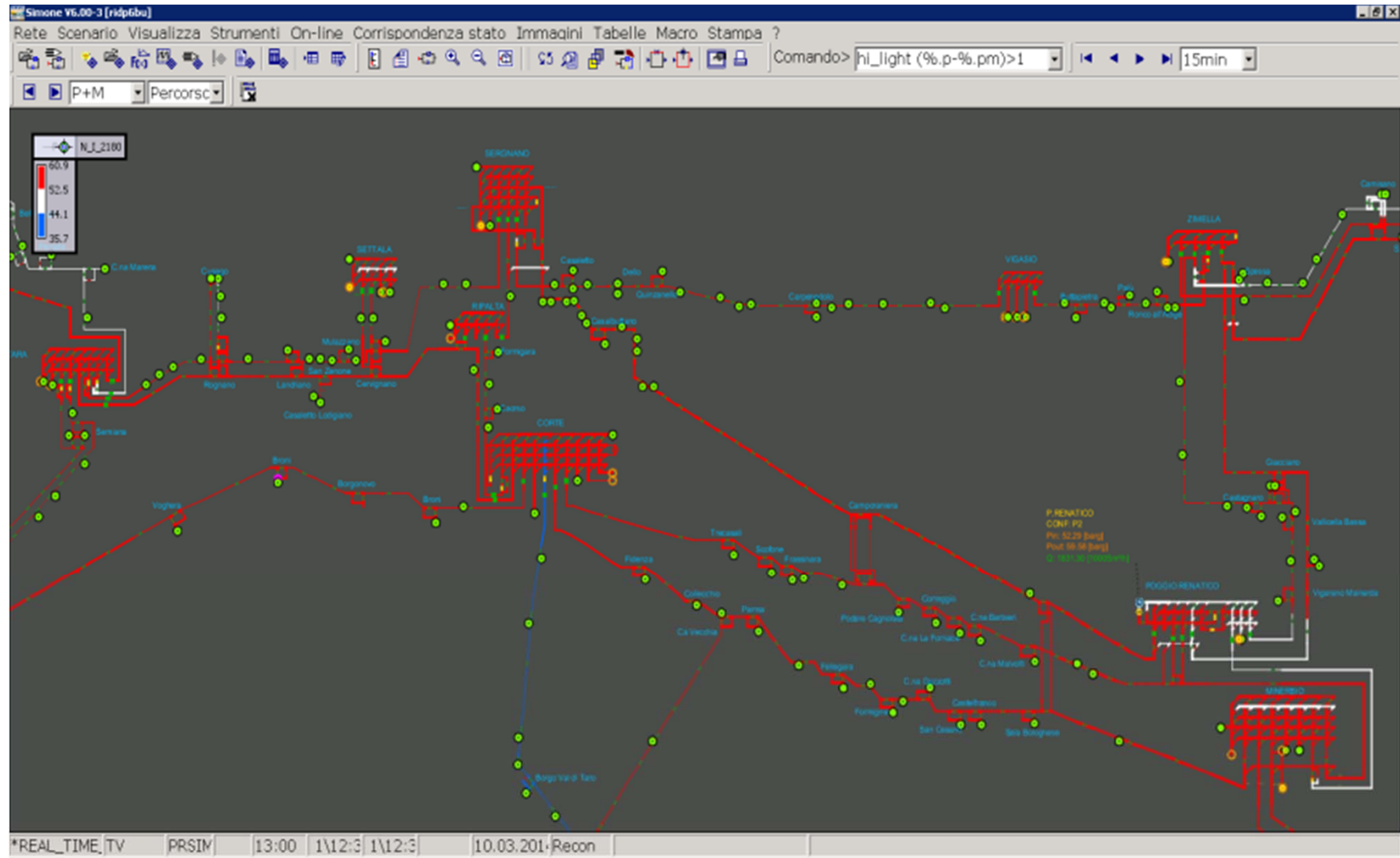
Real Time Simulation

Overall results presentation



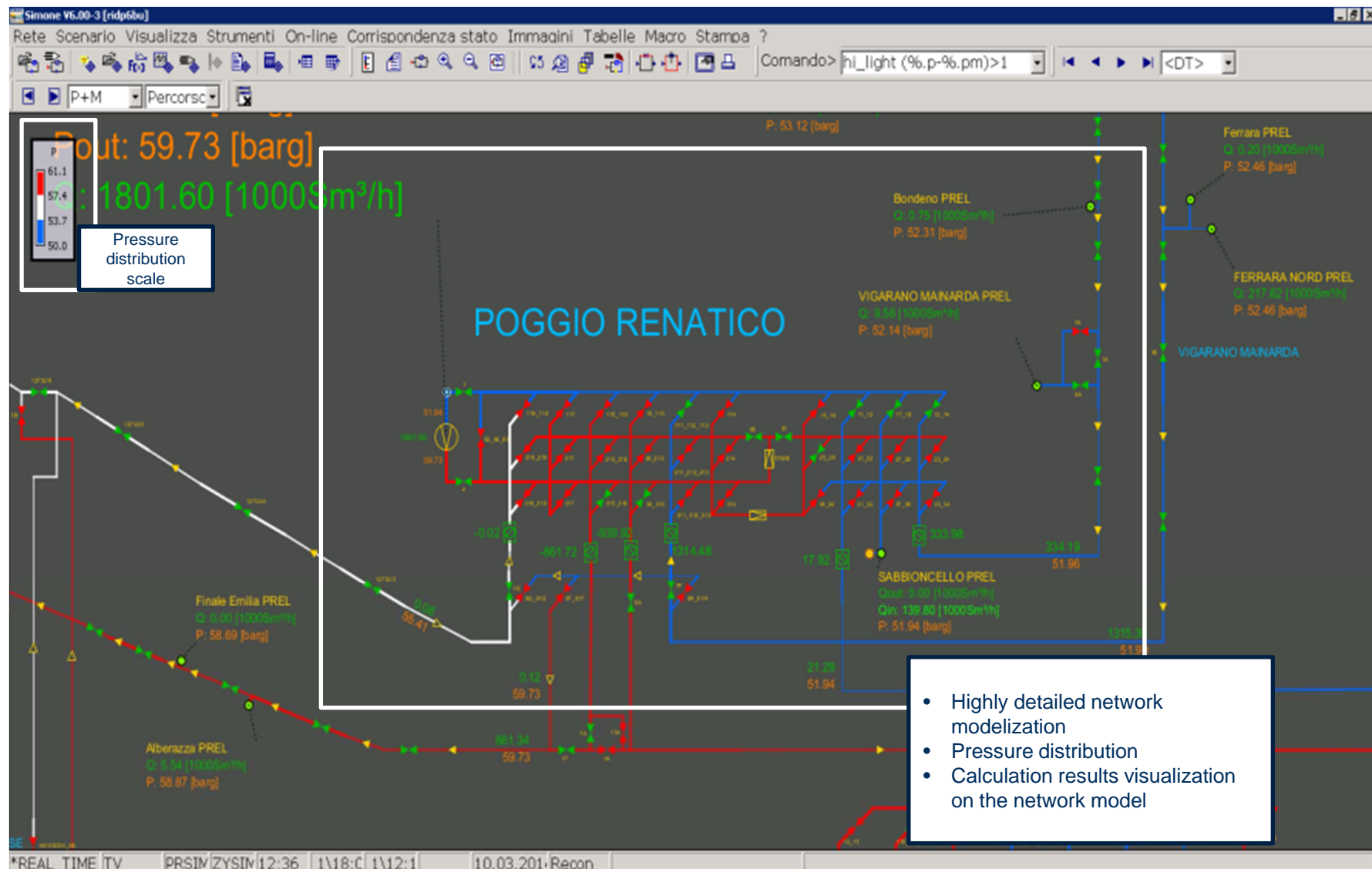
Real Time Simulation

Overall results presentation - Network Model detail (1/2)



Real Time Simulation

Overall results presentation - Network Model detail (2/2)



SIMONE

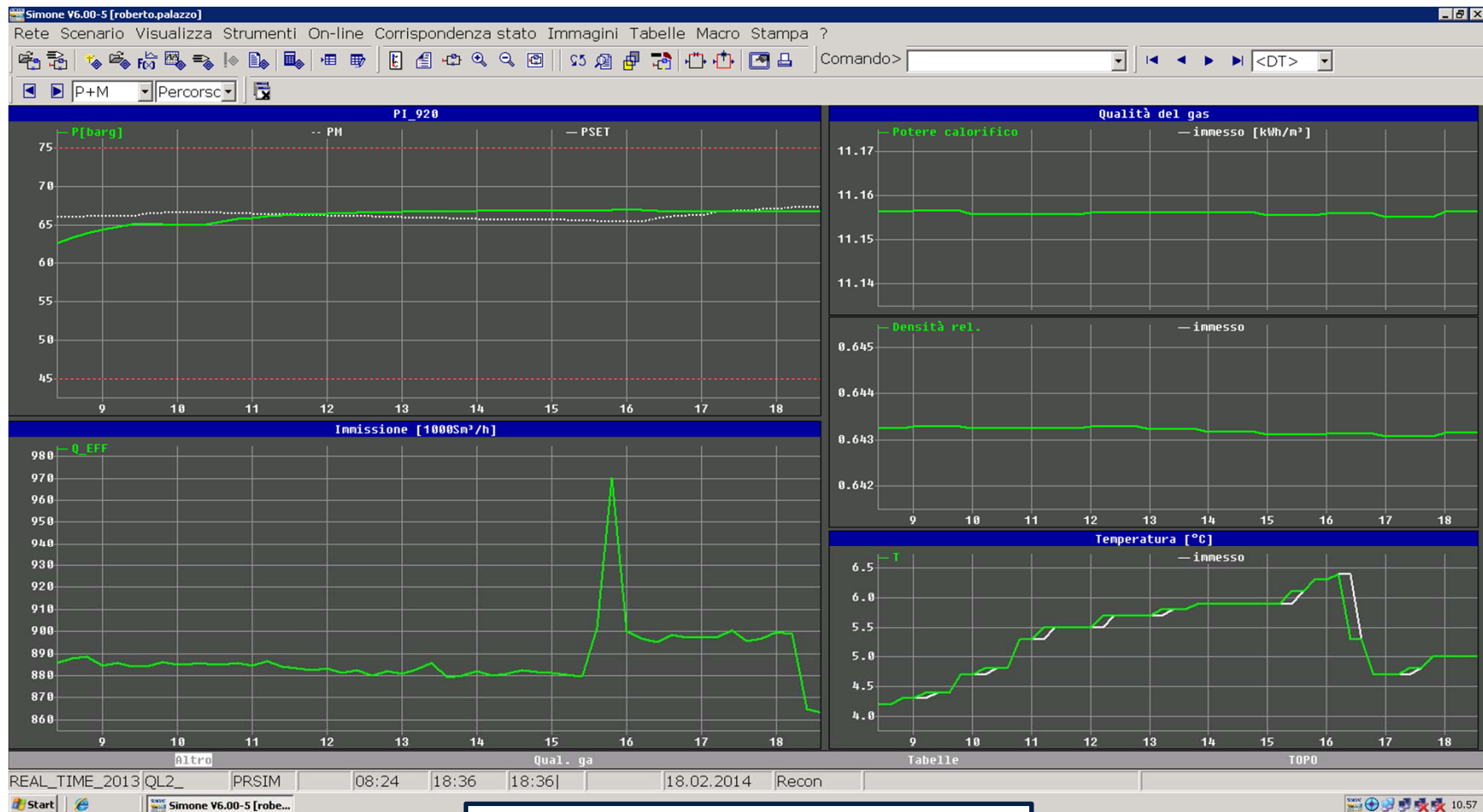
Real Time simulation – Network model and configuration

The **reliability of the entire model** is guaranteed through;

- **Highly-detailed network model** currently covering:
 - 6500 km of pipelines
 - 1814 valves
 - 14 compression units
 - 86 control valves
 - 55 supply nodes
 - 426 configured market points
 - 2616 configured measures
 - 18 gas configured cromatographs
- High importance to **network configuration tuning**

Real Time Simulation

State reconstruction results - Supply Node

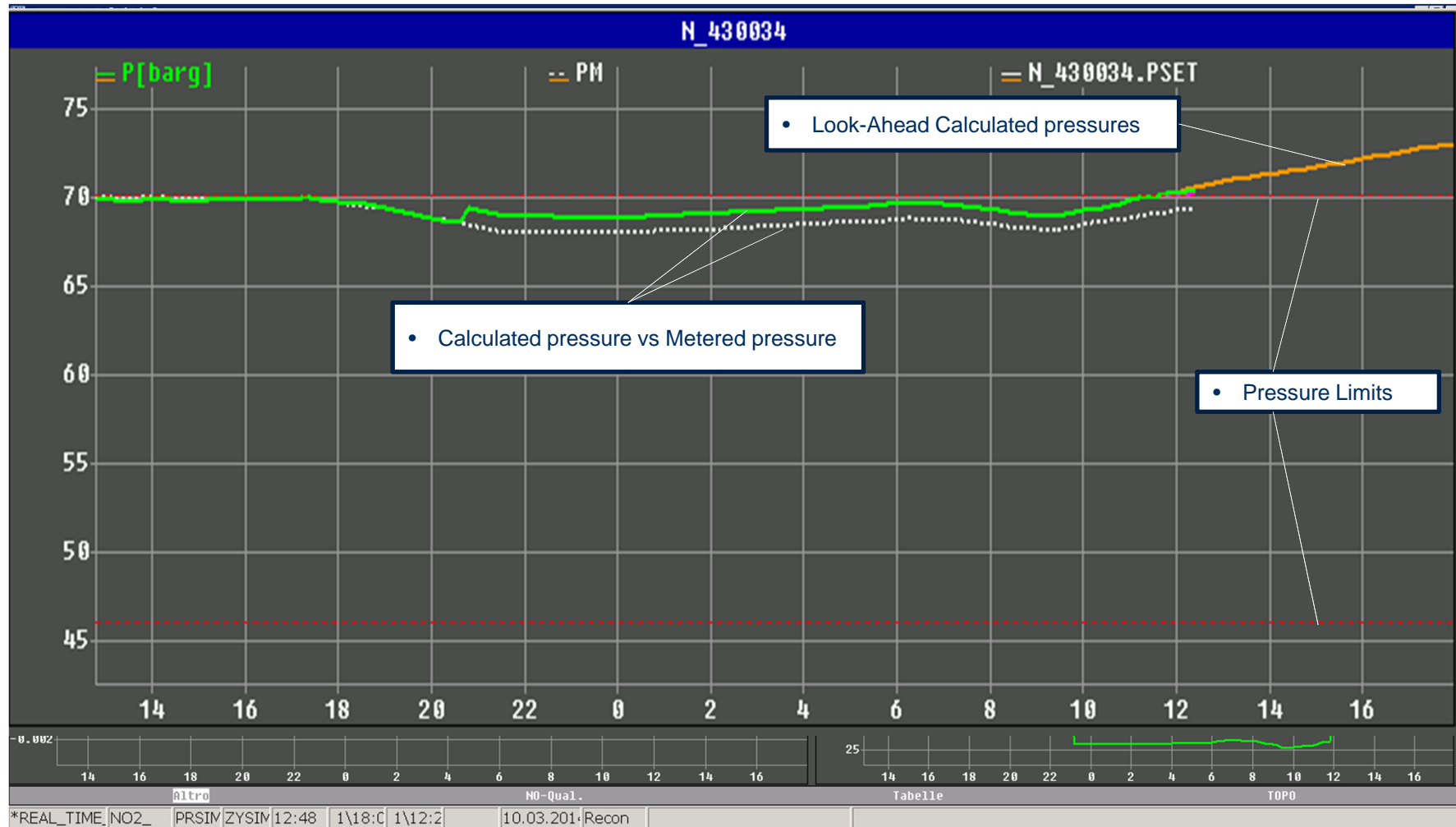


Main results relate to:

- Calculated pressure vs Metered pressure
- Calculated temperature vs metered temperature
- Trends for: Flow, Calorific Value, Gas density

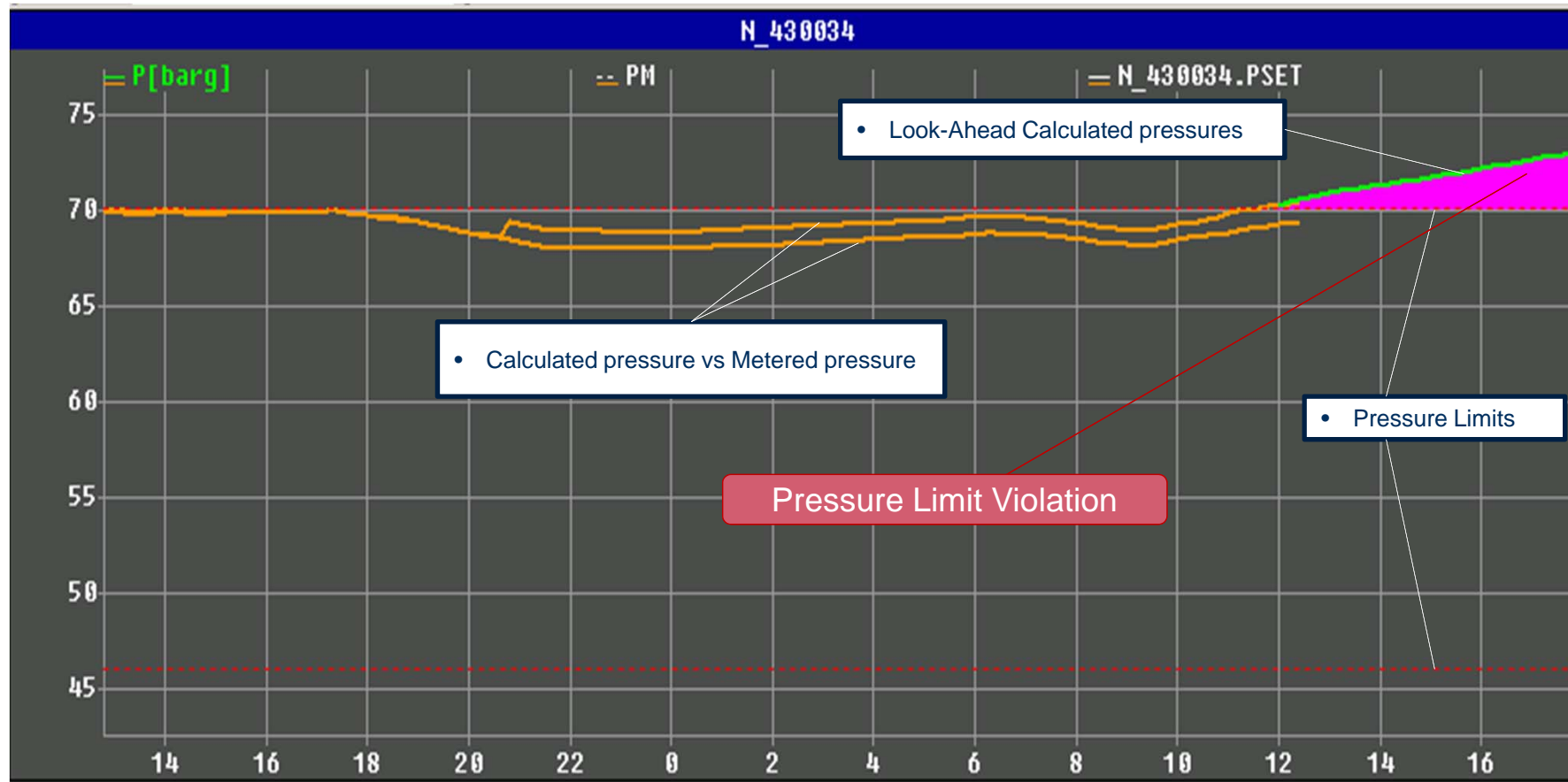
Real Time Simulation

State reconstruction and Look-Ahead results – Line Node



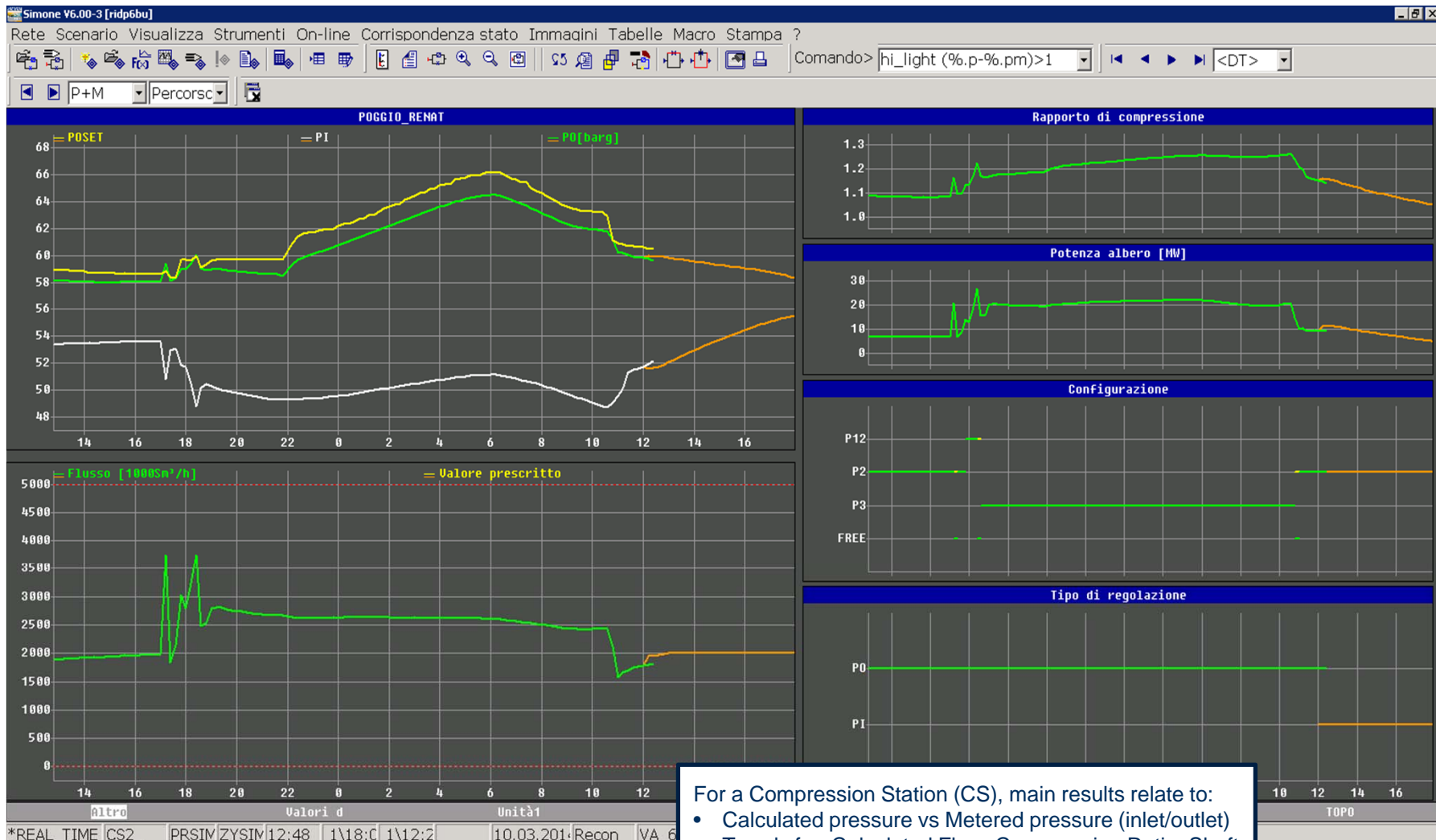
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State reconstruction and Look-Ahead results – Line Node



Real Time Simulation

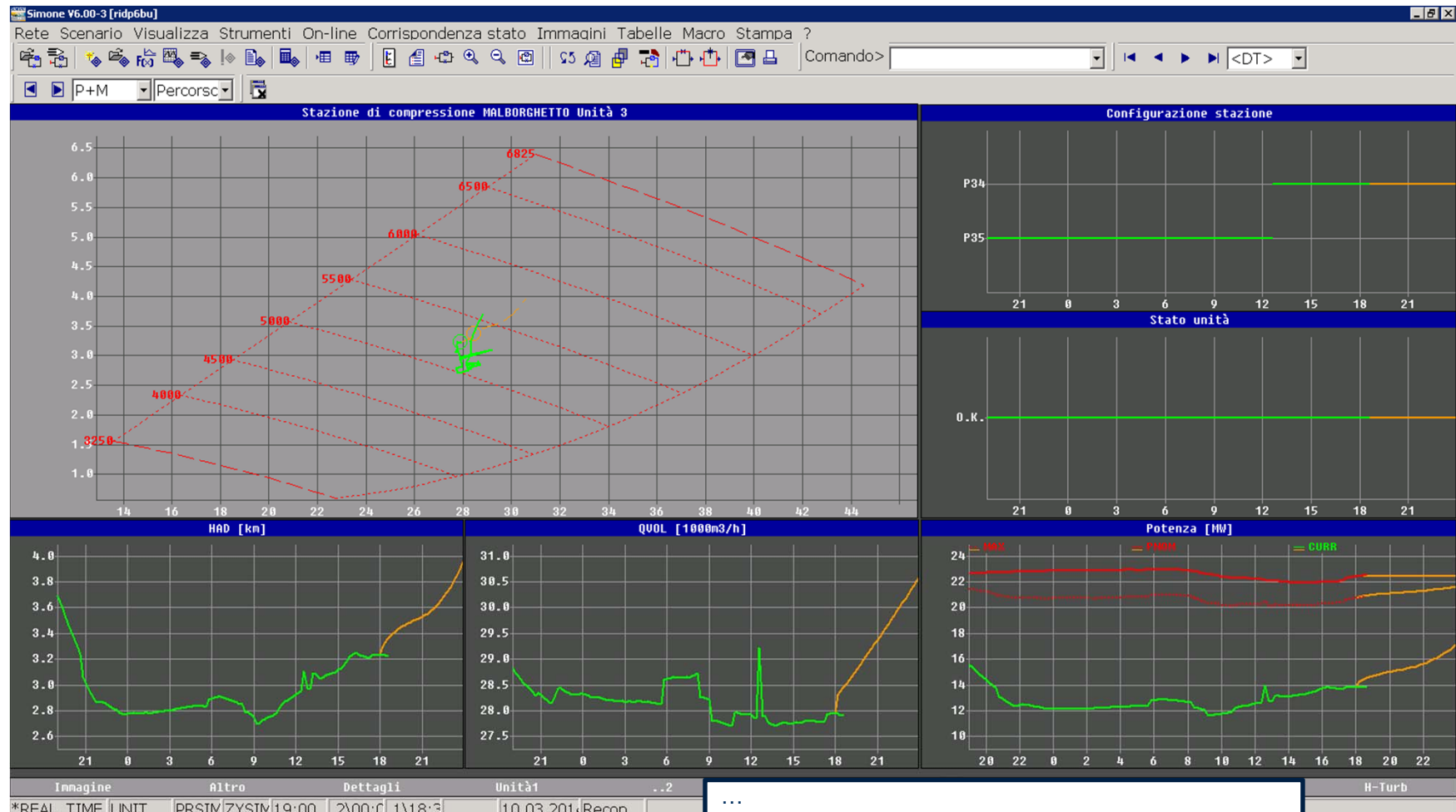
State reconstruction and Look-Ahead results – Compression Station (1/2)



- For a Compression Station (CS), main results relate to:
- Calculated pressure vs Metered pressure (inlet/outlet)
 - Trends for: Calculated Flow, Compression Ratio, Shaft Power, Configuration, Type of regulation
 - ...

Real Time Simulation

State reconstruction and Look-Ahead results – Compression Station (2/2)



- ...
- Adiabatic Head
- Working point
- Unit Status

Real Time Simulation Current Use

Real Time Simulation can integrate and support Dispatching business processes, with main focus on **gas-day network execution** providing through Look-Ahead simulation results:

- An online presentation of time trends of all main calculated measures (pressures, quality, temperature..) starting from a current network reconstructed state
- An anticipation of network measure limit violations, suggesting possible manoeuvres to be performed on the network.
- Enables the possibility to elaborate what-if scenarios with reference to timeframes of significant interest, anticipating possible emergency scenarios

Thanks to a detailed network model and strong affinity with current network execution, Real Time Simulation can also be used as a **training tool** for Dispatching personnel.

Real Time Simulation Additional opportunities

Real Time Simulation input data and results define a structured collection of network relevant data that can be used in order to identify and significant network indicators that enable the possibility to address further analysis on network data such as:

- **Telemetered data analysis**, by comparing telemetered data and reconstructed/calculated data, providing elements to evaluate metering issues, or the opportunity of the introduction of new metering points to be located along the network
- **Linepack calculation analysis** by comparing simulated linepack and linepack results as calculated by Bilancio (Physical Balance)
- **Compression stations monitoring**

Real Time Simulation solution offers the opportunity, if properly integrated and extended with data analysis tools and functionalities, to move towards the implementation of a network analysis and diagnostics tool aiming to support and improve network maintenance processes.



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