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OIL & GAS

Verification methodology for gas quality tracking systems for fiscal metering

Near real time application

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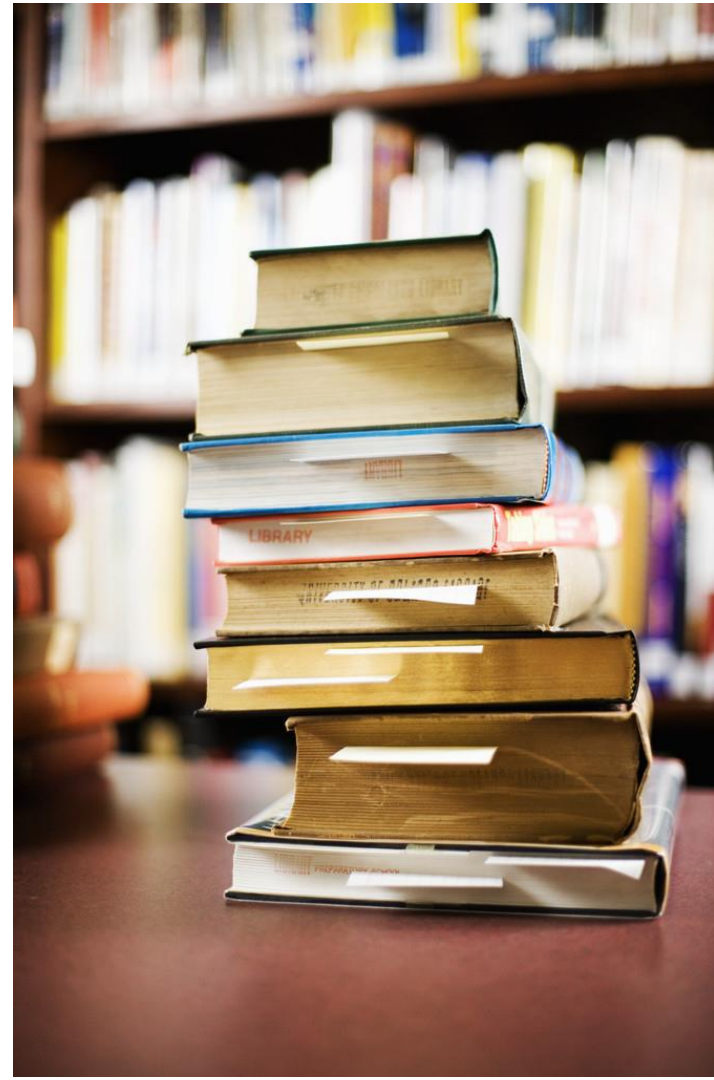
Content

1. Change over time
2. Gas quality tracking system overview
3. Requirement and definitions
4. Considerations
5. Verification methodology
6. Discussion and conclusion



New supplies with varying gas qualities require an update of the fiscal metering process

- Nowadays the gas supply is shifting towards (new) supplies with varying gas qualities. These new resources can be delivered by:
  - New transit lines or LNG terminals
  - Supplies from underground gas storages,
  - and locally, by the feed-in of biogases, produced either by co-digestion or by gasification

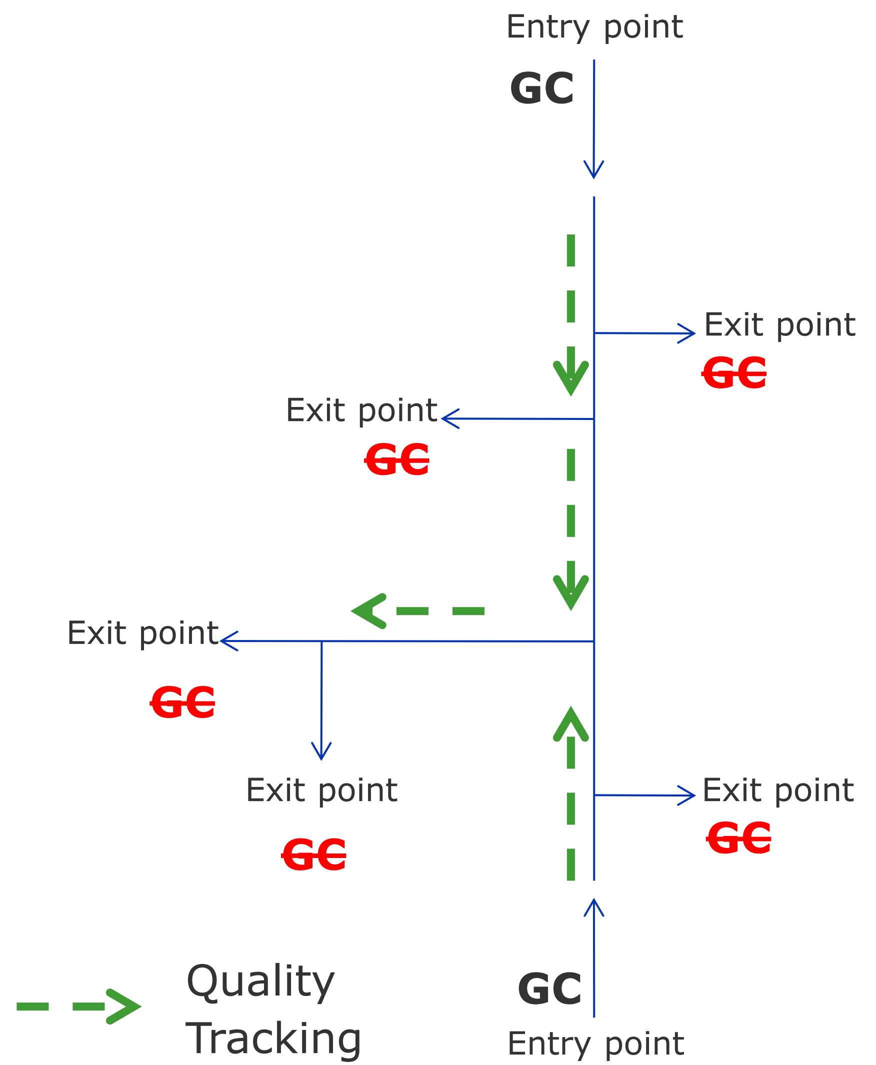
Calorific value variations up to **10%** could be expected, while fiscal metering requires an uncertainty on delivered energy **e.g. <1%.**

- Typical H_s values for LNG
  - Atlantic LNG 41,34 MJ/(n)m^3
  - Brunei LNG 45,23 MJ/(n) m^3
  - Malaysia 44,63 MJ/(n)m^3
- Typical H_s values for entry specifications
  - 37.2 – 41.3 MJ/(n)m^3
  - 39.8 – 42.7 MJ/(n)m^3

The implementation of a gas quality tracking system provides a cost-efficient solution

- Installation of gas chromatographs (GC) at all delivery points increases the accuracy of the gas quality system to the required level, but entails both high investment and operational costs.
- The implementation of a Gas Quality Tracking (GQT) system is a cost-efficient solution to address the increasing gas quality variations in gas transport networks in a proper way.

For this application **GCs are expansive**, both in terms of the investment as well as yearly operational costs.



Simplified GQT system overview

Input
- (Measured) input data
- Network geometry

Simulation
- Flow per element
- Pressure per element

Processing
- Tracking

Output
- Calorific value
- Transit time
- Flow stagnation points

In this case the GQT system has been implemented in a **near real time** fiscal metering application. Calorific values are **tracked online** and recalculated every **15 minutes.**

Requirement

Requirement

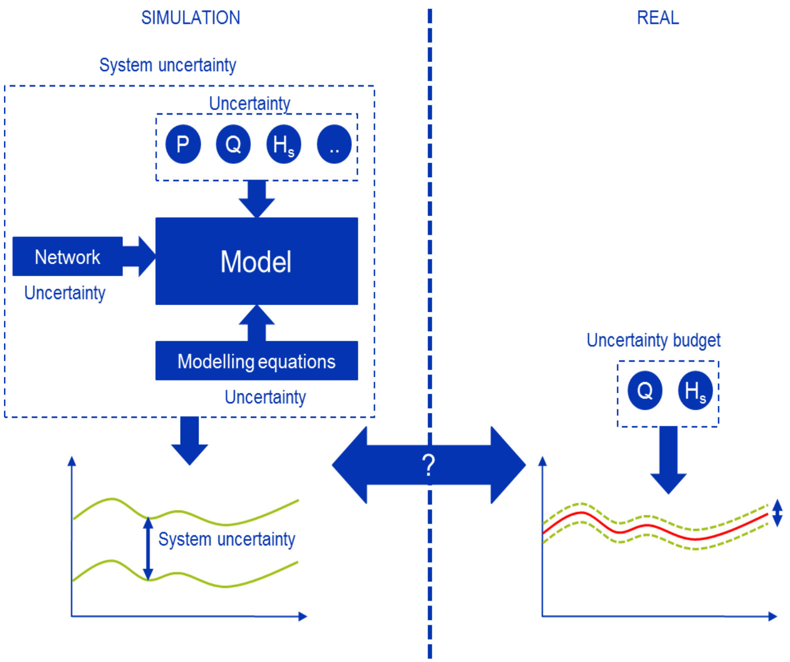
- *Delta transport time* is defined as the deviation between real and calculated transport times due to (measurement) uncertainties in simulation input data.
- For larger gas quality variations the calculated H_s value(s) are not reliable for this specific period of time.
- The allowed number of larger variations in H_s depends on the delta in transport time and the reliability requirement of a fiscal metering systems, e.g. >95%.

The deviation between the real transport time and the time as calculated with a GQT system should be minimized. The aim of the verification methodology is to verify this time deviation.

There are many aspects to consider, amongst others the propagation of uncertainty and network characteristics

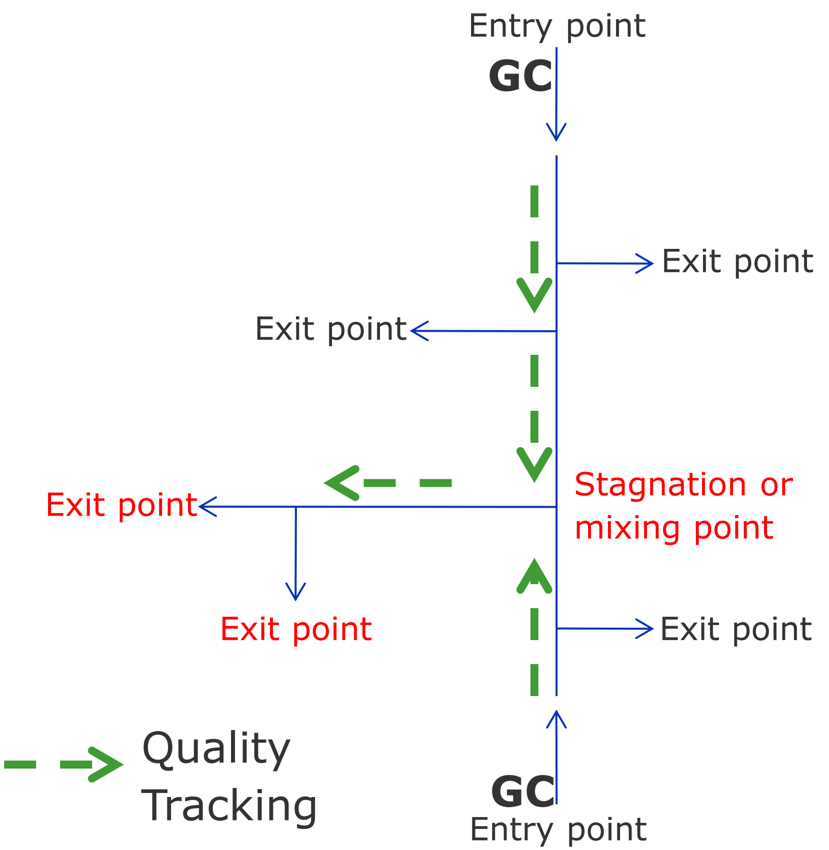
Sources of uncertainty

- (Measured) input data
- Biases in network geometry
- Biases in gas flow modelling

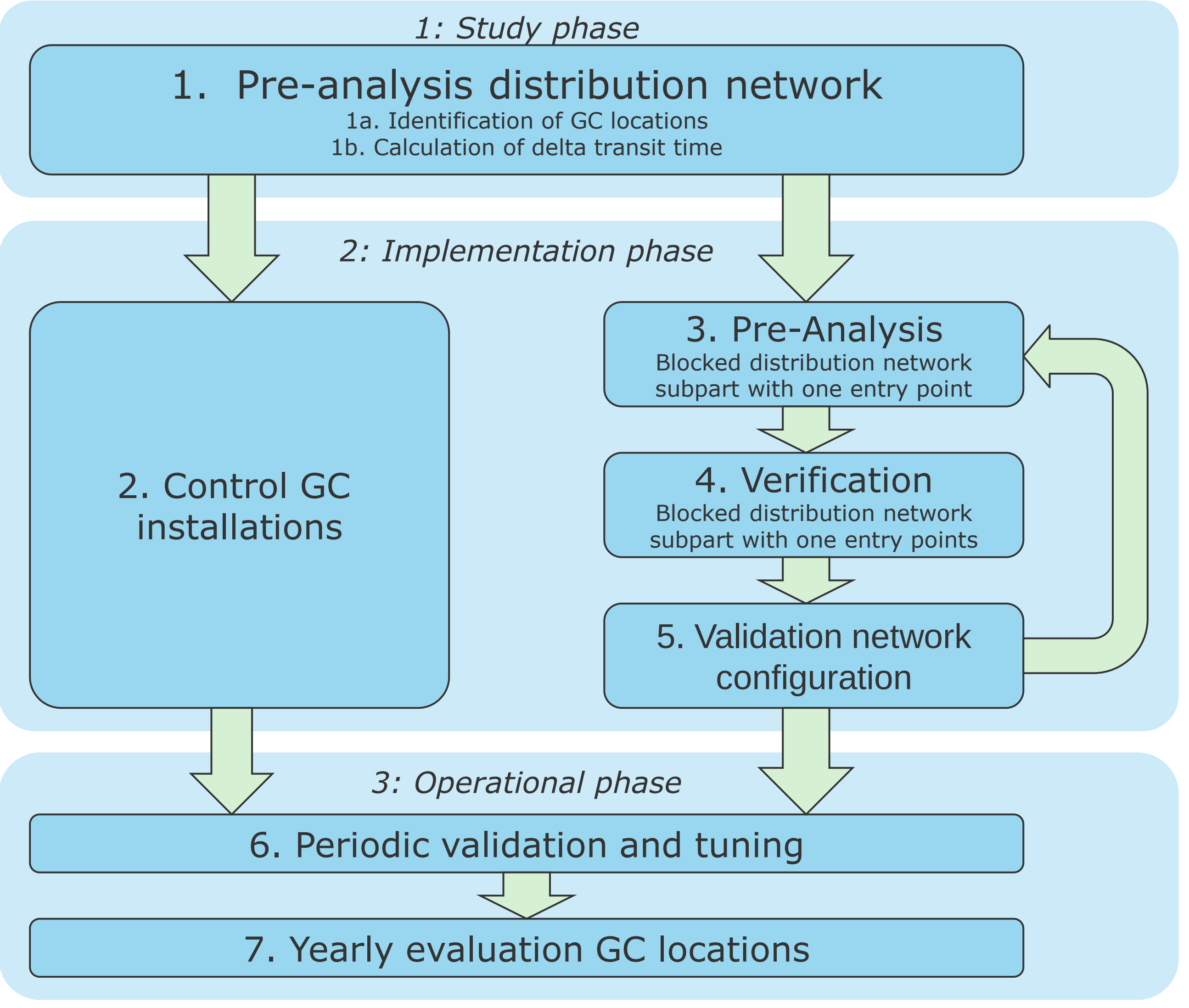


Multiple entry networks

- Sensitive for small pressure variations

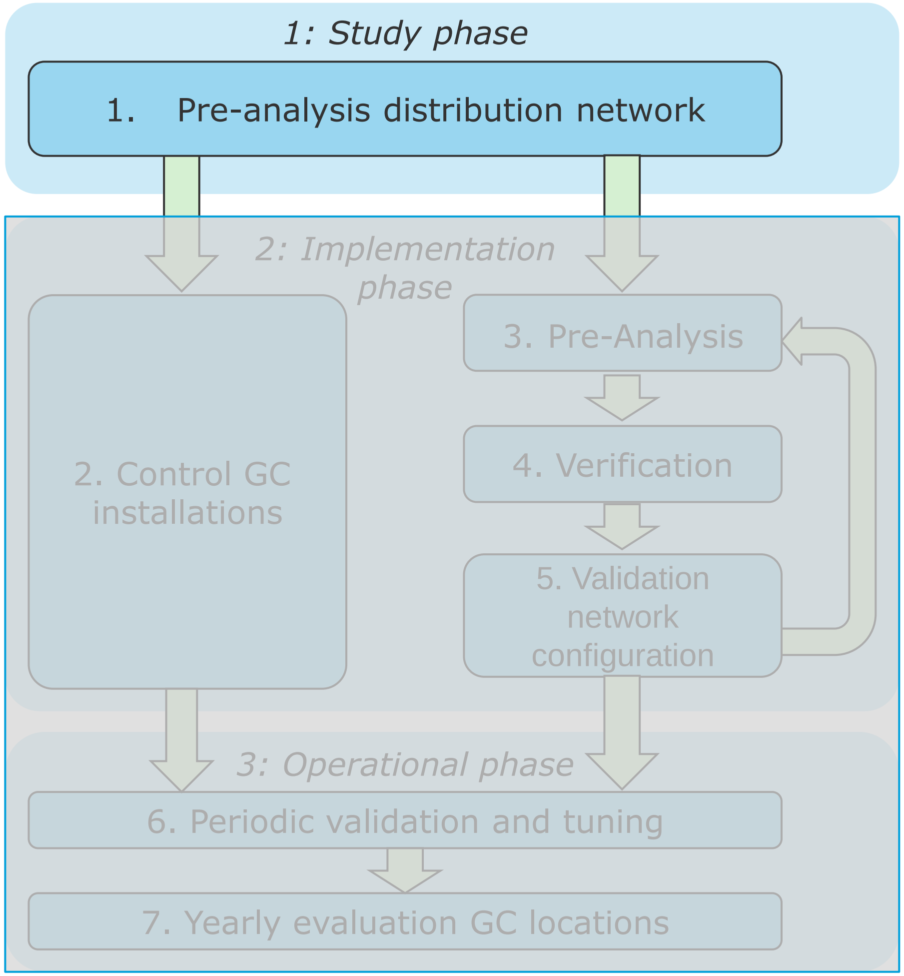


Verification methodology for a near real time GQT system



Phase 1: Delta transport time and control GC locations

1. In the pre-analysis the entire distribution network is considered to:
   – determine the effect of random uncertainties in input data on the resulting random deviations in the calculated transport time, and
   – identify the location of control GC's to verify the results of a GQT system in the case random deviations are too large.

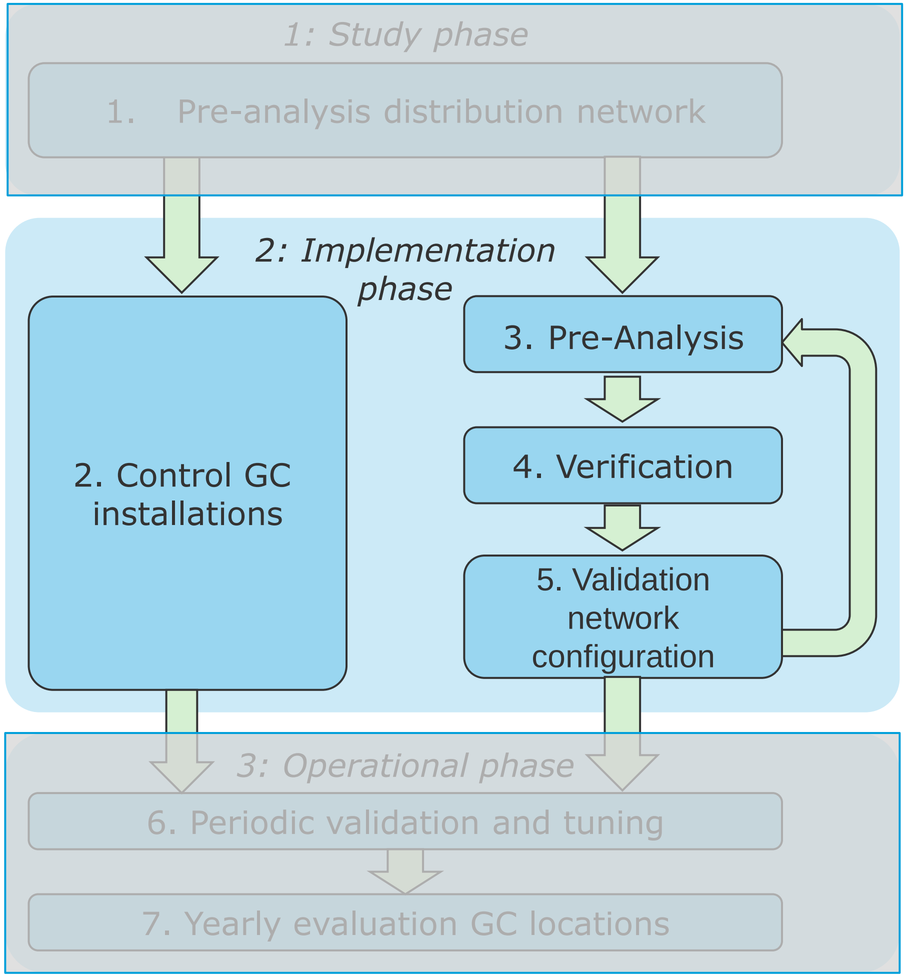


Propagation of uncertainty is analyzed by running 10 Monte Carlo trials.

Phase 2: Field verification measurements of network geometry

2. *An implementation phase* which will consist of the installation of control GC's at the locations determined in the study phase and in parallel field verification measurements to check for systematic errors in the network topology.

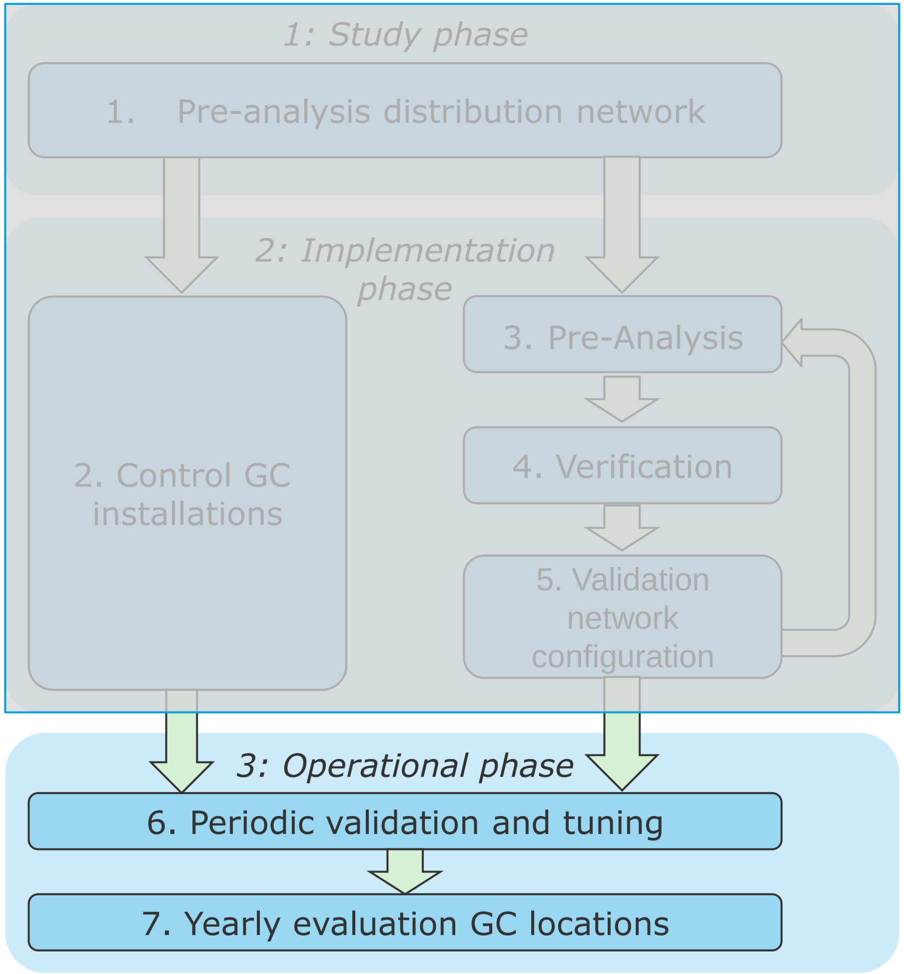
For the purpose of network topology verification, the distribution grid is divided in subparts with one entry point.



Phase 3: Periodic validation and tuning

3. *An operational phase* in which the configuration of the GQT system will be periodically validated and evaluated.

For this particular case **tuning** means adjusting the **pressure input** data within their uncertainty intervals to minimize the deviation between H_s values as calculated with the GQT system and H_s values as measured with control GCs



Discussion and conclusion

Discussion

- Two aspects, i.e. input data representativeness and periodic validation and tuning should be further studied. Although already a large number of considerations are covered within the methodology, these two aspects may involve additional uncertainty that needs to be taken into account.

Conclusion

- The verification plan has been developed for and applied to an operational GQT system in the fiscal metering process of the Dutch TSO.
- The first regional grid with a single entry for which the billing process included calculated H_s with a GQT system was operational in 2009.

The **near real time** application of GQT systems in fiscal metering is **achievable** and has proven to be a **cost-efficient alternative** to cope with H_s variations.

Thank you very much for your attention

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