Vier Gas Services
GmbH & Co. KG

Re - calibration Workshop FORCE
08./09. June 2017
Best practices at Open Grid Europe

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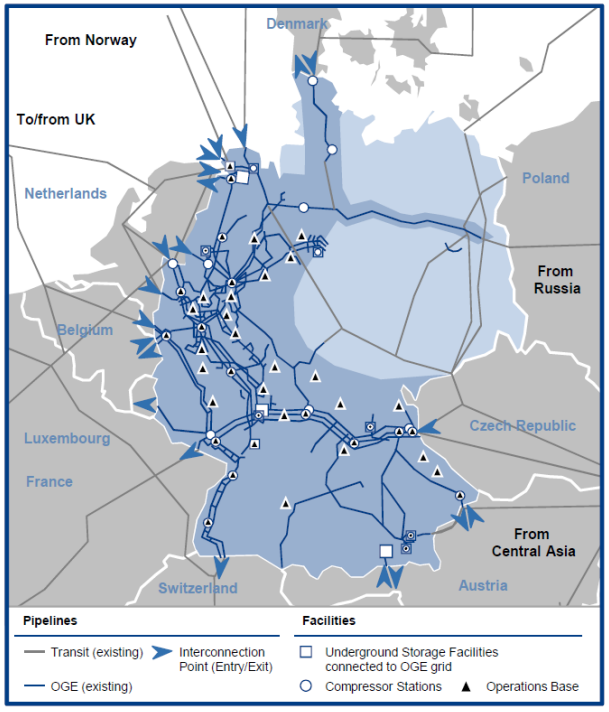
Open Grid Europe

Open Grid Europe
The Gas Wheel

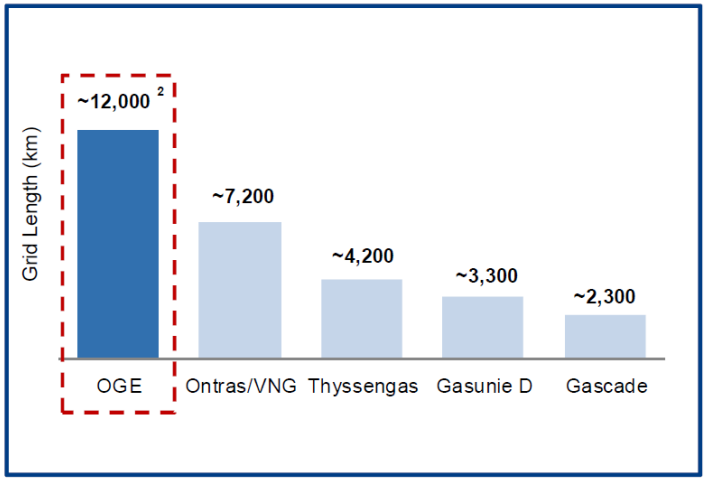
viergas

A Key Gas Transmission System Operator at the Heart of Europe

Centrally Positioned Service Area



Largest Gas Transmission Network and Operator [1]



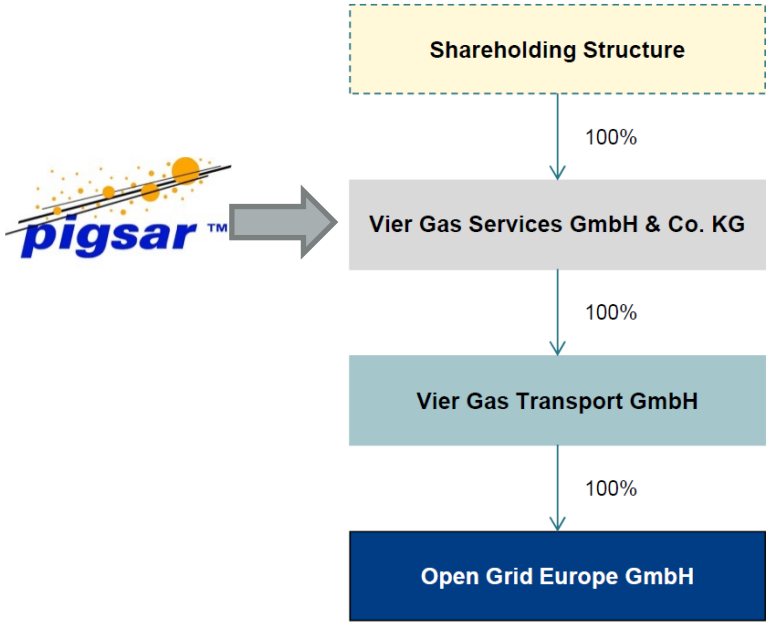
- **Covering 70% of the total shipping volume in Germany with approx. 62.5 bcm p.a.**
- **27 compressor stations and 97 units**
- **Approx. 51 entry and 1,100 exit points with 17 inter-connections to bordering countries**
- **450 national and international customers**

[1] *Source: FNB Gas "Entwurf Netzentwicklungsplan Gas 2015"*
[2] *Thereof approx.7,730km fully owned by OGE*

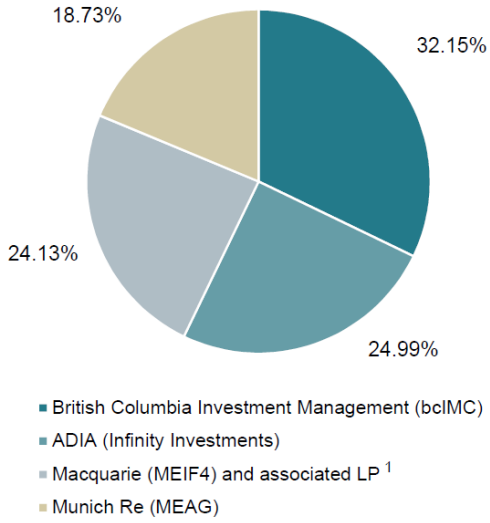
Vier Gas Services – pigsar

Group Ownership Structure: Experienced Long-Term Investors

Simplified Group Structure



Shareholder Composition



[1] *97.7% MEIF4 and 2.3% Halifax Regional Municipality Master Trust*

General remarks

- Generally all measurements performed with regard to trading underly the German metering law or corresponding European regulations.
  - ➢ This regards the measurement of high pressure natural gas volume flow as well
- But: meters for larger volume flows are explicitely excluded from German metering law (stations >150.000 m³/h @ base conditions (0°C, 1,01315 bar))
  - ➢ For these large metering stations it is assumed that market partners organize themselves, e.g. through individual contracts
  - ➢ However: metering stations of so called „REKO“-systems metering underlies German metering law even in cases of > 150.000 m³/h
- Initial calibration is covered by European regulations, re-calibration by national regulations

Meters not underlying German metering law

- This regards meters from larger stations (> 150.000 m³/h) which are not part of a „REKO“-system
- meters which are used for balancing and dispatching purposes
- Entry stations / cross border stations: individual contracts with the corresponding partners, there are no „general“ procedures which are exactly the same for all stations

Re-calibration practice for metering stations with lower priority (balancing, dispatching, control of network …) is under permanent discussion at OGE. Aim is to reduce operating costs by keeping the metering accuracy as good as necessary.

Meters underlying German metering law

- OGE fulfills the German metering law
- Normally no additional re-calibrations are performed
- Special treatment of larger metering stations („REKO“-System)
- In addition to German law there are often individual contracts for larger metering stations (mostly entry-stations, also cross-border stations) with the corresponding partners

MessEV – Anlage 7

MessEV :
Regulation for bringing meters into the market, making them available for the market, for the use of these meters and for re-calibration (freely translated)

(Verordnung über das Inverkehrbringen und die Bereitstellung von Messgeräten auf dem Markt sowie über ihre Verwendung und Eichung (Mess- und Eichverordnung))

Annex 7: Special re-calibration periods for certain meter types) (freely translated)

(Anlage 7 (zu § 34 Absatz 1 Nummer 1): Besondere Eichfristen für einzelne Messgeräte)

- GTMs with permanent lubrication (no external lubrication),
  USMs with Q_{max} > 1600 m³/h: 8 years
- GTMs with external lubrication with Q_{max} <= 4000 m³/h: 12 years
- GTMs with external lubrication with 4000 m³/h < Q_{max} < 16000 m³/h: 16 years
- GTMs with external lubrication with Q_{max} >= 16000 m³/h: not limited
- USMs with Q_{max} <= 1600 m³/h: 5 years

MessEV – Anlage 7 – main/back-up meter

Under special conditions re-calibration periods are unlimited in case of main/back-up meter principle

Rotary piston meters, GTMs, Vortex flow meters and USMs used in fiscal metering between non-changing partners, with Qmax >= 1600 m^3/h:

- two meters are operated in series (one main meter and one back-up meter) non-permanently („Z-configuration“)
- or main/check meters are of different measurement principle and are used permanently in series,
- or two USMs with different feed backs to flow perturbations are used

MessEV – Anlage 7 – main/back-up meter

Under following conditions re-calibration period is unlimited:

- Deviation between main/check meters must be determined during commissioning
- Deviation must be determined yearly
- Change of deviation must be <= 0,5 % (above Q_t), <= 1,0 % (below Q_t), from start on

(Annex 7, 5.6.7 freely translated)

In case of 2 USMs in series: PTB-rule TR-G 18 must be followed in addition!

Series use of two USMs – TRG 18

Unlimited use of 2 USMs in series under German fiscal metering law is allowed if the requirements of TR-G 18 are fulfilled

Physikalisch Technische Bundesanstalt

Technische Richtlinien

Messgeräte für Gas	**Ausgabe:** 11/13 **Ersatz für:** --/--	**G 18**

Herausgegeben von der Physikalisch-Technischen Bundesanstalt in Einvernehmen mit den Eichaufsichtsbehörden.

Anforderungen an Dauerreihenschaltung von zwei Ultraschallgaszählern

Requirements of PTB TR-G 18

1. Requirements on construction of USMs and their installation

   ➔ there must be different influences on each USMs caused by gas flow changes

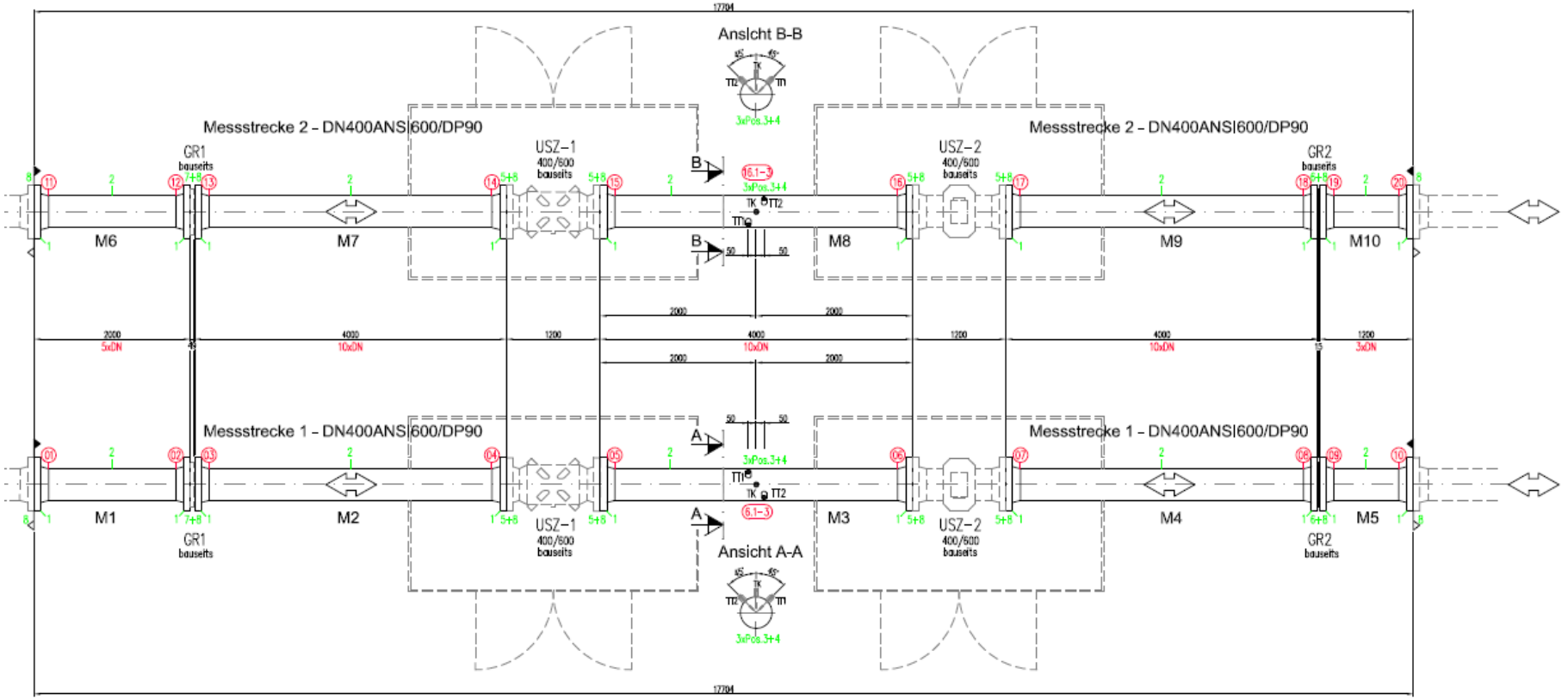
2. Yearly on-site measurements regarding
   - Meter deviations
   - Analysis of VOS

3. Measures and metering limits are given

4. Temporary provisions apply for stations taken into operation before 31.03.2014

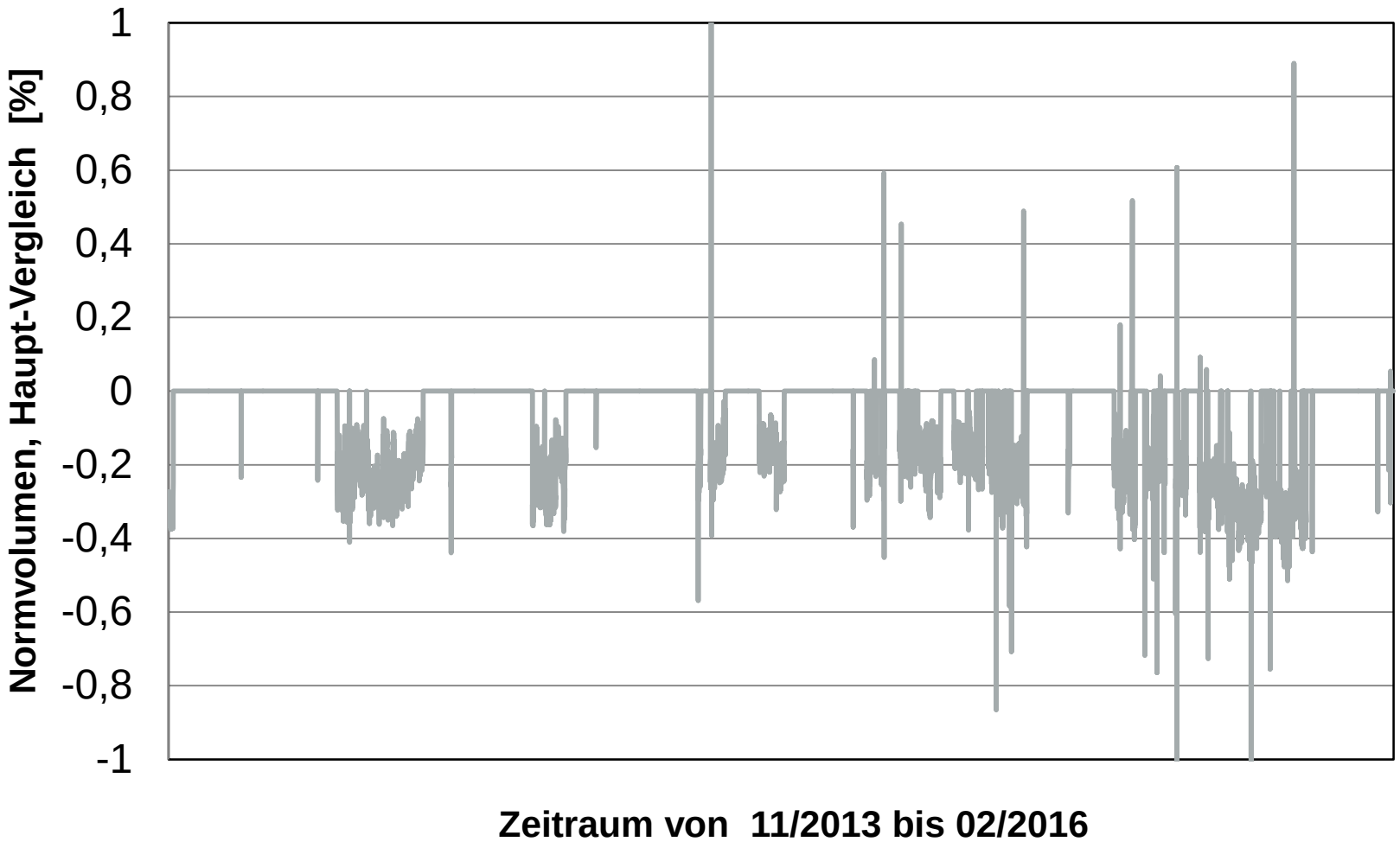
5. Recommendation: Regular comparision of VOS given by USMs with theoretical calculated using actual gas composition T and p

Example for one OGE-station

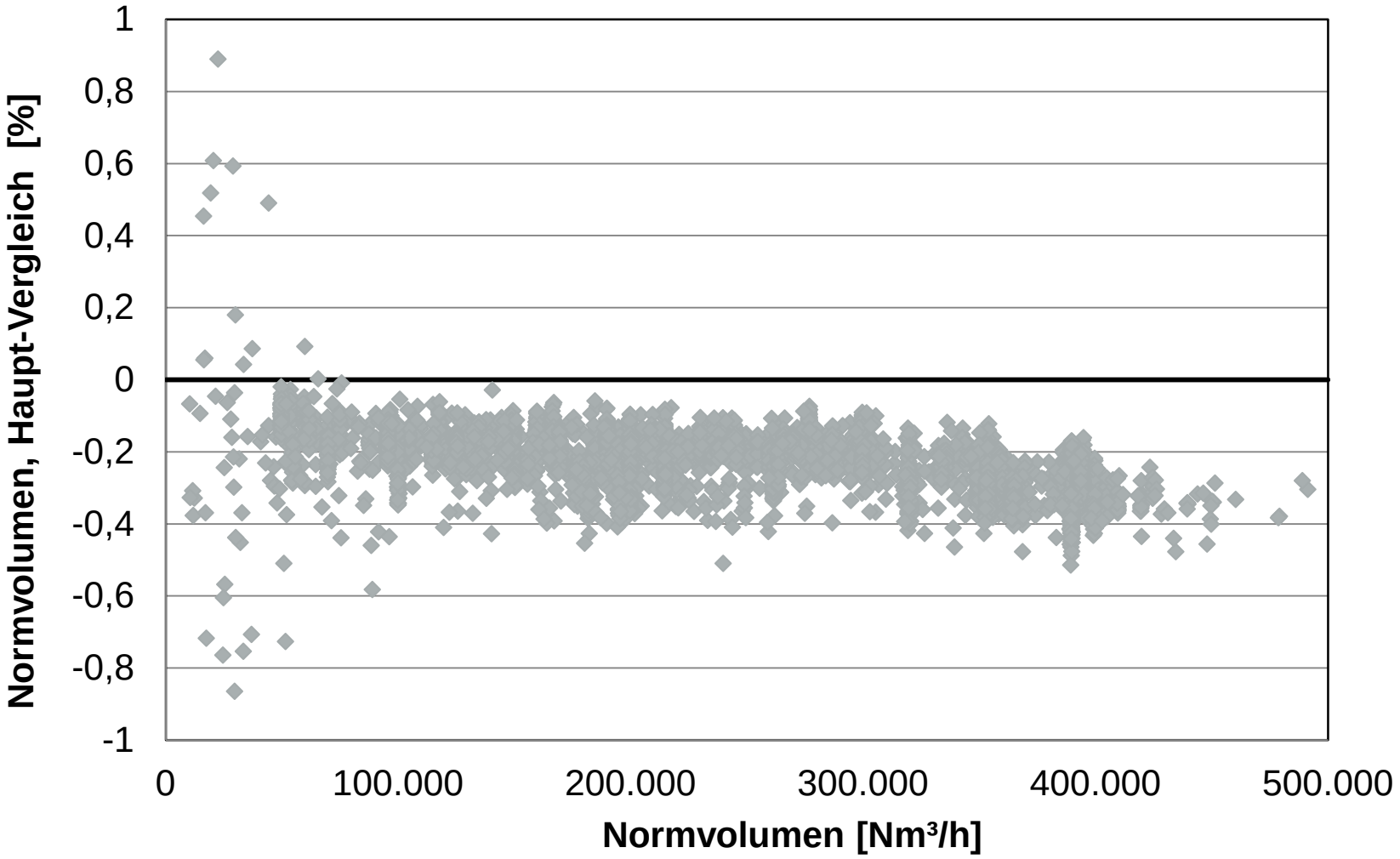


- **2 meter runs DN400**
- **Calibration at pigsar**

Comparison reference volume flow over time



Comparison reference volume flow



Analysis VOS main meter

Messstrecke 1						
	IBN 27.11.2013	13.03.2014 FR1	22.07.2014 FR2	22.07.2014 FR1	09.06.2015 FR1	19.08.2015 FR2
AGA10 (DB9)	428,15 m/s	405,3 m/s	411,7 m/s	413,4 m/s	408,2 m/s	423,2 m/s
Zähler Mittel	428,03 m/s	405,75 m/s	411,38 m/s	413,27 m/s	408,54 m/s	423,15 m/s
Pfad 1-Mittel	0,00 %	0 %	0 %	0 %	0 %	0 %
Pfad 2-Mittel	0,00 %	0 %	0 %	0 %	0 %	0 %
Pfad 3-Mittel	-0,01 %	-0,01 %	-0,01 %	-0,01 %	-0,02 %	0 %
Pfad 4-Mittel	0,01 %	0,01 %	0,01 %	0,01 %	0,03 %	0 %

Analysis VOS check meter

Messtrecke 1						
	IBN 27.11.2013	13.03.2014 FR1	22.07.2014 FR2	22.07.2014 FR1	09.06.2015 FR1	19.08.2015 FR2
AGA10 (DB9)	428,56 m/s	406,20 m/s	411,8 m/s	413,3 m/s	408,40 m/s	423,1 m/s
Zähler Mittel	428,03 m/s	405,3 m/s	411,84 m/s	413,38 m/s	408,92 m/s	423,62 m/s
Pfad 1- Mittel	-0,08 %	0,05 %	-0,04 %	-0,03 %	0,05 %	-0,04 %
Pfad 2- Mittel	-0,09 %	0,05 %	-0,07 %	-0,07 %	-0,06 %	-0,08 %
Pfad 3- Mittel	0,06 %	-0,07 %	0,05 %	0,04 %	0,08 %	0,08 %
Pfad 4- Mittel	0,06 %	-0,07 %	0,04 %	0,04 %	0,08 %	0,05 %
Pfad 5- Mittel	0,03 %	-0,01 %	0,02 %	0,01 %	0,00 %	0 %
Pfad 6- Mittel	0,03 %	0,02 %	0,01 %	0,01 %	0,01 %	-0,01 %

Experience at OGE regarding field conditions

- Lifetime of meters strongly depends on operating conditions
- In case of dirt or condensates in the gas flow, meters can be significantly influenced
- However: gas in the OGE-network is clean and dry which means that these problems normally do not occur in the OGE network
- Accumulation of dirt could lead to over-readings due to reduction of cross sectional area

Experience at OGE regarding field conditions

- With regular care (periodical oiling of GTMs, …) meters usually have very long life time, up to several decades
- Problem for GTMs maybe: too fast pressure or flow rate changes … Bearing or blades maybe influenced considerably ➔ recalibration or repair
- No experince about long-term behaviour of USM transducers (what happens after 20 years …? Any aging effects?). First checks after 8 years show no problems.
- Quality regarding electronics, sensors mechanical parts differs between manufacturers

Regular services on OGE stations

- Metering stations at OGE have different priorities

- Metering stations with highest priority (e.g. entry stations, cross-border stations):
  - individual contracts with the partners about regular ckecks (so called „Revision“, Betriebspunktprüfung, including p, T, flow computer testing)

- Most stations are revised at least once a year

- Remote witnessing for USMs (e.g. VOS-checks).
  - OGE has pushed manufacturers of flow computers and USMs to create new communication ports – compatible for all USM-types used in OGE network – to get diagnostic data from USM

Summary OGE practice

- OGE follows German metering law
- Most stations are equipped with main/back-up meter and are checked at least once a year
- The use of two USMs of different type in series becomes more and more popular
- Comparison of main/back-up meters (Vn, Vb, p, T) is most important tool
- VOS-analysis is a very good method to control meter and also complete metering station
- In case the PTB-regulation TR-G 18 is fulfilled costs can be reduced by avoiding re-calibrations
- Gas in OGE-network is clean and dry which means that there is no specific additional need of shorten re-calibration periods
- Re-calibration practice for metering stations with lower priority (balancing, dispatching, control of network …) is under permanent discussion. Aim is to reduce operating costs by keeping the metering accuracy as good as necessary

Comments from pigsar

- Aside from legal requirements, each user / partner of metering systems must make up his own mind about the issue „re-calibration“
- Not every TSO, operator of metering stations, storage operator, etc. has man power and expertise to „avoid“ re-calibration by applying regular on-site checks, diagnostics, etc.
- Saving money by avoiding re-calibrations is not always recommendable
- The costs of re-calibration are in most cases marginal related to the energy value measured by the devices
- Regular and more often re-calibration gives confidentiality and takes responsibility from the operator
- Field influences are not always that well known

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Legal Metrology in Germany