UNITED NATIONS

E

Economic and Social Council

Distr.
RESTRICTED

ENERGY/WP.3/GE.3/R.14
1 August 1994

Original: ENGLISH

ECONOMIC COMMISSION FOR EUROPE

COMMITTEE ON ENERGY
WORKING PARTY ON GAS

Meeting of Experts on the Transport
and Storage of Gas
Twenty-fifth session, 6-7 September 1994

MAINTENANCE MEASURES AND REGULATIONS IN THE OPERATION AND MANAGEMENT OF GAS TRANSMISSION SYSTEMS

(Draft consolidated report, transmitted by the Government of the Czech Republic)*

The questionnaire was replied to by seven countries, i.e.

- Croatia,
- the Czech Republic,
- Germany,
- Hungary,
- the Netherlands,
- Slovenia,
- Turkey.

Generally it can be stated, that not all of the questions were answered at the same level of information quality. Even if the question was asked to state for example a frequency of maintenance actions, a few of the replies stated only "YES". It was thus relatively hard to make an analysis.

---

* In accordance with the decision of the Meeting of Experts at its twenty-fourth session, held in September 1993 (ENERGY/WP.3/GE.3/6, para. 5 (b)).

Nevertheless it should be claimed that the answers received - even when the sample is relatively small and not representative - can be usefully generalized, as these contain the answers both from countries with very old gas industry and from countries with a relatively recent gas history.

The analysis of the replies has shown that there are plenty of areas of gas transmission pipelines maintenance where the conceptions are relatively homogeneous in the countries which completed the questionnaire. On the other hand there are several areas, where the meanings are absolutely different. Such items are marked by an asterisk.

The synthesis of entries received and analysed is presented in the same structure as the questionnaire.

1. Regular maintenance of pipelines

1.1 The philosophy of maintenance (1.1.1 to 1.1.3)

Generally in the majority of countries there is no system of maintenance and checking of pipelines, in order to determine the age of the pipeline. Only in Germany there is a system of Pipeline Integrity Management, covering the age of pipeline as one of the integral factors of pipeline reliability evaluation. In the Czech Republic higher attention is paid to old pipelines, but it is not a complex programme. In Croatia pressure tests are performed on older pipelines, as well as measurement of wall thickness and coating checking.

There is no exact relation between the lifetime of the pipeline from technical and economical (remission) point of view.

In all the countries there exists a legislative system for operation, maintenance and checking of high-pressure gas pipelines, which varies between the law and the order of ministry (State department). Some countries are planning to use prepared European Standards.

1.2 Pipelines Maintenance

1.2.1 Survey of the right of way (r.o.w.)

.1 walking

The interval varies from 2 x a month to 1 x a year; no interval is significantly preferred

.2 driving

The interval from 1 x a month to 4 x a year, usually only in risk areas, Croatia 1 x a week

.3 using of helicopters

Usually 1 x or 2 x a month, generally only on important lines

.4 clearing of the r.o.w. and accesses to the plants

Only when needed, an interval 1 x in 2 years would seem to be enough

.5 detection of leakages (which instruments are used)

Preferably the flame ionization detector (FID) based instruments are used; the checking is performed usually during walking survey

Generally it should be stated, that walking survey is held as detailed, but not the most important means of condition evaluation. Checking of the pipeline neighbourhood (mainly due to digging activities) is generally made by helicopter, above all on main pipelines. The r.o.w. clearing, used in the past every year, has changed to more free system on-conditions, usually once in two years.

1.2.2 Survey of landslides areas, and how is it performed

.1 geodetical measurements

The Czech Republic reports interval 2 x a year, Slovenia and Croatia as needed; generally there is an effort not to lay the pipelines on unstable areas, e.g. in Germany the pipelines are constructed on unstable areas only in the case of undermined areas

.2 measurements on pipeline in unstable area and methods used for such measurements

Generally geodetical measurements are used or continuous measurement of stresses in pipeline by stable mounted strain-gouges. Croatia performs pressure tests by water or inert

.3 regular system of stabilization of landslide area

Hungary stabilizes unstable areas by plastic net and grass, Croatia by grass only

Generally it is preferred not to lay the pipelines on unstable areas. If the construction on such an area is necessary, the pipeline is usually checked, in most cases by geodetic methods. Stabilization of soil is not generally used.

1.2.3 Survey of inundated areas

Only Germany performs regular checking (3 x a year); Croatia when needed

1.2.4 Checking and maintenance of river and/or road crossings

.1 bridges

(*) The interval has a wide variability from 1 x a week to 1 x a year

.2 underwater crossing

The interval varies from 1 x a year to 1 x in 5 years

.3 casings

The interval varies from 1 x a year to 1 x in 5 years, typical is 1 x a year

1.2.5 Keeping of records on computers

.1 statistics

Typical is yes

.2 working orders

Typical is yes, mainly often-used types of orders

1.3 Cathodic protection (CP) and insulation of the pipelines

1.3.1 Measurements of CP potential (method used)

All the countries report measurement using $Cu/CuSO_4$ referent cell; interval varies in normal conditions from 6 x a year to 1 x a year; in areas with heavier corrosion conditions (stray currents) 1 x a month

1.3.2 Survey of insulation status (method used)

For coating status checking several methods are employed, beginning with simple comparison of CP current in different ages of pipeline and continuing with Pearson survey, close interval measurement or DC gradient measurements

1.3.3 Provision made if error is found on

.1 pipeline and casing in touch

repair in max 3 years

.2 influence or interference of another facility

application of electric drainage

.3 interruption or reduction of CP current

find a fault and repair

.4 diode breakdown in the draining installations

repair

.5 significant insulation damage (what criterion)

repair (only Croatia referred to a criterion of significance - more than 100 m^2, the remaining countries made no comment.

System of CP checking is generally based on potential measurement, commonly a criterion of -0,85 V against $Cu/CuSO_4$ is respected. For coating integrity evaluation, several methods are used, typical is Pearson survey, modern quantitative method is not preferred.

1.4 Maintenance of section and branch-off valves (SBV)

1.4.1 Regular control of SBV operation

.1 local control

Usually 4 x a year, Croatia 1 x a week

.2 remote control

The interval varies from 1 x a month to 1 x a year, the most used interval is 1 x a year

.3 line damage automatic shut-off system check-up

The interval varies from 1 x a month to 1 x a year; the most used interval is 1 x a year

1.4.2 SBV instrumentation equipment control

Interval from 2 x a month to 1 x a year, prevails 1 x or 2 x a year

1.4.3 Control of tightness (method used)

1 x or 2 x a year checking of external tightness (flanges, impulse piping); tightness of closed valve is checked only in the case of fault of valve.

Generally the maintenance of SBV is made at six-monthly or one-year intervals

1.5 Special winter operations on distribution facilities

1.5.1 Pigging and measurement of dew-point of water in gas (method used, tolerable limit)

The system of no special pre-winter pigging prevails

1.5.2 Control of hydrate formation (drying/inhibiting/other method)

Inhibiting of hydrate formation is normally used. Only Croatia refers to drying of gas on system input

1.5.3 Inhibition of hydrate formation

The methanol injection is exclusively used

Compared with recent times, special pre-winter preparation is no longer used. If pigging is performed, the main reason is for improving the pipeline hydraulic properties. Eventual hydrate formation is controlled by methanol injection.

1.6 Maintenance of electric installations and grounding

1.6.1 Control of electric installations

(*) The interval varies from 1 x a month to 1 x in 5 years. An interval of 1 x a year prevails

1.6.2 Measurements of the grounding system of the above-ground installations

Interval from 1 x a year to 1 x in 5 years; 1 x a year prevails

1.6.3 Check-up of the gas ramp in a boiler-room and control of the pump drive

(*) Interval from 1 x a month to 1 x a year

The interval of electro-installation checking and maintenance varies very widely. It might be also a result of a different definition of normal operation measurements and special maintenance checking in different countries.

1.7 On-line internal inspection

1.7.1 System

There is undoubtedly prevailing a system of more-less incidental inspections, e.g. ad hoc inspections of pipelines where there are some operational questions or problems. Only Germany and the Czech Republic prefer a higher frequency of inspection of older pipelines. Croatia has not yet used internal inspection. Slovenia has used only one internal geometrical inspection.

1.7.2 Frequency

As other reasons for on-line inspection pipeline than the regular interval are used, it is not possible to compare intervals used. Only the Netherlands refers to framed system, where an on-line inspection is done on every 100 km part of pipeline roughly 1 x in 5 years

1.7.3 Type of on-line vehicle used

In all the countries a magnetic flux leakage method is used

The internal inspection until now has been used as a method for checking the situation of pipelines in special cases rather than a means for regular checking of the pipeline system.

2. Maintenance of technological equipment

2.1 Gas dehydration plant

The gas dehydration plants (in gas transmission systems) are operated only in Germany, Hungary and Croatia. The frequency of technological equipment maintenance was reported only by Croatia.

2.1.1 Measurement of dew-point

2 x a year

2.1.2 Chromatographic analysis

2 x a year

2.1.3 Check-up of glycol regeneration equipment

1 x a year

2.1.4 Servicing of glycol pump

1 x a year

2.1.5 Control of working parameters of compressors and equipment

1 x a year

2.2 Gas preparation and compressor plant

2.2.1 Check-up of valves

(*) Function is checked at frequencies in wide intervals from 1 x a month to 1 x a year. The Czech Republic reports visual checking 1 x a day

2.2.2 Lubrication of valves

Intervals from 1 x a month to 1 x a year. Interval 4 x a year prevails

2.2.3 Check-up of regulation valves

(*) Intervals from 1 x a day to 1 x a year

2.2.4 Check-up of vessels under pressure

Intervals from 1 x a year to 1 x in 5 years; longer ones prevail

2.2.5 Safety valves control

Intervals from 1 x a month to 1 x in 4 years, 1 x a year prevails

2.2.6 Alarm equipment control

Intervals from 1 x a week to 1 x a year, interval 2 x a year prevails

2.2.7 Fire protection system check-up

Intervals from 1 x a month to 1 x a year, 4 x a year prevails

2.2.8 Anti-pumping protection system of compressor check-up

The most typical interval is 1 x a year

Checking and maintenance of valves, regulators and security systems is made generally 2 x or 4 x a year, which can be mentioned as a proof of high quality of this system compared with the situation some years ago.

2.3 Cooling system

2.3.1 Visual investigation

The interval 1 x a day prevails

2.3.2 Working parameters control

The interval 1 x a hour prevails (as a part of compressor station control constant measurement algorithm)

2.3.3 Pressure drop measurement

Drop is permanently measured in Germany and the Netherlands (no interval mentioned), Croatia reports the interval 1 x 2 hours

2.3.4 Cooling system cleaning

.1 external surface

Generally from 4 x to 1 x a year

.2 internal surface

Usually only when it is needed (when a high pressure drop occurs), Croatia reports regularly 1 x a year

2.3.5 General repair (criteria applied)

The majority of countries report general repair only in the case of leakage; nevertheless the Netherlands refer to an interval of 20 years, and Croatia general repairs after 25,000 operational hours of relevant compressor.

The coolers are not held to be a part of compressor station needing extraordinary care, the only exception is permanent checking of output temperature as the part of compressor station control algorithm.

2.4 Compressor units

General part

2.4.1 Philosophy

The majority of countries report systems of maintenance based on producers' recommendation, usually on limits of the operational hours or the cycles start/stop. The Czech Republic refers to partial application of on-conditions system, when necessity of control or maintenance is decided mainly on diagnostics results.

Part maintenance and intervals

2.4.2 Lubrication system check-up

(*) There are reported intervals ranging from 12 x a day to 1 x after 8,000 operational hours.

2.4.3 System of check-up and maintenance if time-based

(*) Because there are very different types of machines, the data are not comparable; the same operation is for example on Solar machines recommended after 8,000 hours, on Nuovo Pignone after 32,000 hours.

2.4.4 Regular diagnostic system (type, intervals)

The Czech Republic and Hungary refer the interval 2 x a year, the methods used are vibrodiagnostics, tribochemistry and flue gases analysis.

2.4.5 Statistics of disturbances

.1 for servicing coordination - used by Croatia, the Czech Republic, Germany and the Netherlands, mainly for spare parts reservation

.2 used for discussion with producers by all the operators

3. Regular maintenance on measurement and regulation system (MRS)

3.1 Maintenance of MRS

3.1.1 Check-up of MRS and lines adjustment

Intervals from 1 x a month to 4 x a year

3.1.2 Adjustment of regulation and protection systems

Intervals from 4 x a year to 1 x a year

3.1.3 Restoration of vital parts of MRS

(*) The Czech Republic and Hungary report restoration based on results of control measurement, Turkey after reaching the operation hours limit, Slovenia in interval 1 x after 5 years, Croatia 1 x a year

3.1.4 Measuring equipment control

All the countries referred to follow laws or standards in this area

.1 orifice

Intervals from 2 x a year to 1 x in 2 years

.2 turbine meter

(*) Intervals in wide range from 2 x a year to 1 x after 5 years

.3 rotating piston meter

Only the Czech Republic - 1 x a year

.4 vibration gas meter

Only Hungary - 2 x a year

.5 ultrasonic gas meter

No intervals referred to

.6 mechanical corrector

(*) Wide range of intervals - from 2 x a year to 1 x in 5 years

.7 electronic corrector

(*) Wide range of intervals - from 1 x a month to 1 x in 5 years (2 x a year prevails)

.8 control and calibration of pressure, temperature and other instrumentation equipment and transducers

(*) Wide interval range - from 1 x a month to 1 x in 5 years

Germany reports for all types of measuring devices intervals from 1 x week to 1 x a year.

Croatia uses for all the types system:

- visual checking 1 x a week
- function checking 1 x a month
- official recalibration 1 x in 5 years

The intervals reported are in a very wide range - this clearly states the necessity of a unified standard (for example, European Norm), above all for recalibration intervals.

3.2 Control and adjustment of the station telemetry indicators

The interval 2 x a year is commonly used

3.3 Control and adjustment of MRS of heating system and heat exchangers

The interval 2 x a year is commonly used

The operational stability of recent systems had made it possible to enlarge the interval between checking and adjustment of devices to six months, now commonly used.

3.4 Border station control

3.4.1 Visual check-up of installation

Intervals from 1 x a day to 1 x a month

3.4.2 Control and adjustment of measuring equipment

Intervals from 1 x a month to 2 x a year

3.4.3 Comparative control of the measured gas quantities

Commonly the balance input/output or input/selled volume are used

Checking and recalibration of devices on border metering stations has commonly higher frequency compared to the other measuring devices. This is due to the large volumes measured.

4. General information of system used for registration and statistics of maintenance and damages

In general use are the systems of faults and maintenance data storing both at paper and computer form. Usually they are stored in chronological order.

4.1 The planning and control of the maintenance system based on special software on PC is widely used

4.2 Frequency of damages to pipeline system

The majority of countries do not report concrete data

The Czech Republic report once every 10 years, Hungary twice a year, Slovenia 5 x in 10 years, but the extent of damage to the pipeline system is not reported.

4.3 Sources of damage of high pressure main gas pipelines

.1 damages of cathodic protection, defective CP system

Yes (Croatia, the Czech Republic, Slovenia)

.2 mechanical by "third party"

Yes (except Turkey)

.3 agricultural activities

Yes (Croatia, Germany, the Netherlands)

.4 natural causes (landslides, earthquakes etc.)

Yes (the Czech Republic, Turkey)

The Czech Republic reports also microbial-induced corrosion

4.4 Gradual change of pipeline and MRS gravity control (with ageing)

Croatia performs pressure tests by water or inert gas on old pipelines, wall thickness measurement and coating checking. The Czech Republic and Germany report the higher intensity of on-line inspection on older main pipelines. The Czech Republic performs hydrotesting (stress-test) on selected old pipelines. Germany uses a higher frequency of close interval measurement of cathodic protection potential ("intensivmessung") on old pipelines.

4.5 Elimination of disturbances and damage

4.5.1 Technological programmes for elimination of damages

Yes (all countries)

4.5.2 Design system modification on operation and maintenance knowledge

Yes (all countries)

4.5.3 Safety instruction for the gas pipelines systems

Yes (all countries)

4.5.4 Training of damage repair team

Yes (all countries)

4.5.5 On-duty at home

Mainly yes (all countries except Germany)

4.5.6 Responsibility of chief on duty

This responsibility was not specified by the majority of countries.

In the Czech Republic the chief on duty has a responsibility to stop the transmission of gas.

In Hungary the chief on duty has a responsibility to decide if and by what means the repair should be done.

4.5.7 Information system for people

Yes (all countries)

4.5.8 Cooperation with public organizations in the case of pipeline breakdown (police, firemen, etc.)

Yes (all countries)

4.6 Repairs on pipelines under pressure (methods used for temporary and for stable repair)

All the countries report using different types of repair sleeves, both welded and screwed, made from steel or a combination steel/epoxy.

Only Croatia states them as temporary.

5. Exchange of experiences

The majority of countries stated an interest in exchanging the experiences on regular checking systems of pipeline and MRS, also on risk elimination programmes.

The majority of countries did not manifest any interest to exchange the experiences on pipeline failure causes and statistics.

No country has reported any general remark.
