Volume Planning in Ruhrgas Dispatching. Possible Influence of Reliable Seasonal Weather Forecasts.

Presentation at the Workshop on the Application of Seasonal Weather Forecasts Hosted by the European Centre for Medium-Range Weather Forecasts (ECMWF) in Reading, UK, on 14 and 15 June 1999

1. Ruhrgas in Outline

Ruhrgas is a gas merchant company based at Essen in Germany. It purchases gas on international markets and supplies its customers in Germany and abroad. Its annual gas sendout is approx. 600 billion kWh and the customers include regional distributors, municipal utilities and industrial consumers. In order to make the gas available, Ruhrgas operates a modern and efficient pipeline system together with the associated facilities. Apart from deliveries in line with demand as well as security of supply, Ruhrgas offers its customers a wide range of consultancy and other services in many fields. In addition to joint marketing, Ruhrigas makes available to its customers and market partners the latest technological findings in all areas of gas utilisation and distribution as a result of extensive R&D activities.

Ruhrgas offers its suppliers the reliable long-term offtake of large volumes of gas. This is a major prerequisite for the high investments by producers in gas exploration, development, production and transport. On the basis of long-term contracts, Ruhrgas purchases gas from indigenous producers, from the Netherlands, Russia, Norway, Denmark and - since 1998 - the United Kingdom. In 1998, the Netherlands accounted for about 21 % of the gas received by Ruhrgas, Russia for 35 %, Norway for 23 %, Denmark and the UK together for 3 % and indigenous sources for 18 %. Even in a changed political and economic environment, secure long-term offtake will be indispensable for reliable gas supplies to consumers. Ruhrgas is a private-sector business without any government participation. It was set up in 1926 and now has roughly 2,700 employees. Ruhrgas has two holdings for gas-related industrial interests and for stakes in German or foreign utilities. The Ruhrgas Group has a workforce of 9,000 worldwide.

2. Technical Facilities

The Ruhrgas pipeline system forms part of the European gas transmission system. At the beginning of the natural gas age in the 1960s, relatively short distances (200-300 km) had to be covered in our service territory between reservoirs in northwestern Germany or Groningen and end-users. Today, distances of 5,000 - 6,000 km have to be coped with between gas fields in western Siberia and consumers in Germany. The offshore fields in the Norwegian North Sea are about 1,000 - 1,500 km from the sales outlets.

The Ruhrgas pipeline system has an overall length of roughly 10,400 km. Due to its geographical location, this system has become a major hub of international gas transmission. Apart from handling Ruhrgas's own gas, it transports Russian gas to France and Switzerland, Norwegian gas to Austria and the Czech Republic as well as Dutch gas to Italy and Switzerland. The pipelines have diameters of up to 1.2 m, and the operating pressures may be as high as 100 bar. Ruhrgas operates 26 compressor stations with an installed capacity totalling 760 MW. These compressors produce the pressure needed for transportation purposes and for injecting gas into underground storage facilities. To cope with seasonal fluctuations in sales, there are 12 underground storage facilities with a working gas capacity of roughly 4.7 billion m^3.

3. Dispatching

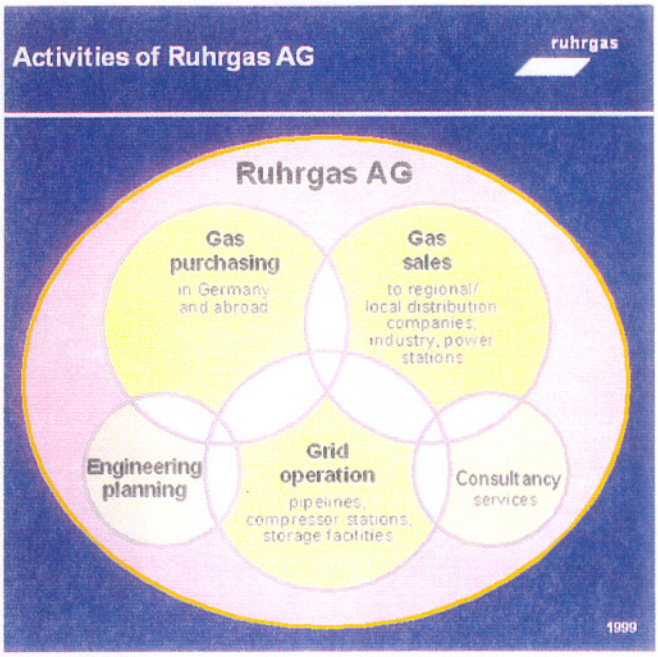
The entire pipeline system is monitored and controlled from the central control room of the Ruhrgas dispatching department in Essen. This dispatching department is responsible for constant operational management of the pipeline system. Its key functions are:

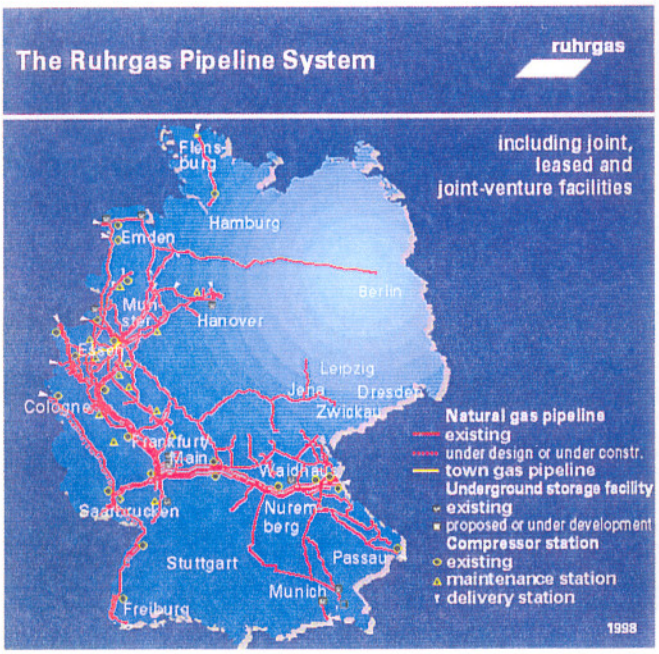
- grid and storage planning, including short, medium and long-term sales projections;
- determination of supply volumes and storage capacity needed to meet demand, with due regard for the supply strategy and planning specified by commercial departments;
- handling of nomination and implementation procedures agreed with gas suppliers, customers and shippers,
- transport optimisation;
- control and monitoring of the gas grid with all its technical facilities.

4. Volume Planning

Volume planning at the Ruhrgas dispatching department occurs with several time frames. In the case of long-term planning, contracted volumes and projected sales are compared with each other over a period reaching far into the future. This provides the decision-making basis for the expansion of transmission and distribution systems and the enlargement of underground storage facilities.


European Natural Gas Transmission System 1999
ruhrgas
pipelines/ LNG receiving terminals
existing
planned or under construction
Kollsnes
Oslo
Kårstø
Stavanger
Helsinki
St. Petersburg
Stockholm
Belfast
Dublin
Copenhagen
Minsk
London
Berlin
Warsaw
Prague
Paris
Bratislava
Vienna
Budapest
Lyon
Ljubljana
Zagreb
Bucharest
Belgrade
Sofia
Lisbon
Madrid
Rome
Athens
Algiers
Tunis
1999


Activities of Ruhrgas AG
ruhrgas
Ruhrgas AG
Gas purchasing
in Germany and abroad
Gas sales
to regional/ local distribution companies, industry, power stations
Engineering planning
Grid operation
pipelines, compressor stations, storage facilities
Consultancy services
1999


The Ruhrgas Pipeline System
ruhrgas
including joint, leased and joint-venture facilities
Flensburg
Hamburg
Emden
Berlin
Hanover
Leipzig
Jena
Dresden
Zwickau
Cologne
Frankfurt/ Main
Waidhaus
Saarbrücken
Nuremberg
Stuttgart
Passau
Munich
Freiburg
Natural gas pipeline
existing
under design or under constr.
town gas pipeline
Underground storage facility
existing
proposed or under development
Compressor station
existing
maintenance station
delivery station
1998


Ruhrgas Sources of Supply
ruhrgas
from the Netherlands since 1967
from the former U.S.S.R. since 1973
from the Norwegian sector of the North Sea since 1977
from the Danish sector of the North Sea since 1984
from the U.K. since 1993
from domestic fields since the beginning of the 60's
1999

Far shorter periods are also considered for volume planning.. For the purposes of day-to-day business, projections are carried out for the current and the next accounting year. The aim is to achieve the most cost-effective use of supply requests and of storage injection or withdrawal. The goals of volume planning are:

- security of supply for our customers, i.e. the sales volume must always be available in each case;
- compliance with contracts, i.e. all terms and conditions of contracts have to be observed without fail.,
- cost-effectiveness, i.e. supplies must be achieved at optimum cost- supply and transport optimisation must not, however, occur at the expense of the aforementioned criteria.

Volume planning in the dispatching department makes use of computer models depicting both the supply contracts and their structures as well as the gas grid with its facilities. Linear optimisation programmes are employed for this purpose. For dealing with the gas accounting year, a model broken down into monthly periods is employed, whereas a day-by-day model is used for monthly planning.

Volume planning is characterised above all by sales projections. These are based on best-fit lines (gas sales versus outdoor temperature) and selected temperature profiles. One of the problems of our business is that we have to cover different scenarios. On the one hand, in a warm year we have to ensure that the minimum annual contract volumes (under take-or-pay contracts with our suppliers) are taken; on the other, in a cold year our sales must always be covered by our potential on the purchasing side and the available gas in storage facilities. Our strategy must therefore fulfil both criteria at all times. Consequently, our sales projections are based not only on the long-term average temperature profile (30-year mean for the period from 1961 to 1990) but also on the temperature profile for a specific hot year and for a specific cold year. Especially in winter months, there are substantial deviations between the sales figures for the different temperature profiles. (Fig.: - 14 OC best-fit line)

Apart from volumes, capacity is analysed in our preparations for the winter. Our planning has to make provision for coping with the peak load situation arising at an outdoor temperature of -14 °C (as the average figure for our service territory). Another critical situation exists if, towards the end of a storage withdrawal period, there is a sudden steep fall in temperature which places high demands on our storage facilities. In such a case, it must be guaranteed that, even though the storage facilities are at a low level, sufficient gas withdrawal capacity is nonetheless available.

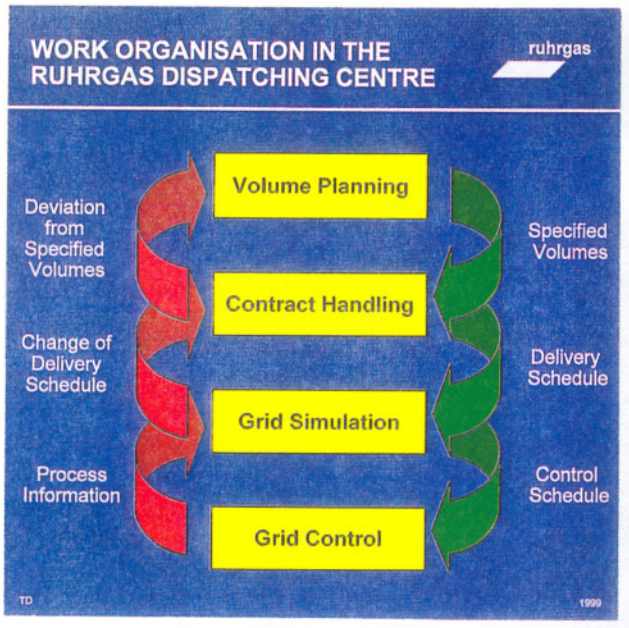
5. Application of Seasonal/Medium-Range Weather Forecasts

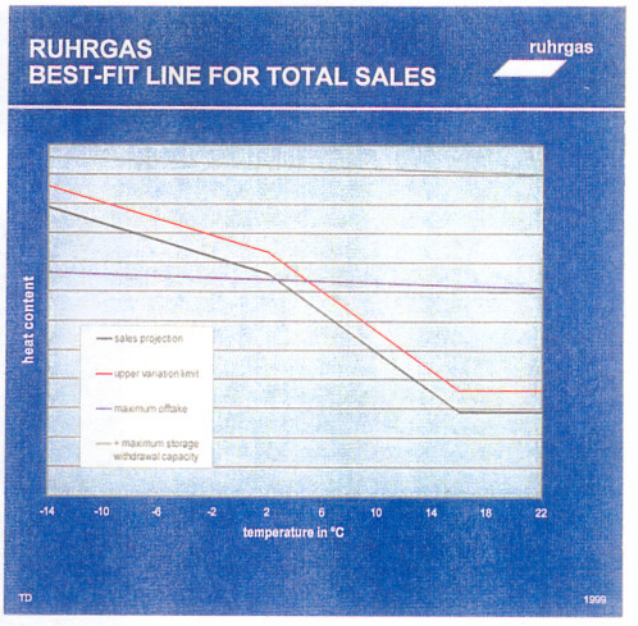
Until now only temperatures have been used as weather-related input parameters for Ruhrgas sales projections. Of course, we realise that other factors like air humidity, wind force and wind direction influence the energy requirements of our customers. We could no doubt achieve even more accurate results in sales projections for the current or following day if we were to take account of those parameters. This would, however, require quantified forecasting of these weather variables. To arrive at monthly figures for lengthy periods, such as the gas accounting year or the winter/summer season, or to determine daily figures for the following month, it would be useful if reliable and quantified temperature forecasts were available. Despite all the progress made in meteorological science, this is not yet the case. As we also have to cope with peak load situations, as just described, medium-range forecasting of weather extremes is likewise of interest to us.

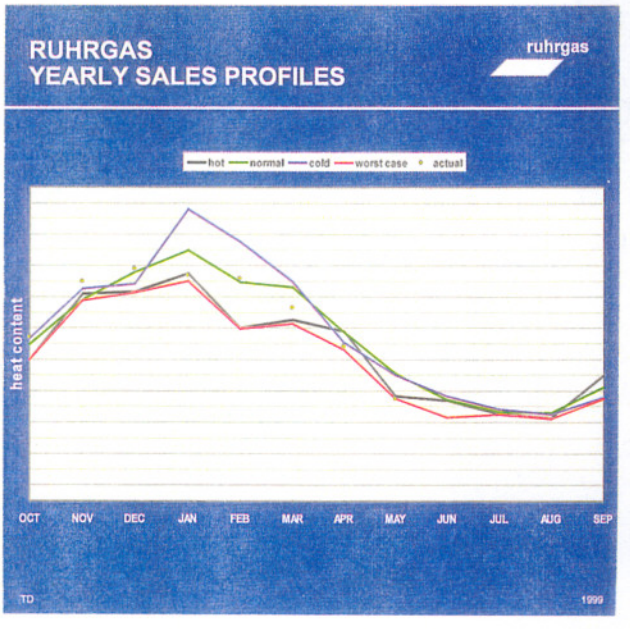
Seasonal Applications

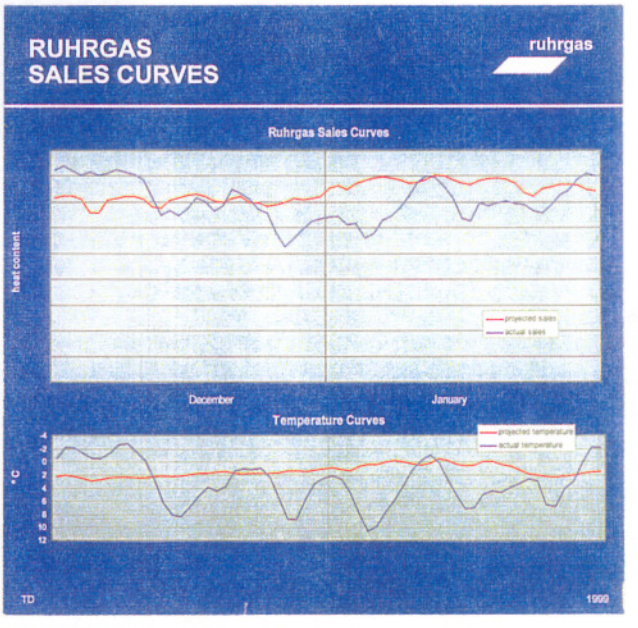
Winter situation: To safeguard sales in accordance with the temperature profile of a cold year, with supply disruptions simultaneously serving as a planning assumption, high withdrawal rates from storage facilities are needed. In order to ensure availability of the working gas needed in extreme cases, i.e. in a very cold winter, the storage facilities have to be refilled to the maximum level by the end of October at the latest because from November onwards there is a growing probability of sales exceeding the contractual supply capacity due to low temperatures. For the same reason, a restrictive policy is pursued well into the winter season on any gas withdrawal from storage facilities on purely commercial grounds. When sales exceed supply capacity, gas has to be withdrawn from storage facilities to offset the shortfall. Once sales decrease again, gas is injected back into the storage facilities. This results in compulsory operations of intermittent gas withdrawal and injection. These compulsory operations for coping with an assumed extreme winter (which occurs seldom but cannot be ruled out) entail high operating costs and restrict the potential for supply optimisation. They could be mitigated or avoided by reliable seasonal weather forecasting.

Summer situation: In summer, the worst case does not involve a shortfall in supplies, but a surplus. The contracts with our suppliers involve minimum take obligations, especially minimum daily offtake commitments. This means that sufficient potential for injecting this gas into the storage facilities has to be ensured. In this case, too, provision must be made for extreme instances. Such precautions may include the withdrawal of gas from storage facilities in the transitional period, which in turn leads to increased supply and operating costs. Here the situation could also be improved by reliable seasonal temperature forecasts.


WORK ORGANISATION IN THE
RUHRGAS DISPATCHING CENTRE
ruhrgas
Volume Planning
Contract Handling
Grid Simulation
Grid Control
Deviation from Specified Volumes
Change of Delivery Schedule
Process Information
Specified Volumes
Delivery Schedule
Control Schedule
TD
1999


RUHRGAS
BEST-FIT LINE FOR TOTAL SALES
ruhrgas
heat content
sales projection
upper variation limit
maximum offtake
+ maximum storage withdrawal capacity
-14 -10 -6 -2 2 6 10 14 18 22
temperature in °C
TD
1999


RUHRGAS
YEARLY SALES PROFILES
ruhrgas
hot normal cold worst case actual
heat content
OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP
TD
1999


RUHRGAS
SALES CURVES
ruhrgas
Ruhrgas Sales Curves
heat content
December
January
Temperature Curves
°C
TD
1999

Monthly planning: In the course of time, the original volume planning is revised on a monthly basis. Actual sales trends and load levels are taken into account, and updated prices and non-availability of facilities are incorporated into the planning. Projections involving different sales scenarios are again carried out, resulting in a supply request strategy, which in turn determines the targets for dispatching operations in the month under consideration. The measures for reaching these targets, such as switching specific territories to gas from other supply sources or contracts or supplying gas to variable fuel customers, are geared towards the sales projection based on the long-term average temperature profile because this is the most probable case. The range of deviation is illustrated here by a comparison of projected and actual data. Here, too, temperatures from medium-range weather forecasting could, if accurate, bring about considerable improvements.

In our field of business, there are numerous other instances where reliable mediumrange temperature forecasts are indispensable. Above all, the following should be mentioned.

- decisions on the sale of spot volumes;
- decisions on the offtake and allocation of summer gas,
- determination of spare transmission capacity and provision of such capacity for use by third parties;
- determination of possible or suitable periods for carrying out any work, such as maintenance, likely to affect operations.

The gas market in Germany and throughout Europe is changing substantially. We assume that there will be a steep increase in the number of third parties requesting transmission and in the trading of spot volumes. Long response times will not be acceptable. Improved foundations for planning activities are therefore increasingly important. Better determination of anticipated sales can be greatly assisted by the availability of reliable medium-range weather forecasts.