Gas Dispatching and Management

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Abstract

Activities in large dispatch centres are usually divided into volume planning and contract management as well as grid control. Volume planning and contract management require high-performance computers for contractual and technical optimisation models, for contract handling models and for communication with partner companies. For grid control, the use of computers for SCADA systems and for grid simulation and optimisation has become a fundamental requirement.

In 1992, Ruhrgas began upgrading the control and information system in its dispatch centre. In several steps, the hardware was replaced by a modern hardware concept featuring a fault-tolerant process computer for SCADA system interface processing. The work-place computers were substituted by sophisticated workstations integrated into a computer network. Further, a X-Windows user interface based on the MOTIF standard was introduced.

Given the complex tasks on the operations side of the gas business in today's highly integrated European gas grid with a large number of gas producers and customers, effective cooperation between the dispatch centres of European gas companies is of paramount importance. One example of good cooperation is the contractual and physical handling of North Sea gas supplies at Emden.

Introduction

Gas consumption in Europe has steadily risen in recent decades and, according to demand forecasts, this trend will continue in the years ahead. In step with the growth of gas consumption, local gas networks were expanded and interlinked across Europe. The control rooms of local grid operators evolved into today's dispatch centres of large European gas companies.

The main function of dispatch centres is to ensure that customers receive gas supplies without disruptions and in accordance with contractual terms. In the past, their activities were confined to controlling and monitoring the gas grid on the basis of transmitted flow and pressure data as well as control instructions given to local stations by telephone. Using state-of-the-art process computers, it is now possible to influence gas flows directly through remote control of governors, compressors and storage facilities.

Another major task of the Ruhrgas dispatch centre is the day-to-day administration of purchase and sales contracts. On the purchase side it is necessary, owing to the policy of diversification pursued by Ruhrgas, to plan and coordinate gas supplies at 22 feed points in the Ruhrgas grid. On the sales side, the needs of Ruhrgas customers have to be catered for at some 1,500 delivery points. Observing the agreed commitments and utilising the flexibility allowed by contracts, the dispatch centre attends to short-term and medium-term volume planning and supply optimisation to meet the common technical and commercial goals.

Functions of a Dispatch Centre

Owing to its wide-ranging tasks, the dispatch centre has interfaces with many links of the gas supply chain. The chief link in this chain is gas offtake by consumers. In most cases, such offtake is forecasted continuously. In some instances, e.g. with power stations and other customers whose consumption is not dependent on weather conditions, there is a direct exchange of information. Interaction with the in-house sales and billing departments is important when serving these customers.

For the purposes of grid control, direct contact with the operations and engineering planning departments is indispensable. When planning facilities, account must be taken of the dispatch centre's needs as regards future remote control of the facilities. Short-term or medium-term maintenance work on existing facilities can only be carried out in close consultation with the dispatch centre. In the case of facilities that are highly important for gas transmission, the dispatch centre alone can determine the timing of scheduled maintenance work within the framework of its volume planning and supply optimisation. In the event of malfunctions in the grid, the dispatch centre has to minimise the effects in cooperation with customers, maintenance staff and partner companies.

The handling of day-to-day gas supply operations presupposes direct, constant communication with suppliers and partners. Parallel to the establishment of a European gas grid, a communication system was therefore developed between dispatch centres operating internationally. This system allows all the requisite communication procedures to be handled quickly and reliably, ranging from telephone communication to automatic data exchange between computers in dispatch centres.

To be able to perform all functions in the dispatch centre correctly in each situation and for each interface, a work flow was developed. Each set of tasks in this work flow is supported by a specially developed tool.

In volume planning, requisite deliveries from suppliers are matched to forecasted offtake by consumers in advance of physical grid control. In the event of elevated demand, gas withdrawal from storage facilities is necessary. If supply potential is not sufficient, the interruption of supplies to customers can be envisaged in accordance with contractual provisions. To ensure cost-effective use of supply and storage volumes against the background of scheduled maintenance work, calculation models featuring contractual and system data are employed. As they provide information for cost-effective volume planning in the medium term up to two years, the models focus on feasibility on the basis of existing facilities.

The results of volume planning provide the foundation for contract management. As a rule, volume planning is on a thermal basis. For the purposes of contract handling, conversion to the units specified in the respective contracts is required. In a standardised communication procedure, the sellers notify gas availability; the buyers then submit their requests, which the sellers finally confirm. Upon completion of this communication procedure, it is known what volumes the buyers will take the next day at each delivery point and how large the physical flow will be at the delivery points. For the subsequent tasks in the dispatch centre, a delivery instruction is then prepared for the next day.

Simulation models are indispensable for optimum technical control of increasingly interconnected grids. Use is therefore made of detailed models incorporating mathematical and physical grid data. They allow various grid conditions to be simulated. Simulations carried out on the basis of the delivery instruction allow a delivery schedule to be drawn up for physical grid control. The technically optimum grid conditions for maximum cost-effectiveness are sought. It will be possible to fully perform this function when optimisation modules are available for the simulation models already in use.

Grid control is the stage at which the requisite grid activities are coordinated, executed and monitored on the basis of the delivery schedule. An essential tool is a supervisory control and data acquisition (SCADA) system for visual display of the transmitted process data. Either continuously or upon certain events, this system provides the dispatch centre with an overview of the actual process for the benefit of control and monitoring activities.

To ensure a closed loop, incoming information is compared with target data of the preceding step in the work flow. Deviations in physical values are examined with the aid of the simulation program to ascertain the implications for the delivery schedule. If the targets in the delivery instruction cannot be attained by changing the delivery schedule, the delivery instruction has to be adjusted. This occurs at the contract management stage. Any change to the delivery instruction must usually be reviewed at the volume planning stage.

Control and Information System at the Ruhrgas Dispatch Centre

The aforementioned interfaces, steps and tools are part of any modern and efficient dispatch centre. Constant training is needed to ensure that staff have the requisite, ever-increasing know-how for optimum use of the tools and procedures. Another important factor is the provision of an efficient control and information system.

To meet the high demands on the control and information system at the Ruhrgas dispatch centre, a project for upgrading the system was launched in 1992. Due to its hardware structure, the old system was marked by increasingly high expenditures on maintenance.

The new concept involves a client-server architecture, i.e. services are made available to all users via central computers. Each work place is equipped with one or more computers linked to the central computers by means of a network. The standard elements (e.g. MOTIF interface) allow considerable scope for extensions and modifications at the work place, depending on functional requirements. Key components of the network are a fault-tolerant VAX FT 610 computer, three identical VAX 6610 computers and up to 100 work stations. The upstream telemetry computers are linked to the network via the fault-tolerant computer. The three identical computer units can distribute their tasks in such a way that, even if one of them fails, the work of the dispatch centre is not restricted at all.

Given the stipulation that a high level of availability of the dispatch centre should be guaranteed throughout the project, the project was divided into three steps. In a first step, the central computer units were replaced. After this step, the goal was attained of reducing maintenance expenses and being able to use a redundant hardware configuration. As the second step, the man-machine interface used in the old system (computers with asssociated monitors) was replaced by versatile work stations. Furthermore, a user interfaced based on the X-Windows standard was introduced. In the third step running until mid-1997, the old process software is being adapted to the standard software introduced with the new computers. This step will also see the integration of sophisticated program parts, such as a user interface with interactive graphics for grid simulation. In addition, a relational database that can be expanded for future developments is being installed.

Handling Procedure Illustrated by Norwegian Gas Supplies

When Norwegian gas was first delivered to European gas companies in 1977, a handling procedure for the dispatch centres was simultaneously established. Current contract handling can be illustrated by the Troll gas deliveries to German buyers.

In these agreements on Troll gas deliveries, seven producers and three German buyers undertook to sell and buy gas respectively. The dispatching representative of the producers is the gas sales centre (GSC) in Stavanger, and that of the German buyers is the Ruhrgas dispatch centre (RGDZ). In a weekly forecast, the GSC informs the buyers of gas availability. As part of their daily volume planning, the buyers determine the requests for the next day. By means of an internal coordination procedure the buyers then fix a joint request. This is transmitted to the GSC by the RGDZ using a direct computer link.

Concurrently with the administration of the Troll agreements with the German buyers, all other contracts between the producers and buyers throughout Europe have to be handled. Joint delivery instructions are drawn up in collaboration with all dispatch centres involved in the Emden feed point. They are communicated to the operators responsible for the physical handling of volumes.

When the Troll gas deliveries commenced, the volumes ordered and supplied under the contracts were identical to the physical deliveries via Emden as the sole feed point. It was thus relatively straightforward to draw up detailed delivery instructions. Following the commissioning of the Zeepipe, physical deliveries can occur at two feed points. The delivery instruction for the feed points cannot be prepared until contract handling has been completed. The Etzel joint storage project of Norwegian producers and Ruhrgas adds another dimension to the handling procedure. Gas withdrawal from the storage facility for the Norwegian producers must as a rule be made available in the opposite direction to the physical flow in Emden. When drawing up the delivery instruction, it has to be borne in mind that, in the case of full contractual fulfilment, the physical flow from Norway via the Emden feed point does not coincide with the total of the contractual volumes ordered.

Outlook

The introduction of a new computer generation at the Ruhrgas dispatch centre is a good basis for advancements necessitated by new demands. Due to the expansion of gas business in Europe, the tasks of the dispatch centre will also increase. The next step in this direction are the Norwegian gas deliveries to European gas companies from 1 October 1995 onwards, which are to be handled via the new Europipe metering station in addition to those handled by means of existing systems. The complexity and interconnection of gas grids will thus become greater.

In view of the increasing efforts needed for handling these gas flows, the aim is to achieve process optimisation. In collaboration with customers, suppliers and partner companies, the existing handling procedures and communication links are to be improved further. In the context of the dispatch centre's internal tasks, great importance attaches to the concentration of data flows, the compression of data for application programs and the development of expert systems.

The Dispatching Environment

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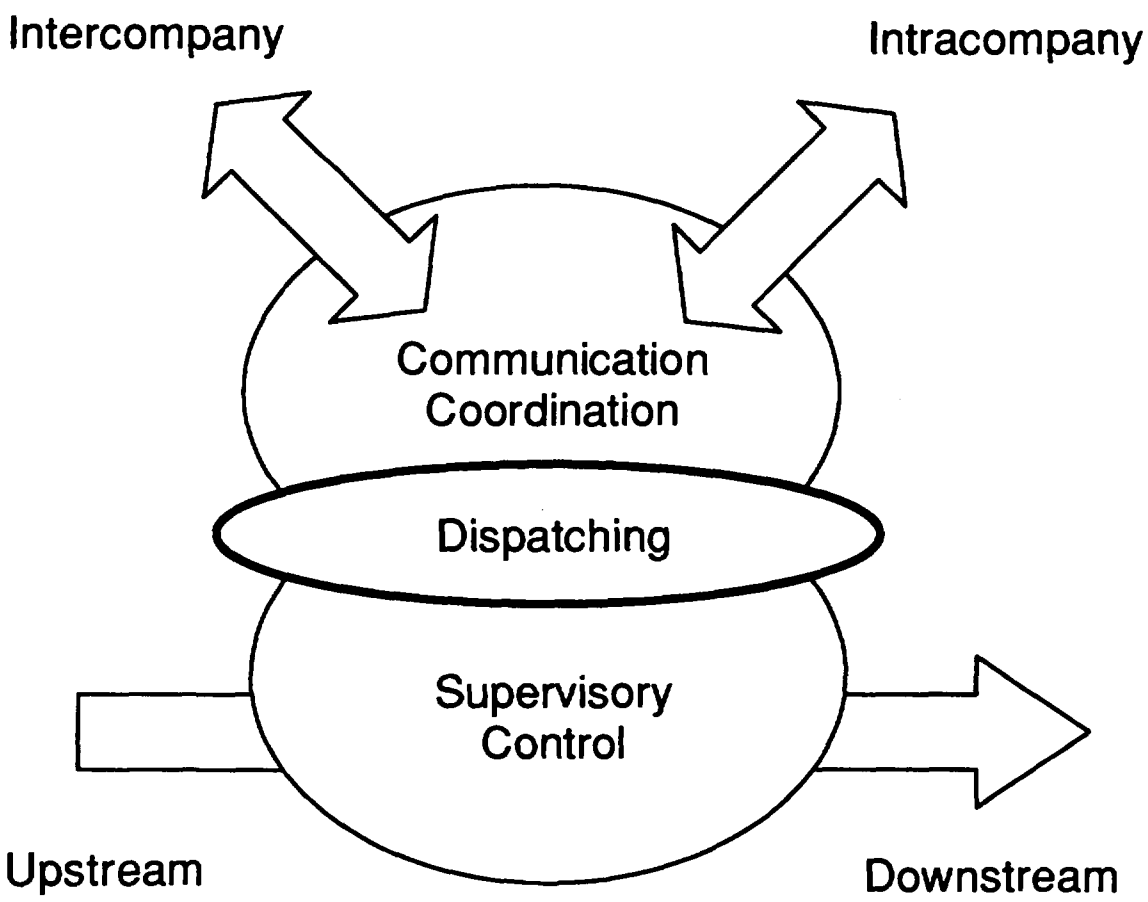

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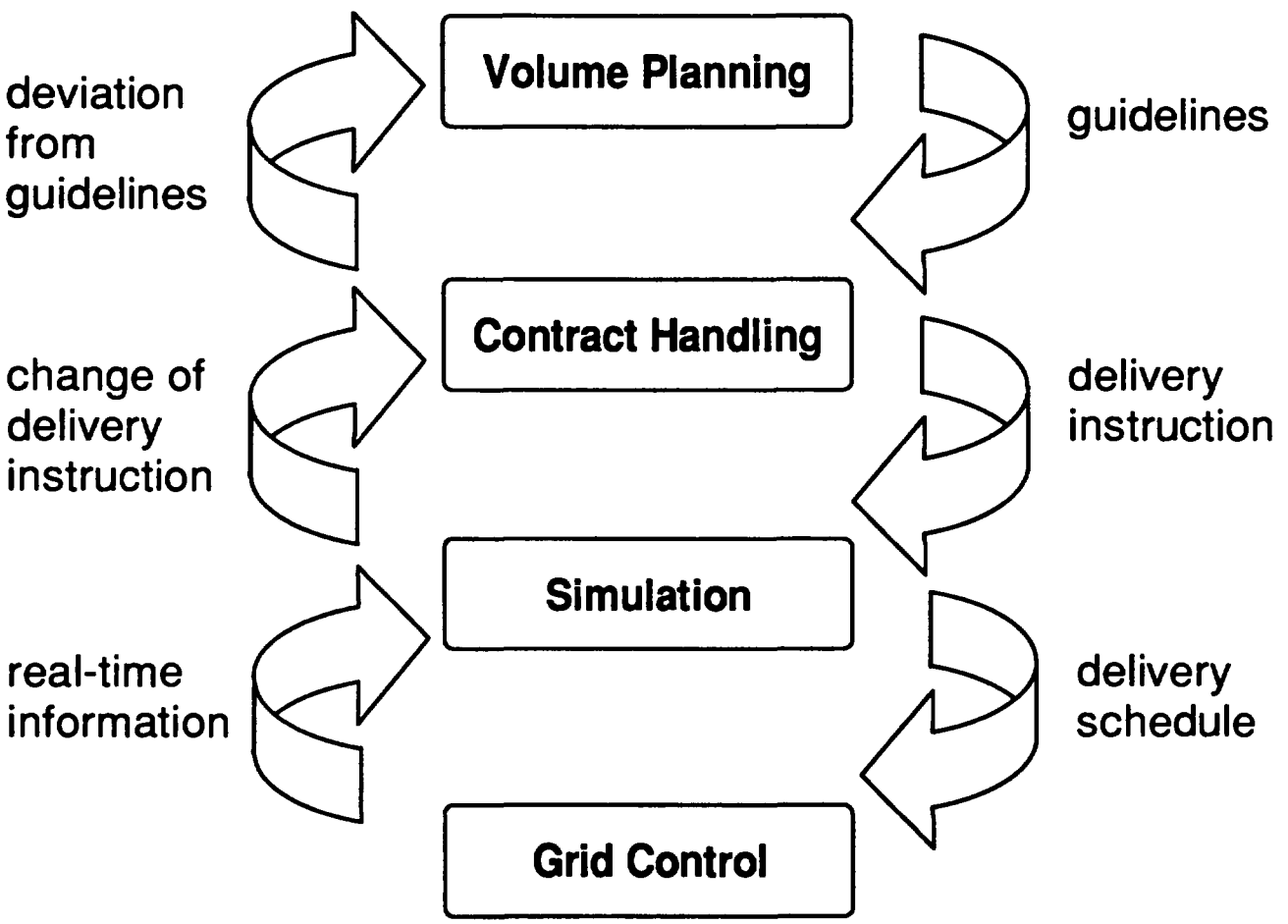

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Configuration of the Dispatch Centre Information System

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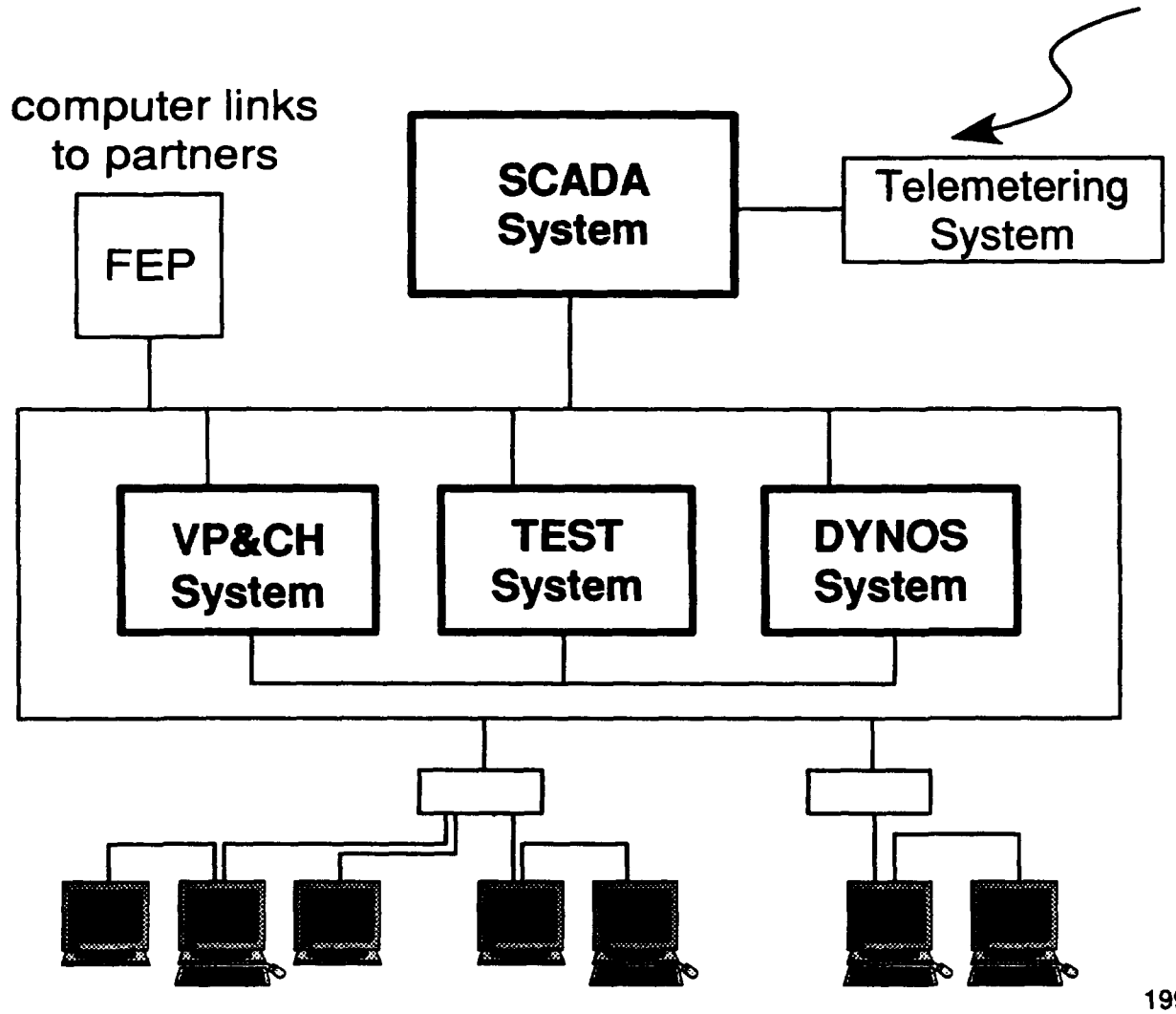

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Principle of Communication Procedure

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