# Natural Gas in Reserve

**In Austria, four underground depots secure the gas supply in times of high demand. One of them is located in the town of Thann in Upper Austria. OMV AG, the leading oil and natural gas company in central and eastern Europe, has updated their storage facility there with modern automation components and the APROL process control system.**

**An invisible transport web runs all across Austria. By supplying and distributing natural gas, EPI Asset Gas (a division of OMV) pipelines have secured a key position in the European natural gas network. At a speed of about 30 km/h, underground gas rushes through pipes up to 100 cm in diameter. Immense gas storage must be available due to the large amounts consumed – amounts that still need to be planned daily and kept up to date. The OMV facility in Thann keeps this gas in a state of readiness, in particular for consumers in and near Upper Austria. Two additional storage areas have been set up in Lower Austria (Tallesbrunn and Schoenkirchen/Reyersdorf) for Vienna and surrounding areas, as well as for international partners who use them for temporary storage. The fourth storage facility is located in Buchkirchen (Upper Austria) and is managed by RAG.**

The deep-ground storage areas were originally gas fields themselves which were then examined regarding their usefulness for storage once they were exhausted. It was hard to imagine that they would just remain hollow after being completely emptied. As Senior Engineer Rudolf Pfafl from OMV's exploration and production division, Asset Gas, explains, the properties of the soil in the horizons capable of storage are porous (sandstone) and can be used to hold running water. For this bottom area to be controlled pressure-wise, it is necessary to leave a "cushion gas reserve" in the 500 to 1,500 meter-deep storage area. This is a sort of minimum reserve which may not fall under a certain amount of pressure. In this respect, highly sensitive data which identifies automated operation of the storage station, needs to be taken into account.

One-third of Austria's annual natural gas consumption is provided by these four storage facilities. This can reach up to 37 million cubic meters per day during the peak consumption period in winter, whereas current gas production in Austria remains constant at 2 million cubic meters per day, regardless of the time of year.

Daily fluctuations and up to seven times higher consumption levels in winter require that the natural gas surplus be tapped from the amount imported during the summer. Thann provides a working gas volume of 250 million cubic meters – a level which also corresponds to the volume of the cushion gas. In comparison, the OMV storage station in Tallesbrunn and the Schoenkirchen/Reyersdorf facility provide 300 million and 1.77 billion cubic meters of working gas volume, respectively.

When consumption levels are not so high, the gas is forced over 17 storage

Engineer Rudolf Pfafl (left), responsible for process control and electrical engineering at EPI Asset Gas and Hermann Obermaier, Sale Manager Austria.

*"The SCADA system which has existed since 1990 used a separate visualization device, but we have exchanged this idea for a more universal plan. Today's demands are fully met. For example, we have a good grip on what's going on with the system through remote maintenance and diagnostic functions, and we're able to see right away if there are any irregular turbine fluctuations, etc."*

wells at up to 60 bar (around 870 PSI) using three turbines. The wells are connected over a distribution network to the station where four main tasks are carried out: separation, warming, dehydrating, and compressing. Each of these areas can be operated with the B&R system in the facility's maintenance area. That's where flat-screen displays control access to the process control system while providing the maintenance director with an overview of the entire system. The control system with the computers and I/O channels is located in an adjoining room.

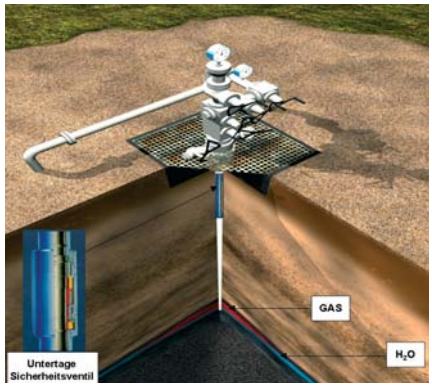
The process to begin with, the gas is led through inlet separators which remove all solid matter and any liquid byproducts. The gas is then run through another set of filters which finely comb the gas for any other impurities. This is necessary before the gas is dehydrated. The dehydration process removes water vapor, guaranteeing a gas dew point at -8 degrees Celsius at 40 bar (580 PSI). This takes place in the station using a closed glycol dehydration system.

The next step in the process is extremely important since it requires the highest degree of precision from the control system. Pressure and flow measurements are the deciding factors that determine how the gas in the Kronstorf line, leading away from the station, is delivered. The pressure determines whether the gas is fed into the line with or without compression which amounts to approximately 45 bar (653 PSI). So if the gas storage itself has only minimal pressure at the end of the heating phase, compression is applied with the three Solar turbines (2 x 1 MW and 4 MW, gas-operated). Accordingly, four modes are possible: gas extraction either with compression or without compression and storage with or without compression.

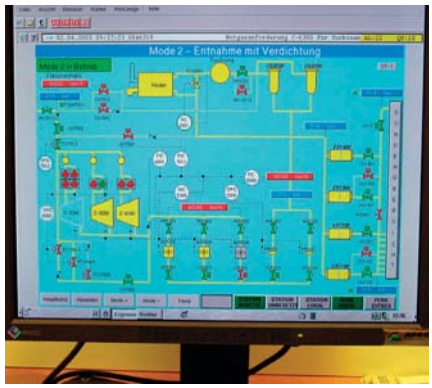
What sounds simple actually takes an extreme amount of effort. That is why Hermann Obermair, sales manager at Bernecker+Rainer in Austria, describes this as being one of the many strengths of the APROL process control system. "A decisive factor for operating a storage facility efficiently lies in the quality of the controller. Our method makes it possible to determine the exact flow volume in the computer as a controlled value every 50 milliseconds by applying the so-called compressibility formula." The actual problem was that the externally calibrated device for measuring the quantity of gas was only used for subsequent calculation and data acquisition but not for efficient controlling of the system in general. This resulted in long calculation cycles, which only provided an actual value after two seconds. Efficiently converting the complex formula allowed a high quality of flow measurement.

This process control system is designed for fully-automatic and unmanned operation. Even the task definition of implementing standard function blocks in the application software could be carried out. B&R engineers invested two years developing the system in close cooperation with their clients. An OMV-wide standard resulted which was able to ensure that software libraries worked transparently and efficiently for every gas storage task. This also guaranteed that future projects would be able to use standardized software. Matters of security, such as login levels and system management (remote maintenance, dispatching, etc.), were met practically while conforming to all corresponding standards.

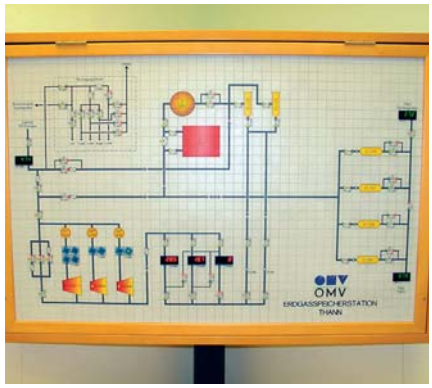
The wells, which automatically start, open, or close as the need arises, are optimized according to the latest knowledge acquired by the storage facility engineers at OMV. In addition, the exact supply plans within the gas network adhere to the highest level of precision. Remote wells are provided with compact controllers which collect data on-site and control hydraulics. They have been improved with additional safety valves at a depth of 50 meters which use fail-safe technology. In total, there are more than 200 analog values and around 600 pieces of binary information to be processed by the control system at the Thann station. The permanent staff at the Thann station, 3 employees and a systems manager, is connected to the main headquarters over the internal OMV data network radio via a "dispatch headquarters" in the Florido Tower in Vienna. If a rare error occurs, a readiness team is always on standby around the clock.



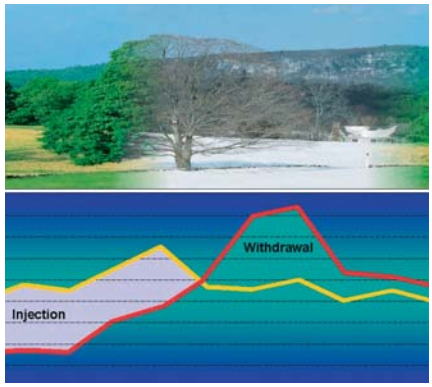

Wells look after connecting the underground gas storage facility.



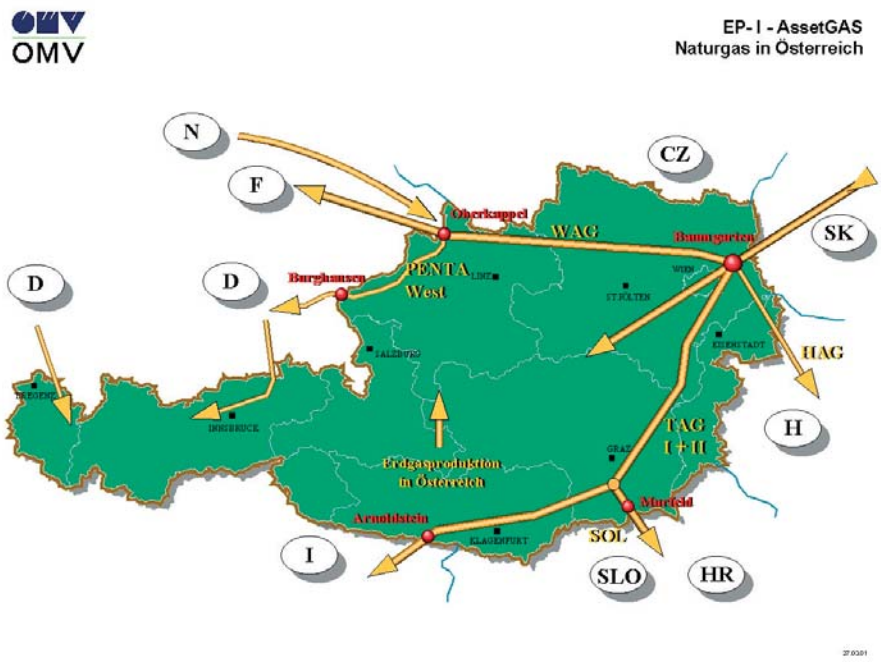

B&R's APROL system guarantees unmanned, automatic operation.




For a quick check: An overview of the system.




Fluctuations in yearly demand.




The B&R process control system, APROL, is used together with redundant B&R IPC5600 servers, a self-sufficient engineering server (also an IPC5600), as well as two B&R APC680 operator stations. Two B&R 2010 controller systems, a special controller, two coupled systems, and five B&R 2005 substations are all used as components of this automation project. Additional Panelware devices are also installed for each of the substations, located 3 kilometers away, for on-site diagnostics and input.

The facility itself is networked with Ethernet TCP/IP. PLC crosstalk and the special substations are integrated with Profibus FMS based on RS485 and repeater technology. This guarantees that all controller functions keep working and the facility can continue to be operated even if the process control system suffers a complete failure. The distant substations are also programmed and configured universally from the engineering station located at the facility's headquarters. A "mimic" operator panel is installed in the maintenance area where the most important functions for switching systems on and off can be carried out.

An extensive Oil & Gas control library is included in the software solution, as well as communication to the three Solar compression turbines, the satellite remote system, and to the four temperature and pressure instruments. Other special features include. Integration into the OMV wide-area data network

- Communication with and remote maintenance of the gas wells.
- Hot standby redundancy for the server.
- Volume recording for calculating the gas flow.
- Flow calculations according to AGA NX19 for high-speed control.
- Automatic application software for unmanned operation of the gas storage.
- Integration of the existing OMV office world for control and remote maintenance.
- Approx. 100 process diagrams for convenient, quick operation of the complex system.
- Countless diagnostic and information diagrams developed together with OMV to respond more efficiently to different system states.
- OMV Asset Gas standard on-site/ remote dispatch – control authorization for secure and explicit operation of the process control system.
- OMV Asset Gas standard alarm handling, including alarm hierarchy images and fast selection.

Hermann Obermair explains the details of the process control system: "APROL is a Linux-based, universal, flexible process control system with a uniform system platform, from the field level to the control level." The possibilities for integrating subassemblies of varying performance into the process control system, whether on-site or remotely, and being able to configure them directly using the APROL engineering tool CaeManager, turns APROL into a uniform process control system. It handles all functions for acquiring and processing data, as well as process visualization, using one platform. This was proven while changing over the project in Thann. The integrated project management also includes a revision system and automatic documentation which supports and simplifies qualification/validation procedures for systems.