Lake water cavern purification system.

ACSM Spa is an avant-guarde company in applying the best technologies in managing municipal systems. One unique example is the water purifying plant situated in a cavern on the Como Lake, supervised by Movicon and famous for being the only one of its kind in the world.

The cavern is the indisputable star of the ACSM Spa story where the water purifying plant of Como Lake is located. Many pit stops were created by the numerous technicians and curious passers-by along the slopes of the Baradello mountains while construction was still going on. Even though the plant is ready and in regular, it has a problem with meeting the many demands of visitors. Over 200 people a week visit including arranged trips for primary school children, secondary school and university students. No doubt the work of great intrigue stimulated by a compromise between epic pioneering and advanced technology.

Our country is without precedents. Expand a circumscribed antiaircraft shelter dating back to the second world war to accommodate a gigantic water shed capable of doubling the previous treatment capacity (an increase from 300 to 600 lit/sec.) has truly been a great leap ahead for Italian contractors and urban planners, which until now has only supplied us with underground roads and parking.

Before knee-high Wellington boots were needed to wade through the mud now you only need a yellow safety helmet (used more as a gadget rather than for safety reasons) to penetrate the dug out tunnel of a network of pipes leading to the central water mains, which feed the water from the lake to tanks to undergo three treatment phases. The cavern has also attracted the attention of RAI, the national TV company who telecasted a documentary about it on Piero Angela's SuperQuark television program.

From Plato to the Norwegians

Through the years the caverns has conjured up Ogres and other creatures from the darkness, a sort of Plato's allegory of 'The Cave' where we rather tend to see shadows or a fictitious reality of the actual truth itself. The idea of digging the new ACSM drinking water central in the mountain was pushed forward by urban planners and technology. This involved giving back a part of the city by moving the plant's central out-of-sight into the carven of a tangle of tubes and metallic infrastructures. The work of those companies who took part in constructing this adventure was very valuable in turning fiction into fact. Two of these companies were from Norway, specialists in tunneling through rock. Those working on the construction site included Selmer, Degremont Italy, Nessi & Majocchi, Rini, Sintertec and Sguassero all equally as valuable. It took only two years to build, a miracle considering how long it usually takes to complete construction in this country. Fernando De Simone is the man responsible for this project and is one of the top experts at a international level in this field.

Only one of its kind: sizes to be reckoned with

35 thousand cubic meters of rubble and rock removed to make way for the tunnel (instead of dumping the surplus rock and rubble it was put to good use in road maintenance). The tunnel varies between 15 to 20 meters in width with a maximum height of 15 meters. 16 million square meters of treatment capacity annually (600 lit/sec, in respect to 300 lit/sec of the old drinking water plant). Whole project took only 2 years to complete.

Cavern Security

There is much concern for the increasing international terrorist threat especially after 9/11, the tragic attack on the Twin Towers in New York. The ACSM Spa plants, like all associations dealing with the public interest, may become the target of terrorist acts to contaminate the water, or vandalism, considering that they supply drinking water on a grand scale to the public at large. This threat has been taken seriously and special measures to protect the plant have been made. The already existing strict control checks have been further strengthened in a plan put together with police headquarters. The company, to explicitly guarantee safety right from the start of the new water purifying center (which has become less vulnerable due the fact that it is situated in a cavern), have restricted public visits and cut short the tour around the plant.

An idea to suspend the Tognocchi program for a few months arose during a meeting between influential citizen representatives: certainly not because it may be dangerous for children but to reduce the risk of vandalism and terrorism to zero.

The drinking water plant

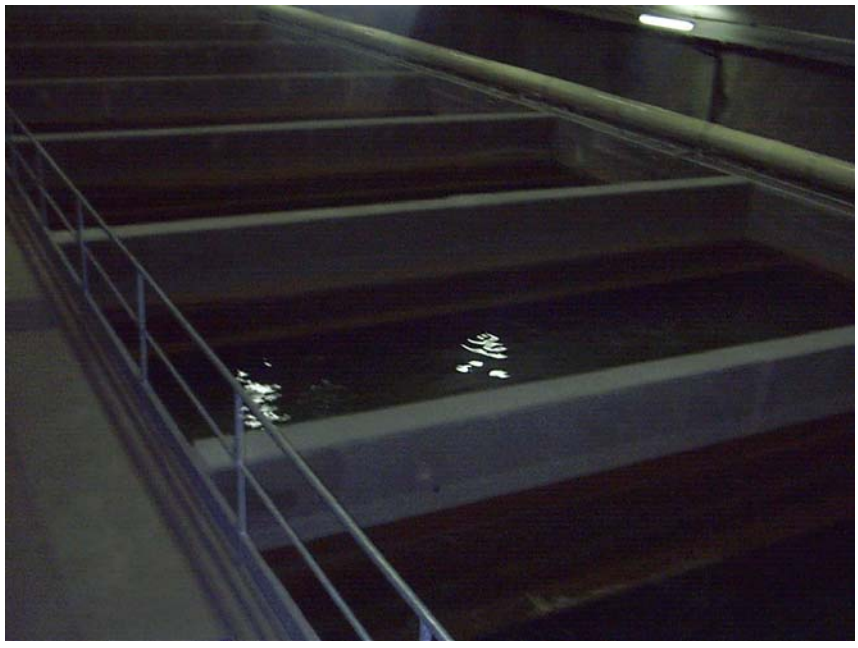
The plant is setup in a cavern, dug out of rock, with a volume of 35,000 m³. The main sizes of the cavern are: 150x18h 8÷16mt.

The purifying plant pumps water to the main networks in the Como Aqueduct that governs the other tank terminals:

- CENTRAL COMO, Baradello Tank, quota 265
- EAST COMO, Refrec Tank, quota 310
- SOUTH COMO, Doss Tank, quota 325
-

These pumps have a power of ~ 1000 kw. A group of emergency electric-generators at 1200 kw have also been installed in the plant. All is run completely in automatic and managed by remote control from the ACSM offices.

The city of Como has been taking water for drinking purposes from the lake for 20 years. The water is taken from the P.ta locality of Geno at a depth of 45 meters with a constant temperature of 10÷12°c.



Detail about one of the basins used for the water purification system.

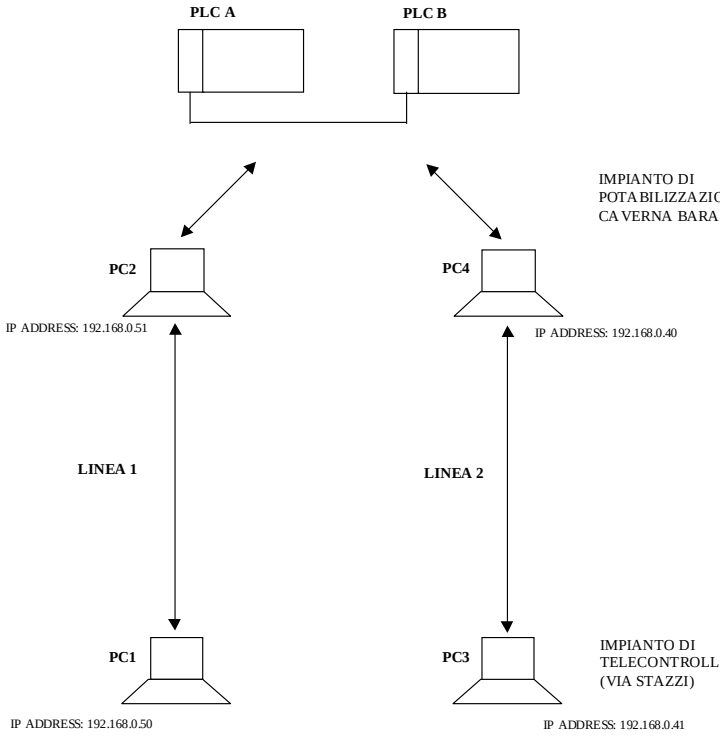
The city requires an annul supply of 12.000.000 m³ water at a 500 lit/sec. potentiality. The new purifying water plant has a potentiality of 600 liters per second, and is located 250 m above sea level.
By using this system ACSM is able to supply the entire city of Como with fresh clean drinking water from the lake with an extra-capacity power of about 100-150 liters per second to meet the demands of new users. Ozone and chlorine dioxide are mostly used to treat water during the purifying processes. The system is run on the following structure:

- Storage tanks holding 1000 m³ of lake water to be fed through the different treatment processes and industrial aqueducts.
- Pre-ozonisation basin, (3 minute contact time) to reduce bacteria buildup.
- 6 multilayer sand filters (Overall size of 31,5 f m² at a filtration speed of 11 m/h)
- Ozonisation basin (10 minute contact time)
- 6 active granular charcoal filters (overall charcoal depth of 31,5 m² with 15 minute contract time)
- Final disinfection tank (with chlorine dioxide) 1000 m³
- Water accumulation tanks and distribution control

The use of chemical agents has been drastically reduced (chlorine dioxide is used in the final disinfection stage) allowing further organic and physical-chemical improvements of the finished product, thus guaranteeing a higher quality of water than the one supplied before. The purifying treatment process is in fact capable of producing drinking water in conformance with the European regulations. The plant has been adopted with specific mechanisms, which ensure that the service continues working when system failure or breakdowns occur. In addition to this, standby emergency interventions with sodium hypochlorite have been setup whenever the ozonisation system is temporarily interrupted.

Let's make a synthesis on how the drinking water purification plant works in Lake Como's water cavern, by listing the main concepts according to the following sections:

1. Lake water entry into storage tanks. Lake water entering the drinking water plant is accumulated in the B001 and B002 storage tanks. The water level of these two tanks is controlled by modulating the flow of the water from the lake into the plant. This operation is carried out by the ACSM control center located in Stazzi street.
2. Flocculation and pre-ozonisation basin. The raw water of the two storage tanks, B001 and B002, is then fed through the B003 distribution tank into two other tanks known as the B010 and B020 basins for the first disinfection phase where ozone is blown into the water in the form of microscopic bubbles. The B011 and B021 coagulation (or flocculation) mix tanks are found at the side of the pre-ozonisation B010 and B020 basins where the appropriate dosage of aluminium sulphate polychlorinated is added and mixed in the water to coagulate impurities into floc which is the clumping together of small particles to form larger particles.
3. Sand filters. There is a set of 6 double-layered filters called "Mediazurs". These receive the water from the coagulation section and pass it through to the post-ozonization with the aid of three



Water Purifying plant telecontrol system architecture.

elevator pumps. Each filter has six automatic valves and one regulation valve, which is controlled by a Regulator (Regulazur). Other common equipment is also used with these filters (two air injector cleaners and three wash pumps belonging to the 'services' group).

4. Intermediate Elevator stage. The lake water passes through the double-layered filters into the B200 filtered water recovery basin where it will be elevated into to the post-ozonisation basin with three pumps. During this process the system controls the pumps based how the plant has been automated and the parameters setup by the supervisor.

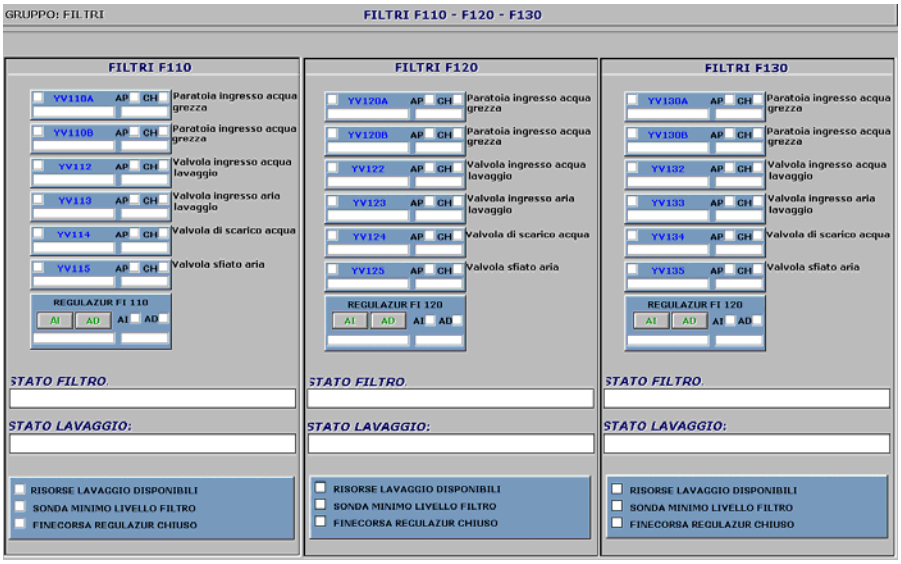
5. Post-ozonisation. The ozonisation is composed of two identical production lines which use the oxygen from the air to start with. The ozone produced is sent, as anticipated, in two pre-ozonisation lines and in another two post-ozonisation lines; the ozone residue, which remains after the treatment, is eliminated with thermal destruction. Analogous to what happens in the pre-ozonisation phase, also in this case the ozone is dispersed into the water but it is more concentrated.

6. Carbon Filters. After the post-ozonisation phase the water undergoes a new filtering treatment done by a set of carbon filters called "Carboazars". Other equipment common to filters are also used (two air pump cleaners and three wash pumps belonging to the 'services' group).

7. Final treatment. At the end of the second filtration phase through carbon filters, the treated water enters into two B510 and B520 tanks. The water acidity values are corrected by adding caustic soda; the last disinfection phase is also carried out where Chlorine Dioxide, or an alternative Sodium Hypochlorite, is added to the water.

8. Network surge. The treated water enters the B525 ready for network distribution after all the necessary treatments to make it drinkable have been completed. Each group of pumps is equipped with capacity meters that inform the central supervision system of the total volume of water sent out for distribution.

The plant also manages and supervises groups of devices relating to the services (pumps, blower pumps, compressors, washes, dryers, power center). In particular the electric energy needed for working the plants apparatuses and cavern lighting is taken from the public electric network distributors (ENEL), and divided into three lines, managed by the power center. Two of these three lines feed the water purifying plant while the third is in reserve. There is also a generator on standby (electricity-generating group) which supplies electric energy to the plant on a temporary basis whenever there is a power cut.



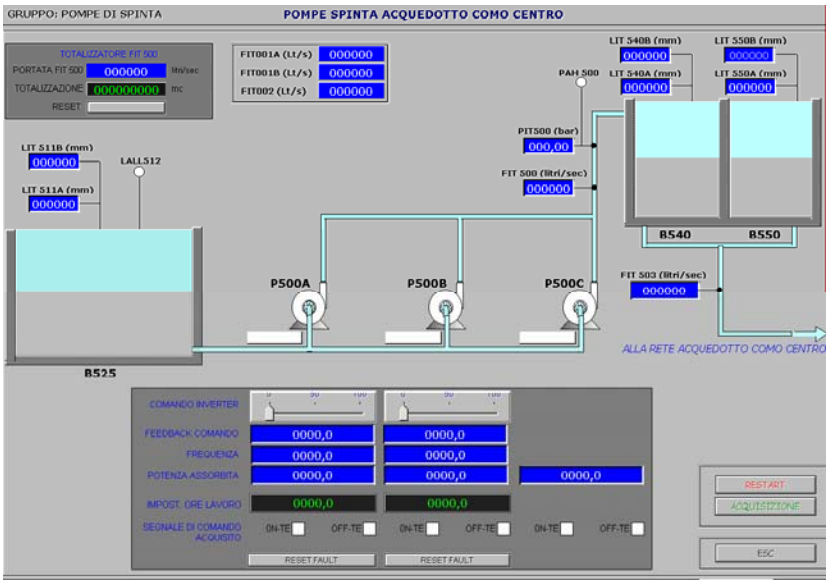
Plant system management becomes extremely simple and safe.

Telecontrol

The water purifying plant in the cavern is managed by two redundant PLCs and monitored with four supervision stations based on the Movicon Scada Platform, two of which are situated inside the Cavern (PC2 and PC4) and two in the ACSM remote control station (PC1 and PC3).

The two Movicon supervision stations inside the plant are connected directly to the two redundant controllers, which supervise the plant's automation in

general; each one of these stations is connected to one of the supervisors of the remote control center via Stazza by two telephone lines (Line 1 and Line 2).
By using the supervision system, as well as controlling the status of how the plant is running, you can control the machines, and set the process values (set points, thresholds etc…).
In order to avoid any misunderstandings and to get a clearer outlook on plant management, the designers have fixed it so that commands to the plant cannot be carried out from more than one workstation at the same time, and that only those relating to the Master workstation are enabled. Each workstation can become the Master station by pressing the appropriate button on the video screen page relating to system control. In this way the different items can be controlled from the selected station without causing any conflicts between any other workstation.
The carven plant's supervisor PCs, situated in the remote control room, contain different screen pages each one carrying out a different task. These supervisor PCs communicate directly with the plant's control system and transmit the control's system's signals to the two supervisors residing in Stazzi Street. Besides displaying information deriving from the water purifying process, the two supervisors in the telecontrol room record these signals on files in open format based on relational DB.
By using the telecontrol system, the operators can safely manage the plant locally and by remote in guided step-by-step procedures with optimal performances.
The supervisor clearly displays the plant system's data in graphical screens that represent clear layouts of the areas and status in real time on all the workstations. These screens are used for interacting with the plant to activate automatic cycles, set working parameters or impart manual commands to machinery devices. All the imparted commands are recorded on the appropriate files, indicating the workstation number where the command was activated or where the parameter was set.
The telecontrol also acquires and records all the system's analogic parameters and displays them in trends for both realtime and historical log analysis.
The recorded analogic measures in trends and events recorded in the Data Loggers are archived in the supervision stations located in the Central ACSM control (PC1 and PC3). As a precaution, the trends recording of the process analogic measures are memorized in the system supervisors every twenty-seven days; the data can also ve saved in numeric format (and therefore adapted to the archive in electronic sheets such as EXCEL) by using the 'Export' button presented in each Trend.
The alarms management is one of the main tasks of the telecontrol system, and allows speedy interventions to be managed in the event of breakdowns.
The alarms in the water purifier system are displayed in Movicon system video screen pages of each workstation. When an alarm occurs or is acquired, its description and status are instantly shown on this page. All the alarms and events are recorded chronologically in the historical log, displayed in the supervisor in a window through which the operator and put the various event into different order according to data type (time, event type, etc.,) by using the drop-down menu corresponding to the 'sort by' item.
The trends data log of events and operations executed is saved on the supervision control station's Hard disk and on a backup CDRom.



One of the screens managed from the telecontrol system based on Movicon.

The ACSM Company
Established at the beginning of the 60s as a Municipal Gas company, ACSM soon developed, accompanying the economic,

social and environmental transformation of the Lariano territory. This constant and controlled growth distinguishes ACSM's history. A history marked with initiatives and special care given to clients.
Acquisition of water services in 1970, waste incinerators in 1973, turned into a joint-stock company in 1997, entered into the telecommunication sector with Laritel, in 2001 they ventured into waste disposal and opened a new futuristic water purifying center (based in a dugout cavern): on the way pit stops were made: ACSM has been busy in consolidating and articulating services to the benefit of its territory and community. This adventure gained crowning glory when it entered into the stock market (1999), consolidating its strong presence in the public services sector while gaining a strong capacity to strategically attract synergies and alliances with the top companies. All this while keeping totally active in the services' strategical side (energy, water, environment, telephony), the company has been able to demonstrate that it can activate relations and projects directed at new business and stock market horizons.

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