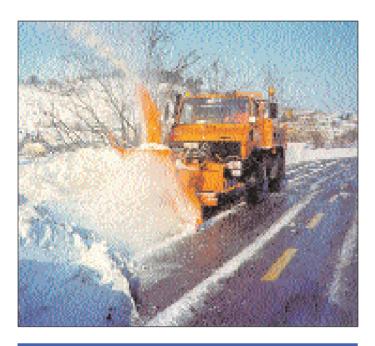
*W*interstrassendienst



Castelrotto Meeting of 8th December 2000 ELECTRONICS AND COMPUTER TECHNOLOGY IN ROADWAY SAFETY: INNOVATIVE MANAGEMENT STRATEGIES FOR WINTER ROAD MAINTENANCE



Today's modern society is characterised by a pressing need to move goods and people as quickly and safely as possible. To help meet this need, the chief goal of administrations or companies responsible for managing roadways is to offer a more effective and reliable maintenance service.

Autostrade SpA, which directly oversees approximately 2,800 km of the Italian motorway network, is well aware of the problems inherent in this effort and has put into action several programs, not the least important of which places focus on winter road maintenance -- specifically the management of chemical deicers, the equipment used for their storage, and the spreading of these substances on the road. For this reason, the Florence section of motorway, known for the orographic characteristics of the territory and for an intense and constant flow of traffic year round (with peaks up to a daily average of 45,000 vehicles on both carriageways, 32% of which categorised as heavy traffic), has adopted advanced technologies to ensure prompt, high quality maintenance operations, determining factors for ensuring rapid and safe travel also during the winter season. Employing solutions such as calcium chloride - the most effective deicer in extreme weather conditions and emergencies - has called for the need to set up regular and strategically placed storage facilities along the tract. To this end, the Società Agristrade based in Bolzano was commissioned to supply for the section 15 facilities with a storage capacity of 560,000 litres that can equip tank truck road sprinklers and spreaders equipped with a salt humidification system.

by Noris Strappazzon*

Description of facilities and technologies

Two types of facilities with different capacities were chosen according to the sites where they would be installed and to their operating requirements:

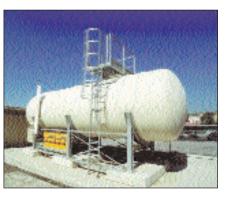
 Large capacity (140 cu m) vertical storage modules built entirely in vitrified steel, whose resistance to corrosion of the deicers, solid or liquid, have been widely demonstrated and statistically proven over their 30 years of use. Because of their high storage capacity, it was decided to use them at the Snow Station of Rioveggio and Roncobilaccio on the rigorous section of motorway crossing the Apennines between Bologna (Emilia-Romagna) and Florence (Tuscany) on the Emilia side.



 Horizontal storage modules with a capacity of 40 cu m constructed in fibreglass (also a corrosionproof material) located in the following points:

A1 Motorway - Apennine section ("A1 Nord")

Snow Stations of Sasso Marconi - Barberino - Calenzano







A1 Motorway section from Firenze Nord - Chiusi ("A1 Sud")

Snow Stations of Firenze Sud - Incisa - Romita (two facilities) - Valdichiana - Chiusi

A1 Motorway section from Firenze - Pisa Nord ("A11 Mare") Snow Stations of Pistoia - Serravalle - Lucca

These facilities, researched and developed using advanced technologies, boast a high degree of automation and guarantee optimum levels of reliability and safety, yet inexpert personnel (i.e., sub-contracted personnel not directly employed by the Company) often forced to work at night and in adverse weather conditions are able to learn the procedures immediately.

The facilities are computerised to the extent that they feature a highly developed set of remote controls for access to users and the manufacturer in order to optimise operation and achieve the highest standards of reliability.

To achieve these objectives, the facilities have been installed with:

- Electrical control board including powerful process controller interfaced to the inverter
- Hydraulic system for handling the saline solutions
- User-friendly control panel
- Remote control
- Remote assistance

Electronic control board

Thanks to the combination of the process controller/inverter, the



electronic control board enables full automation of all saline solution handling operations through the use of special software.

The electric pump is started up on the control panel according to the function selected by the operator and is pre-programmed at different motor rpm according to the different pressures and flow rates demanded of the pump. At the same time, the absorption of current is optimised and the system automatically carries out following: the f the solutions by delivering

loading of the silo and the circulation of the solutions by delivering

the maximum pressure and maximum flow rate; the loading of the tank truck road sprinkler by supplying a flow and pressure slightly reduced to allow rapid execution of this operation; the loading of the small tanks of the dry salt spreaders installed with a humidification system, delivering a greatly reduced flow and pressure in order to avoid overpressures and hazardous overflows.

The capacity and flexibility of the inverter enables instant modification of the operating parameters of the elec-



tric pump by adapting them to any new requirements. This also ensures optimum efficiency of the electric pump's motor and avoiding overheating and unnecessary strain on the motor, while optimizing power consumption.

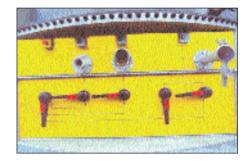
The management software also contains a feature for automatic circulation regardless of what is input manually by the operator: the electric pump is activated cyclically during the intervals when the facility is not in use in order to maintain a correct mixing of the contents and as a result to limit the deposits of insoluble materials on the bottom of the tanks, which are known to be very substantial in CaCl2 solutions. This important feature greatly reduces the risk of clogging in hydraulic system and electric pump.

Hydraulic system for handling saline solutions

This system comprises a special electric pump equipped with a stainless steel shaft and bronze impeller to resist the accentuated chemical aggression of the CaCl2 solutions.

It also includes a pressure switch to safeguard it from involuntary "dry" start-ups and the resulting damage, as well as a system of intake, delivery and circulation pipes constructed in corrosion-proof material (PVC). A set of corrosion-proof throttle valves (in polypropy-

lene) with a large handle enables gradual opening and closing, thereby reducing the risk of water hammering, which can compromise the integrity of the pipes and, most importantly, the electric pump.



Control panel

The control panel is positioned outside the storage modules at a height allowing easy and safe access by the operator. Built in an identical version for the two different types of facilities (40 cu m and 140 cum) and bearing a silk-screened plate in the Società Autostrade colours of yellow and blue, it has been designed with simple graphics that are easily comprehended even by outside personnel who may not have received specific training. The operator therefore receives "guidance" while performing the service: he need only to carry out the manoeuvres for setting up the facility, such as opening the intake and delivery gate valves pertaining to the selected procedure, make connection to the corresponding hydraulic

> quick coupling and press the start-up button. All functions are well marked and easily identifiable by clear, simple graphics. A mushroom-head stop button and/or emergency button with rotation resetting enables interruption of the flow.

Remote control

In recent years, enormous technological developments in the field of electronics and data communication systems have resulted in advanced management options and remote controls.



Winterstrassendienst



	Position no.	Monitoring station	Monitored remote facilities				
	1	PIAN DEL VOGLIO	Sasso Marconi 40 m ³ Rioveggio 140 m ³ Roncobilaccio 140 m ³				
	2	BARBERINO	Barberino 40 m ³ Roncobilaccio 140 m ³				
ntres	3	CALENZANO	Calenzano 40 m ³				
Peripheral Control Centres	4	INCISA	Firenze Sud 40 m ³ Incisa 40 m ³				
eripheral	5	AREZZO	Romita 140 m³Romita 240 m³				
æ	6	CHIUSI	Valdichiana 40 m ³ Chiusi 40 m ³				
	7	MONTECATINI	Serravalle Sud40 m³Pistoia40 m³				
	8	LUCCA	Lucca 40 m ³				
	MAIN Control Centre	DIREZIONE DI TRONCO DI FIRENZE	ALL				

Management software

The architecture of the interactive remote control software, developed for a Windows environment, is powerful and versatile and enables managers of the service to query the remote facilities using a menu that can activate the telephone connections between the Control Centre and the peripheral facilities, and as a result to obtain updated information regarding their filling status and eventual loading and discharge operations that have bee performed since the date of the last connection.

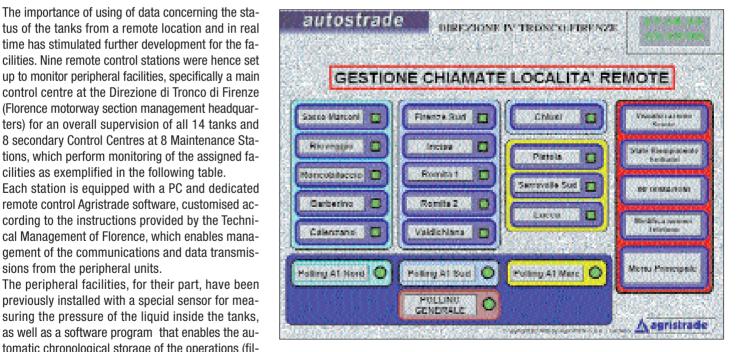
The queries can be of three types: single call-up, call-up for groups of facilities (A1 Nord section - A1 Sud section - A11 Mare section) or a general call-up of all controlled tanks.

The system activates the direct connection with the module or groups of storage modules, acquiring all data relative to the quantity of solution stored and its eventual handling (loading and discharge).

The software will make three automatic call attempts; as soon as connection is made, a special box adjacent to the call button turns red (instead of remaining green) to confirm that connection has been made

If connection is not made, a crossed-out telephone is displayed in the same position; however, the call can be tried again.

At the end of each call, a set of univocal archives for each facility is automatically generated and stored, with record of all data on the loading and discharge operations.



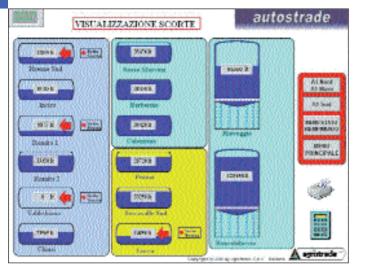
tomatic chronological storage of the operations (filling and withdrawal) performed by the facility in special memory areas that can be queried from a distance. This allows a constant availability at any of the remote monitoring centres and updated report on the filling status of all the tanks, in addition to the statistical and control management on the use of the facilities.

cilities as exemplified in the following table.

sions from the peripheral units.

The software also allows managers to modify at any time the telephone numbers of each remote system. The monitor displays the tank's filling status (general or individual) with indication of any understocked tanks. To view the actual guantities in the tanks, this function is enabled only after the call-up(s) are performed.



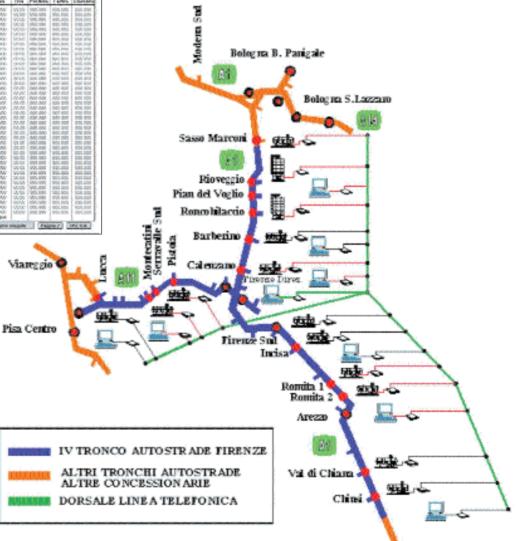


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The display on the monitor or the printout of detailed logs on the use of the facilities is updated to the date of the last connection. Because the data is transmitted through dedicated telephone lines of the Società Autostrade, management costs of the remote control are practically non-existent.

Remote assistance

The remote control will allow activation of the remote assistance service to the facilities, which in turn will allows the supplier to hook up to the facilities through the telephone line, monitor their status and eventually intervene to modify or integrate the management software, as well as give instructions to personnel operating at the Snow Station directly from the Bolzano headquarters. SERBATOIO DI FIRENZE SUD



Clearly this new feature gives the enormous advantage of being able to identify and repair facility malfunctions immediately, which in addition to eliminating costly repair by specialised personnel, can avoid greater damage (interruptions, traffic slow-downs, etc.) caused by a failure to perform or delay in spreading operations.

In conclusion, the goals attained were unthinkable until a few years ago. The electronics and computer technology used since the very

beginning has made it possible to transform traditional hydraulic and storage facilities into highly advanced systems capable of managing highly complex services that are basic to safe and efficient winter travel.

*Technical Director of Agristrade SpA