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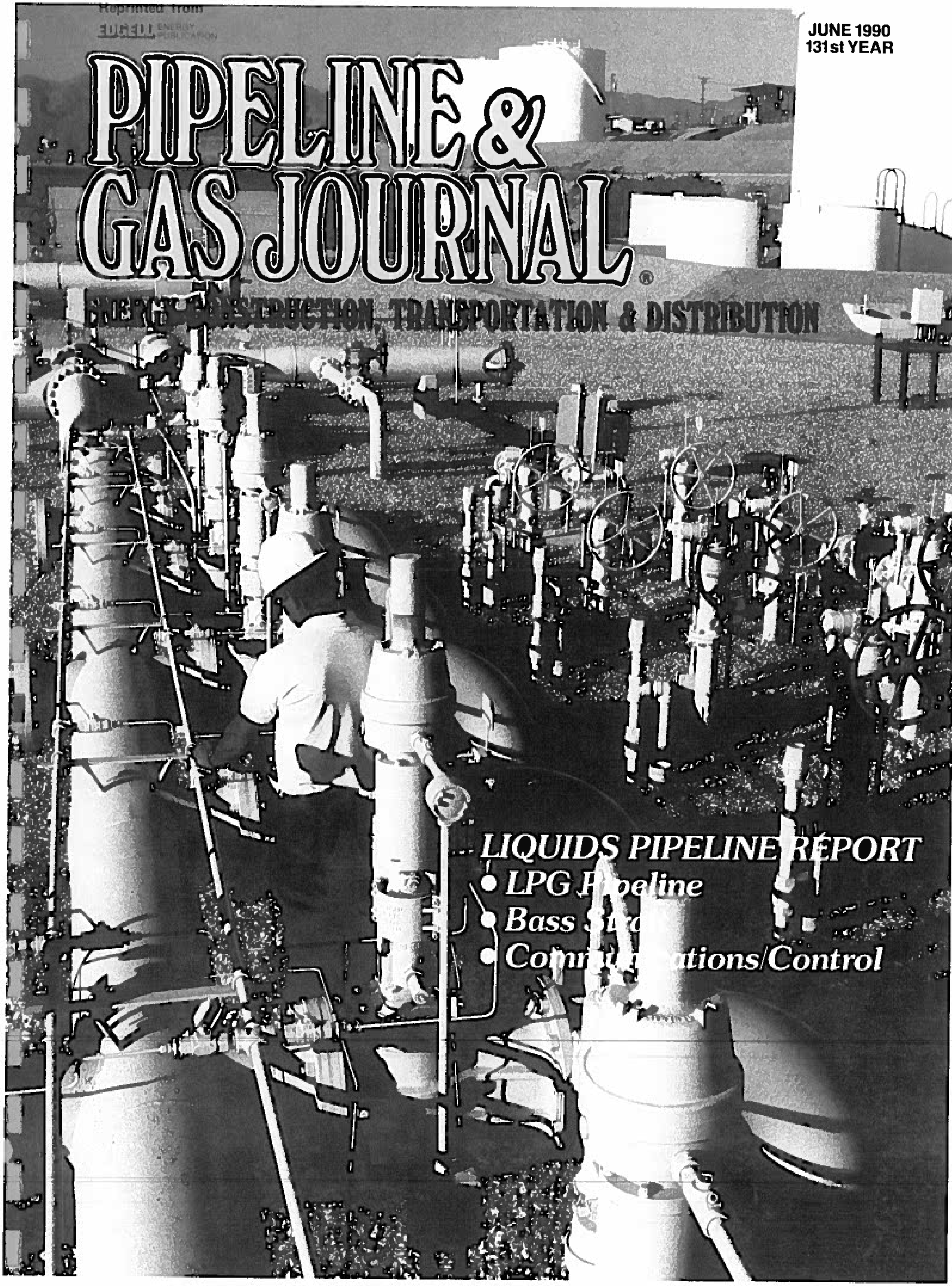

LIQUIDS PIPELINE REPORT

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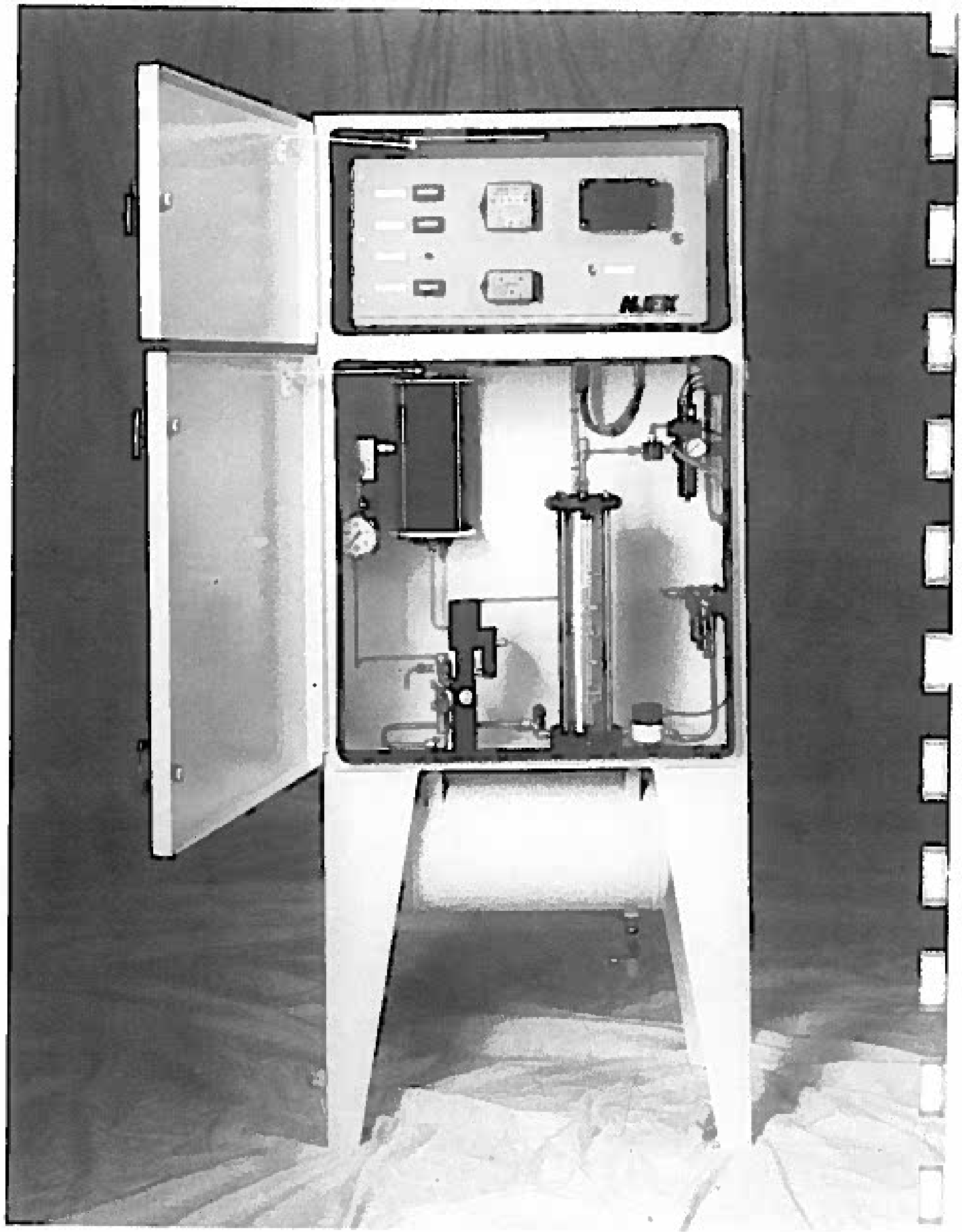
New Equipment Enhances Natural Gas Safety

System Approach To

TECHNOLOGY REPORT

by Jeff Pylant,
design engineer, NJEX International Corp., Snyder, Texas



Complete system approach to gas odorization used in the sophisticated new NJEX-7100 provides detailed quantitative data for analysis, adjustment and accountability.

Clean-burning natural gas has become the fuel of choice for millions of consumers around the world because of its versatility and availability.

Because natural gas is colorless and odorless, modern natural gas odorization procedures have been established as a means of saving lives and protecting property.

The need for odorization of natural gas was seen in the late 1800s. However, it took a gas accident in East Texas, the tragic New London School Explosion in 1937 when more than 200 school children were killed because the presence of natural gas was undetected, to make odorization a common practice throughout the industry.

By the 1940s, gas odorization was widely endorsed by the industry. It was determined that leak detection would save lives, and legislation was passed requiring the odorization of natural gas. Today, state and federal regulations concerning the odorization of natural gas place a great deal of emphasis on enforcement.

Monitoring techniques. Natural gas odor levels are usually monitored by several techniques, including the room test and the use of a dilution apparatus such as an odor tester, odorometer or odorator.

Although there are various procedures involved in odor- level determination, the most common mechanism used in the industry is the human nose. Because the objective is to determine the actual degree of odor, not the amount of odorant, the human olfactory sense continues to serve as the standard of pungency.

Safety decisions. The primary objectives of all gas odorization programs should be to provide for the public welfare and safety, and to meet or exceed regulatory requirements.

In order to reach these goals, many decisions have to be made. These include the selection of an odorant, the desired odorization rate and the proper equipment needed to obtain the desired rate.

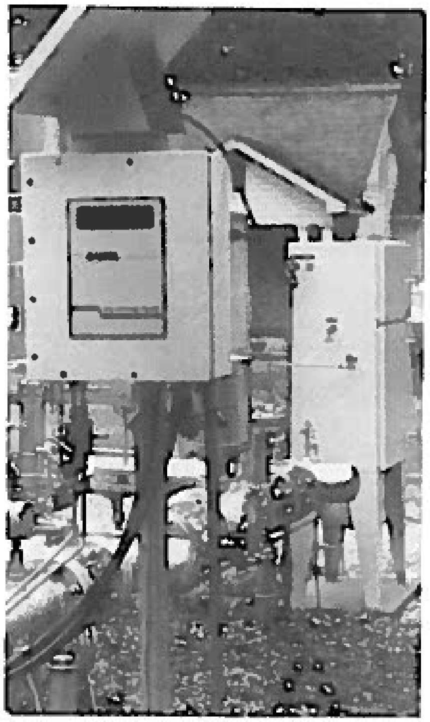
The proper odorant should be selected after a thorough study of the chemical and physical properties of individual odorant components and available odorant blends, an analysis of the quality of gas to be odorized and a review of existing operating conditions.

Selection of the odorization rate is usually based on the size and geographic location of the gas distribution system.

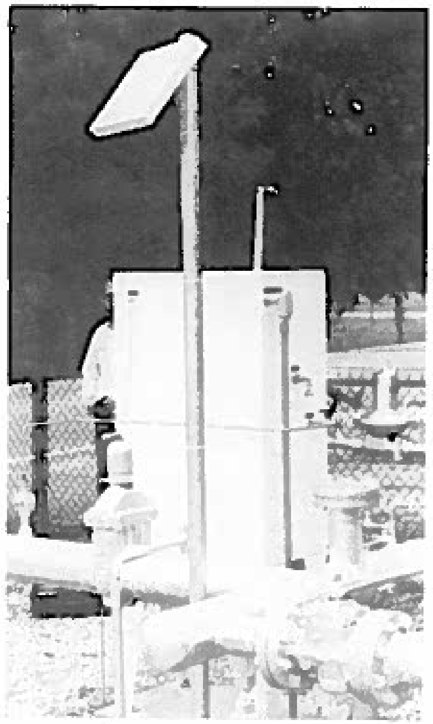
The minimum odorization rate should not be less than 0.3 lb per MMcf with a normal maximum rate of no more than 2 lb/MMcf. However, the rate may be significantly higher to obtain a satisfactory odor level. Customer reports of non-hazardous leaks usually increase as the odorization rate increases.

After the proper odorant and required odorization rate have been determined, the proper equipment can be selected.

Gas Odorization



Unit in the second series of field tests interfaced with a Daniel flow computer to obtain proportional-to-flow capabilities and automatically check system from a remote location.



System's high output solar panel and large-capacity battery provide power for use in remote locations, with a 30-day reserve at maximum injection rate without charging.

Total approach. Y-Z Industries Inc. began designing odorization systems after several customers of the company's existing sampling devices asked Y-Z to improve what was available on the market.

These customers wanted a total system approach that would address a range of needs. They said the equipment should be capable of performing in a proportional-to-flow mode under varying conditions and in remote locations. It should provide verification of pre-set proportional-to-flow odorization rates, an easy, positive method of odorization documentation and a system monitoring and alarm system capable of notifying the operator in the event of a malfunction.

Recognizing that the injection pump is the heart of an odorizing system, parameters were set in three areas.

First, the unit must be made of materials compatible with the chemicals injected. Second, the pump must operate at a much faster stroke-rate than sampling pumps. Finally, the pump must displace a larger volume per stroke.

The pump underwent extensive design and development. By early 1989, we were confident the pump would prove reliable and field worthy. During the initial research and development period the pump stroked 5 million times with practically no noticeable wear.

At this point, information was obtained from appropriate odorization personnel at major gas utility companies, natural gas pipeline companies and state and federal regulatory agencies. In addition to the beneficial factors mentioned earlier by the customers, these respondents cited extreme reliability, low maintenance and solar power as desirable.

Initial testing. The first prototype was completed in late 1989.

Lone Star Gas Co., Dallas, a major intrastate gas pipeline and distribution utility, cooperated in the initial testing.

The odorization rate for this specific application was 0.5 lb of odorant per MMcf. This experiment proved valuable as gas flow rates varied greatly with ambient temperatures ranging from below 0° F to 55° F.

Upon completion of the test, several modifications were made and a second system was completed. It was ready for field tests in January 1990.

With the cooperation of Entex, a division of Arkla Inc., the unit was installed at a station near Abbeville, La. The improved unit interfaced with a Daniel Industries' flow computer to obtain proportional-to-flow capabilities. This also provided a means to automatically check system status from a remote location.

Gas flow at the Abbeville testing site ranged from 500 Mcfd to approximately 6 MMcfd. The required injection rate was set at 4 lb/MMcf. According to Entex odorization personnel, the test was successful.

Pump. The single most important element in any odorant injection systems is the pump. This component is the main contributor to the success or failure of the odorization systems available currently.

The Model 7100 Odorant Injection System™ from NJEX International Corp., Snyder, Texas, uses the proprietary Model 7000 injection pump, which has been specially engineered and designed to overcome problems associated with odorant pumps/injectors. These problems include – but are not limited to – short seal life, material incompatibility and pump volumetric inefficiency.

The extremely stable, reciprocating positive-displacement pump is made proportional to flow by varying the time between strokes. The Teflon® diaphragm of the plunger-type pump separates the odorant from the pump's hydraulic oil.

Seals are located in the hydraulic-oil side of the pump and are exposed only to the hydraulic oil, not the caustic odorant. In addition to solving the problem of short seal life, this arrangement overcomes material incompatibility problems because the odorant contacts only the Teflon diaphragm and the chemical/odorant manifold, made of 316 stainless steel.

Controller. The NJEX system integrates the Model N-150 controller to perform in a proportional-to-flow mode.

The controller tracks the flow rate of the gas pipeline supplier using a flow input signal from a flow computer or a differential pressure transducer.

The controller continuously monitors the input signal and calculates times between each stroke. The maximum injection rate is determined by the unit with the minimum injection rate set by the suppliers.

The N-150 controller can distinguish between a low-flow situation and the loss of a flow input signal. If the flow input signal is lost, the controller automatically returns to the preset injection rate. The controller can also be operated in a proportional-to-time mode.

The NJEX system is powered by a 12-v solar panel and battery system for use in remote locations. Battery capacity allows for a minimum of 30 days operation without charge.

Dual verification. Documentation and verification are crucial to any odorization program.

The NJEX system incorporates a dual verification system.

The primary method is a flow switch connected to the odorant pump discharge that verifies that chemical is actually being injected with each successive stroke of the pump. The flow switch closes every time the pump is stroked if a sufficient volume of odorant is forced through the switch.

The switch interfaces with a counter to provide a continuous readout of the strokes displaced. The system also has a counter for the number of strokes signalled by the controller. These two counters give the operator separate verifying readouts that should always be equal.

The second system is a verification tank, the VeriTank™, that acts as a meter on the inlet side of the pump. The tank, which contains an upper and a lower level switch, is designed so that the volume between the two switches is equal to 1 lb of odorant.

The filling of the tank is controlled by the VeriTank module. Filling begins when the falling liquid level meets the lower switch and is completed when the rising level meets the upper switch.

The number of fill cycles is recorded on a counter, representing the number of pounds of odorant injected. The VeriTank control module also generates a signal for computer logging each time 1 lb of odorant has been injected. This provides a documented account of when the odorant was injected and how much chemical actually was injected.

Alarm system. The NJEX odorization system is equipped with an alarm system that alerts users in the event of a malfunction.

The alarm module monitors the injection pump, VeriTank system, battery and flow input signal.

The module signals the user under various alarm conditions. In the event of any alarm, a red LED is illuminated. A contact closure is provided so the user can respond to any desired function. The alarm module is equipped with a status switch, allowing the module to determine what component is causing the alarm. The alarm module also features a switch for system testing.

The alarm is automatically reset when the problem is corrected. **P&GJ**