

red Hild sits at a gray folding table. The blue glow of dual 30-inch computer displays reflects off his glasses as he clicks his mouse. First the outline of North America appears on the screen. A spidery network of lines representing underground pipes works its way south from Alaska, Canada, and the Atlantic coast and north from Mexico. The lines become denser in California and Oklahoma, but they really thicken from Oklahoma into Texas. Harris County fills in solid—seen on the cover of this issue—as if the state rests not atop dirt and rock but a giant network of pipelines.

“It just so happens that Oklahoma, Louisiana, and Texas were blessed,” Hild says. His Southern idiom fades when he delves into technical intricacies but returns strong when he presents information in simpler terms. “All states have oil and gas with the exception of the far Northeast. Them Yankees up there don’t have nothing.” He points to the gathering lines “streaming” from Canada to big California cities, but for the most part all pipelines appear to lead to or from Texas.

Thomas Colbert, an architecture professor and co-guest editor of this issue, long heard murmurings, rumors, and vague allusions to a vast underground network of pipes and old oil fields underneath Houston, whole zones of land undeveloped because of the danger below. He accompanied me to Hild’s League City office. The man we found was more Oracle than human.

Drilling a natural gas well in the Kilgore system? Hild can tell you exactly where all the closest pipelines are, what distribution points you can connect with and who owns them, the risk of flooding, and what school district might tax you. Give him a set of coordinates—any spot in North America—and he can

show you all this plus the rivers, lakes, bays, and swamps; power plants, substations, and transmission lines; railroads and refineries; compressor stations, receipt and delivery points, meter stations, oil pumping stations, oil reservoirs, underground gas storage, and above ground gas storage.

“My company, HTSI, scans any data we can get and then brings it into ArcGIS,” Hild says. “We digitize all the lines, correct them according to aerial photographs, and make them just as accurate as we



Above: Homes near the Bammel Gas Storage Facility

can.” Often it is his own customers, including Shell, who supply him with data.

When Hild finally zooms in on Harris County, the solid purple resolves into distinct if incomprehensible complexes of lines. I ask about one thick band. On closer inspection, it turns out to be 42 *separate* gas lines—not segments or pieces of the same line. Hild moves his mouse over the area. “If I click on that pipeline, then it tells me that the pipeline belongs to DCP Midstream Limited Partnership, it is a nine-inch natural gas line, it is active, the subsystem is

owned and operated by Anadarko, and it is a gathering line.”

What appears to be the very thickest concentration of pipelines along a single right-of-way is at the Ship Channel where Pasadena Freeway and Beltway 8 cross. Hild zooms in—there are 274 completely separate pipelines in this easement.

As Colbert and I drive back to Houston proper, it is as if we have been taught to recognize birds or leaves for the first time. At a stretch of “undeveloped” land between two strip malls, we notice the little signs we have ignored most of our lives warning of butadiene, butene, oxygen gas, natural gas, and petroleum lines below. The J-shaped pipes and small sheds now seem obvious.

The visit to the Oracle of League City is the revelation Tom sought. New York is defined by the collective experience of its underground. Underneath Houston is this thing of even greater national importance that does not even have a name. Throbbing veins and arteries come to mind. A bodily metaphor seems right because the pipelines are incomprehensible, though they are not a body but a machine built and maintained by humans at enormous expense, a vast hidden machine.

Like Hild, Ken Beckman, Senior Vice President of Cardinal Gas Storage Partners, works from a nondescript office building off the highway, this time in northwest Houston near Wilcrest. He takes us into a conference room. All along the window sills and wall shelving are core samples from beneath the surface of the Earth.

“Within Houston, we have five underground gas reservoirs,” he says. I imagine giant cavernous spaces, but he picks up one of the core samples to demonstrate otherwise. “This particular sandstone comes from about 3,000 feet below the ground in Mississippi.” For a second, he gives the rock a messy kiss. I know geologists are a curious breed.

A Journey Into THE GREAT BELOW

HOUSTON IS AT THE HEART OF AN INTERNATIONAL NETWORK OF PIPELINES AND RESERVOIRS THAT BOOSTS THE LOCAL ECONOMY. BUT IS IT SAFE?

by **Raj Mankad**



Above: Pipelines markers in Pasadena.

They deal in geologic time, they speak the poetry of ages. Even so, of all scientists their work is among the most practical, gritty, and sought after by industry. But making out with a rock might be expected at an ashram, not a reputable office. Beckman inhales and exhales with the rock to his lips. “You can breath through it,” he says. “And that means you can flow gas and oil through it.”

Parts of the city, then, sit atop porous rock packed with high-pressure gas. The first questions we ask: do people live on top of these sites, do they know, and how long before the giant inferno?

“People live on top of Bammel gas storage field,” Beckman said. And before getting into the details of safety, he makes clear his own comfort level. “I actually live very close to the Bammel field, if not on top. It is a World War I vintage gas cycling operation on the north side of town at Kuykendahl and FM 1960 that was converted over to storage in the 1960s. The community has grown out over it since then.” Most of the reservoirs in fact are old, used-up oil and gas fields that have been recycled as storage.

The other facilities are West Clear Lake, off I-45 and Nasa Road, and Katy Gas Storage at Pin Oak Road. In addition there is gas storage at salt domes in Liberty County, Moss Bluff, North Dayton, Pierce Junction, Spindletop, High Island, and Cote Blanche. Beckman confesses that even he has a hard time spotting the locations above ground. For example, the Katy reservoir is a wooded area marked by a berm, or mound of earth, planted with pine trees. “You wouldn’t know it was there except for the fancy gate they have in front of it.” Unlike Bammel, the Katy facility came into use after residential development and was heavily fought by residents at the time.

Perhaps the most persuasive point about safety—besides Beckman’s willingness to live on top of a reservoir—is that the fields held hydro-

carbons for millions of years before human beings drilled into them. Old gas fields are normally used to store gas. The locations of the well bores, the pressure at which the fields once held gas, and how much gas they held are all known from the days of extraction. The danger is exactly at the points where humans breached the millennial geologic structures. The last accident in the area occurred at Moss Bluff when a wellhead failed. “It looked like a giant blow torch,” Beckman said. “They had to repaint the compressor barn and nobody got hurt. It scared the well operator.”

The worst incident he could recall occurred in Hutchinson, Kansas in 2001. Damage to the casing of a reservoir well allowed gas to escape and migrate underground seven miles into the city of Hutchinson, popping up through abandoned salt mines and forgotten wells. Two people, John and Mary Ann Hahn, died when an old well beneath their mobile home exploded.

Headlines do not celebrate the lives gas storage saves. It serves two major functions: supplying gas during periods of very high demand and moderating swings in price caused by panic buying and selling. All in all, there are 4.2 trillion cubic feet of working gas space in the United States, of which approximately 3.6 trillion cubic feet is filled annually. The United States uses around 23 trillion cubic feet per year, so storage capacity is a fraction of total consumption. Natural gas, for the most part, is burned to heat water for hot showers and tea or to supply industry needs as soon as it is produced. It takes about a day for Oklahoma gas to reach Houston and two more days for it to reach New York through pipelines.

The storage consulting Beckman performs for utilities almost entirely concerns the ten coldest days in the north: the 30-degree-below winters



Harris County. Thickness of lines indicates the number of individual pipelines.

that strike the Yankees. He is like the stingy uncle always reminding you to save, as he prepares for the coldest day that strikes once every decade or two—the kind of person who is mocked until the streets freeze over and heat is a matter of survival.

If Hollywood ever makes an apocalyptic movie about Houston, the trailer will show the petrochemical complex exploding, the ship channel turning to a river of flame, scenes already familiar from news about pipeline attacks in Nigeria, Columbia, Mexico, and Iraq.

In a post-September 11 world, should not pipeline maps and gas reservoirs locations be treated as secrets? It almost seems Houston has done all the work except lighting the fuse.

According to Hild, the ubiquity of danger has a paradoxical effect. The sheer number of pipelines in Houston—marked with signs at each street crossing—not only makes them unguardable but also less valuable as targets. Damage to a few pipes would not bring down the whole system. “It’s not

like you are going through [a Central Asian country] and there’s one 40-inch pipeline,” he says. “If you were a terrorist, you would get very tired blowing up pipelines here and not getting nothing done.”

Nonetheless, the September 11 attacks had a chilling effect on the willingness of the government and industry to share information about infrastructure. This trend worries Beckman. He argues that transparency is necessary for a healthy democracy with an informed citizenry capable of understanding the costs and advantages of pipeline and storage infrastructure.

Beckman’s neighborhood alone is sitting above 450 million dollars worth of gas and storage facilities at Bammel.

If cap-and-trade rules are passed by the U.S. Congress, CO₂ could be captured at industrial sites and piped into old oil wells, packed in at high pressures to be kept out of the atmosphere. The expertise of men like Hild and Beckman will be



Natural gas is stored beneath Beckman’s neighborhood.

even more in demand.

“We live and die by pipelines,” Hild says. And in the pragmatic way of speaking that seems to permeate energy industry engineers, he adds, “I’m no advocate or whatever, but the reason the Houston economy is going strong is those pipelines. They keep our gas flowing. The national economy might be going to hell but you’ve still got to move those fluids.”

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