The North American Society (NASTT) and the International Society for Trenchless Technology (ISTT) International No-Dig Show 2009

Toronto, Ontario Canada
March 29 – April 3, 2009

Paper C-1-01

Auger Boring Challenges in the Virgin Islands

Arvid Veidmark, III[1]

[1] EVP/Sr. Estimator, Specialized Services Company, Phoenix, AZ, 602-

Abstract: This paper recaps the complexities of an auger boring project successfully completed at a major oil refinery, located in St. Croix, U.S. Virgin Islands.

Aging Pipelines

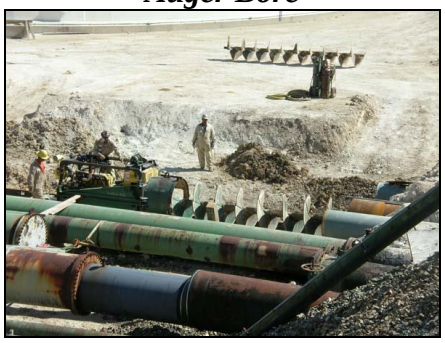
Established in the early 1960's, and constructed atop a quarter mile of dredged ocean floor, the St. Croix refinery is one of the largest and most modern in the world, with crude oil processing capacity of 700,000 barrels per day. Over time and extreme weather, two of the refineries four major fuel lines began to leak, costing over $800,000 per day in lost revenue and making this not only a challenging project because of its location and soil types, but also an urgent one.

The original pipelines, constructed at such an angle that made renewal impossible, now intersected major fire and power lines. Trenchless auger boring was chosen as the most suitable replacement method and construction began in early October, 2007.

The project called for four auger bores to install (2) 30" OD steel casings and (2) 48" OD steel casings. Along the 120' bore path, each of the steel casings had to pass through at least six different soil types ranging from coral cobbles to sticky clay. This proved extremely challenging because of the lack of binding material in the outer layer of coral that could have resulted in cave-ins, and the density of the inner layer of sticky clay that made turning the auger impractical.

Employing a combination of innovative methods, proven technology, and a life time of experience, all four steel casings were successfully installed and the project was completed in mid October, 2007, amazingly eight days ahead of schedule.

Auger Bore



Introduction: Saint Croix is an island in the Caribbean Sea, and a county and constituent district of the United States Virgin Islands (USVI), an unincorporated territory of the United States. It is the largest of the U.S. Virgin Islands, being 28 by 7 miles (45 by 11 km) and hosts one of the world's largest and most modern oil refineries.

Construction of the 45,000 barrels per day (BPD) refinery began in October of 1966. Substantial expansion occurred in the period 1966 to 1974 to increase the refinery's capacity and making it the largest refinery in the world at that time: Heavy oil upgrading capacity was gradually added beginning in 1981 eventually increasing the refinery's capacity to 485,000 barrels per day BPD.

To accommodate the original 2,000+ acre facilities on the south shore of St. Croix, a ¼ mile of wetlands was dredged and contained by a 120' long x 20' high dike that eventually became home to a service road, power and fire lines, and four major fuel lines that connected the refinery to adjacent holding tanks.

Many years and four major hurricanes later, two of four fuel lines had to be shut down due to leaks. At a cost of $800,000 per day in lost revenue, immediate upgrades were required.

Design Considerations: Lack of as-builts and supporting documentation for the original facility and containment areas proved an immediate challenge. Although it was well known that a 30" fire line, a 12" water line, and a 12000 KV electric line existed in the area of the newly proposed pipelines, their exact location and depth was unknown. Initial soil investigation revealed moderate clay and coral at 15-ft. however, soil conditions beyond that point were also unknown.

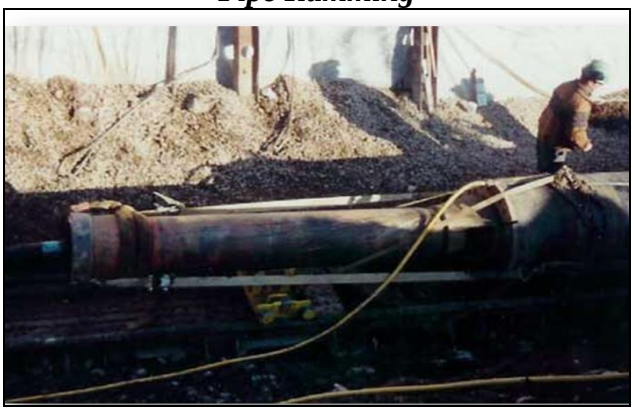
Methods Considered	Advantages	Disadvantages
HDD	None	None
Hand Tunnel	Line and Grade Accuracy	Not allowed due to Safety Rules
Auger	Speed	Drift of casing
Pipe Ramming	No voids	2 steps to install, vibration, noise

Hand Tunnel

Auger Bore

Directional Drilling

Pipe Ramming



To minimize the cost and risks associated
with this project, horizontal auger bore was selected as the most suitable method. Four 120' auger bores to install (2) 30" OD steel casings and (2) 48" OD steel casings were required.

4- 120' bores planned to replace existing casing

Installation Challenges: Construction began in early October, 2007. The first of the two bores to install 48" OD steel casing failed. Extreme weather had stripped the binding material from the outer layer of coral causing the loose material it to cave in. Dropping a foot below grade, a second bore successfully cleared the loose material but became bound in dense sticky clay at approximately 60ft. Water was pumped in and around the auger to loosen the clay and allow the auger to glide for another 40 ft. Once again the auger encountered the outer layer of coral as it exited the dike making turning the auger impractical. It was then shut down and used as a jacking device for the remaining 20 ft. successfully avoiding an overflow oil drain that was discovered during the installation

Loose Coral

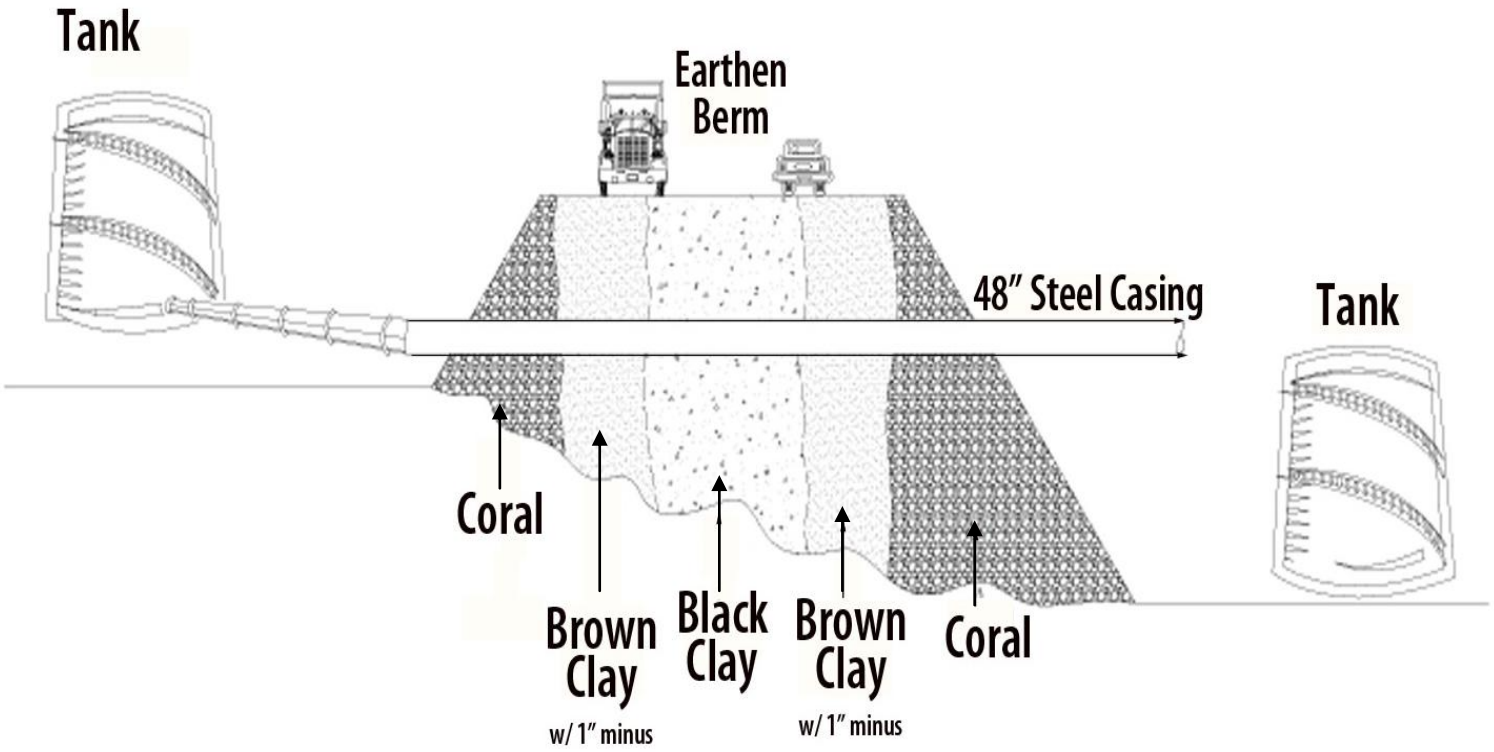


Illustration of layers of soil

With little room to maneuver, and little time to spare, each of the three remaining casings were installed successfully and the project was completed in mid October 2007, amazingly eight days ahead of schedule.

New Fuel Lines Side A

New Fuel Lines Side B

Conclusion: Although the lack of as-builts did prove detrimental initially, we were able to employ a combination of innovation, technology, and experience that resulted in success.

As demonstrated on this project, the lack of as-builts and documentation will be the initial hurdle for any project. An excellent set of as-builts can save much time and money for an owner and contractor, helping them to make more informed decisions and reduce risk. It is common for changes to be made during construction. What becomes the challenge is making sure those changes are reflected in the as-built records.