**SoilFreeze’s Ground Freezing for Excavations Made Possible by Technical Systems Chilling Equipment**

*Company’s shoring technique saves time and costs in construction projects*

SoilFreeze is the only U.S. construction company specializing exclusively in ground freezing services for construction and related industries. The company provides structural shoring, groundwater cutoff, and soil contamination remediation through an innovative ground freezing technique that is more environmentally friendly, lower cost, and saves time compared to other shoring and groundwater cutoff techniques. The technique is demanding, however, and requires extremely reliable, durable refrigeration systems. Since its founding in 1998, SoilFreeze has relied on chillers manufactured by Technical Systems, Inc. (TSI), a division of RAE Corporation, to meet its precise refrigeration needs.

**Ground freezing: an environmentally friendly and time-saving shoring option**

In order for contractors to dig on a construction site, be it a tunnel shaft, foundation, or other excavation project, the ground must be shored in order to give the excavation a stable structure, prevent cave-ins, and cut off groundwater from the surrounding area to avoid it being drawn into the excavation site. A number of techniques exist for structural shoring and groundwater cutoff, but many are time-consuming and extremely expensive.

Artificial ground freezing was developed and initially used in mining as an alternative to these methods, but for decades, relied on the construction of semi-permanent refrigeration equipment on each individual building site. This construction demand rendered it prohibitively expensive for all but the largest, most long-term projects.

Ground freezing is extremely environmentally friendly, however, especially as compared to other excavation options. The ring of frozen ground around an excavation site forms a waterproof barrier, eliminating the need to pump groundwater out of an excavation site, treat, and store it. It also eliminates the risk of spreading contaminated groundwater into previously uncontaminated areas. This is especially of concern in drought-stricken areas such as California and in areas with dangerous soil contamination, but is important in all situations as the removal of groundwater can cause buildings in the surrounding area to settle.

The process of freezing the ground before an excavation is time-consuming up front, but ultimately saves time as the excavation does not need to be stopped repeatedly while in process in order to shore up and waterproof newly excavated areas.

In 1998, SoilFreeze was founded and introduced artificial ground freezing into the U.S. civil and commercial construction market as a means of providing environmentally friendly, cost-effective, and time-saving soil stabilization. Prior to this, the method was only in use in mining and environmental control applications in the U.S.

The company installs piping vertically in the ground to form a freezing system around the perimeter of the excavation site. A flow system is hooked up to these pipes in order to circulate refrigerant (in this case, a brine solution) through a chilling system; this fluid pulls heat out of the ground and is re-cooled by the chillers continuously until the ground reaches -20ºF. This process takes between four and eight weeks, depending on soil conditions and ambient temperatures.

Once the ground reaches -20ºF, the brine solution continues to be circulated to maintain this temperature and keep the ground structurally sound throughout the excavation process. Excavation work ranges in duration based on the construction project, but can last up to two years or more.

“The definition of permafrost is when the soil remains frozen for at least two consecutive years; by that definition, we have created permafrost in places like Los Angeles,” said Larry Applegate, President of SoilFreeze. “That kind of long-term, extensive ground freezing requires extremely reliable chilling equipment.”

In addition to needing to run continuously and reliably for two or more years, the equipment must be durable and easily portable in order for the system to be cost-effective in a greater range of projects.

**Chiller design for reliability and portability**

When it was founded, SoilFreeze located Technical Systems through a refrigeration expert. The company chose to purchase chiller technology from TSI because they were able to custom build to their exact specifications; namely, they needed powerful refrigeration units that could achieve extremely low temperatures regardless of ambient conditions, start up quickly, remain in operation reliably for long periods of time, and be easily transported around the country for use in many different construction projects over time. This was These specifications were a departure from previous ground freezing applications, which relied exclusively on site-built chillers to freeze the soil.

“We contacted RAE Corporation many years ago to purchase our very first chiller. Over time, we’ve continued to purchase their equipment, because they have proven to meet our needs,” Applegate said. “We currently own 15 RAE chillers, of varying ages.”

While some projects are small and require just a single chiller to achieve and maintain the proper ground temperatures, others will demand as many as a dozen chillers. The packaged, air-cooled chiller refrigeration systems by TSI are built to SoilFreeze’s specifications, and have been updated and refined over time.

“The team at Technical Systems have been great partners to SoilFreeze throughout our company’s lifetime. The TSI team has taken the time to learn what we do and what we need our refrigeration equipment to do, and they have designed accordingly,” Applegate added. “When we needed a narrower, longer chiller for a project inside a tunnel, they built it. They’ve built us equipment in a wide range of sizes, that can work in extreme temperatures, and that can take being trucked around the country and get loaded off the truck quickly and start up almost immediately.”

Jeremy Colvard, Vice President at RAE Corporation, confirmed that his team has worked hard to meet SoilFreeze’s needs over the years. He said that among other modifications to standard chillers, the chillers built for SoilFreeze are designed to be loaded and unloaded with forklifts or cranes, and to be controlled remotely.

“We designed a microprocessor control system so that Larry and his team can remotely connect to and communicate with the refrigeration units. When you’re leaving equipment in place for weeks, months, even years at a time, you don’t want a technician to need to watch over it. You do want to be able to control it if any problems arise, though,” Colvard said.

“It is critical to SoilFreeze’s success that our equipment run smoothly and reliably, because if the units fail and can’t be brought back online, weeks of work can be undone. We understand that, and we build our machines to meet those needs,” he added

In addition to this connectivity and the accommodations for forklifts and cranes, the TSI chillers feature coils manufactured by RAE Corporation that are designed to be easy to maintain and keep clean, which is critical to long-term reliability in construction environments. The TSI chillers are also built to a rugged, industrial-grade construction standard, compared to the typical light commercial products available on the market. Additionally, the chillers feature a flooded condenser head pressure control system, which enables them to run at ambient temperatures as low as -20ºF, far below the capability of compressors in a typical commercial chiller.

**Case Study: Seattle Seawall**

A recent example of the success enabled by the partnership between TSI and SoilFreeze is the ongoing reconstruction of the Seattle Seawall, which separates the west side of downtown Seattle from Elliott Bay. The project began over a year ago, and is expected to be completed in early 2017. The crumbling seawall being replaced is close to 100 years old, and is being upgraded in accordance with new earthquake safety regulations.

“The project is costing hundreds of thousands of dollars a day, all told. The reliability of our equipment is incredibly critical in a project like that, where any holdup in construction is extremely costly,” Colvard said. He added that operation on the Seattle construction site has been smooth.

While every SoilFreeze project is unique, Applegate said, this one is set apart from many others due to its massive scale.

“At one point, we were running 12 or 13 chillers on just this one project, freezing the soil 35 feet deep for over a half mile stretch,” he said. “Due to the massive scale of this project, I am confident that by eliminating the need for dewatering this extremely wet ground and thereby guarding against water contamination, we have saved the city of Seattle millions of dollars.”