

ALISO CANYON STORAGE FACILITY RELIEF WELL OPERATIONS



DEC 28, 2015

SoCalGas® will drill a pair of relief wells in order to stop the flow of gas leaking from a well at its Aliso Canyon Natural Gas Storage Facility. Historically relief wells were drilled into the reservoir close to a leaking well to relieve the gas pressure entering it, thus making it easier to control. However, modern locating and drilling technology has enabled relief wells to be directionally drilled to intercept and directly plug a leaking well.

SoCalGas began planning relief well operations in early-November, started drilling the first relief well on December 4, 2015, and is currently preparing the site and plans to begin drilling the second relief well as a backup in late-January. The first relief well is being drilled from around 1,500 feet away and will intercept the leaking well at more than 8,500 feet below ground. After intercepting it, SoCalGas will pump cement into the bottom of the leaking well to permanently cut it off from the natural gas reservoir. This operation is expected to take until late-February or late-March to complete.

DRILLING PROCESS

The relief well drilling operation is being conducted 24/7 by some of the world's most experienced relief well drilling experts in collaboration with a team from SoCalGas. It is being monitored by the California Division of Oil, Gas and Geothermal Resources (DOGGR) and will proceed in five general phases.

Phase 1 - Set Foundation:

A well is composed of several segments of pipe, each with a smaller diameter than the section above it and each encased in cement. The first segment of pipe, called the surface casing, is the widest and has the important job of providing a strong foundation for the well and providing an extra layer of protection for the subsurface environment. To install the surface casing, SoCalGas will drill a 17 1/2-inch hole to about 1,200 feet of measured depth* (MD) and insert a 13 3/8-inch pipe all the way down the hole. This approximately 1,200-foot segment and all the others are put

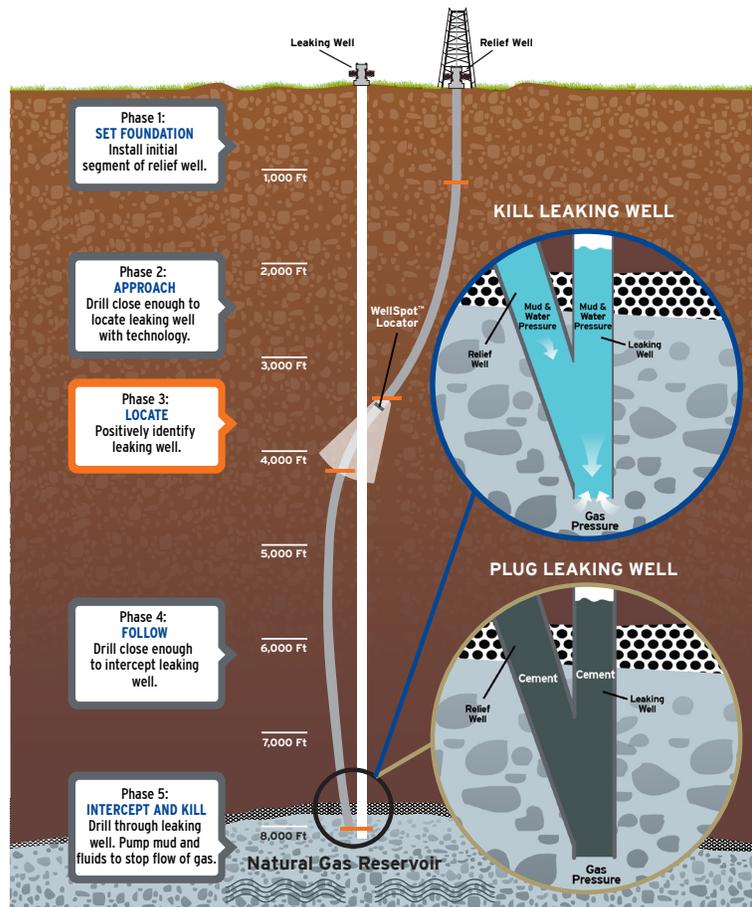
together by screwing 40-foot sections of pipe together as the string of pipe progresses deeper into the hole.

Additionally, at the beginning of each phase, SoCalGas will install a blowout preventer, which is a set of valves and pipes designed to prevent the force of any gas or fluid that could unexpectedly run up the relief well, for the safety of the work crew.

*Measured depth (MD) represents the distance drilled, as opposed to the actual vertical depth below the surface.

Phase 2 - Approach: The objective of Phase 2 is to drill to a designated location closer to the leaking well and within the effective range of the equipment that will be used in the next phase to locate the well. The drilling crew will directionally drill an approximately 12-inch hole toward the target well to about 3,800 feet MD and install a 9 5/8-inch pipe, typically called the production casing, inside.

Phase 3 - Locate: During Phase 3, progress, in terms of feet-per-day, will slow; however, the objective in this phase is less to drill for distance and more to positively identify the target well and others nearby. An active magnetic ranging tool, called Well Spot™, will be used to “range” for the leaking well. The tool includes two components, one to generate an electromagnetic field and another to detect changes in that magnetic field that would indicate the locations of the wells. As this phase progresses, the drilling crew will alternate between drilling and ranging, requiring the drill bit to be retracted and exchanged with the ranging tool, which could take up to a day each time. Once the leaking well has been located, the crew will drill past it at a relatively close distance and then wind back to it at around 4,500 feet MD in order to confirm the location of the leaking well and to properly position the drill bit for the next phase of drilling. To avoid the other wells nearby, rare earth magnets will be placed inside those wells so sensors in the drill bit can steer clear of them.



Phased planning may change as drilling progresses.

Illustration is for informational purposes only. Drawings are not technically accurate or to scale

Phase 4 - Follow: Because the leaking well does not go straight down, the crew will have to continue ranging so the relief well follows the leaking well while maintaining the proper distance and angle. This phase will be one of the longer phases in terms of time because the drilling crew has to work its way down to below 8,000 feet MD by alternating between drilling and ranging. Importantly, at the end of this phase, the relief well will need to be in the proper orientation and angle, less than five degrees, to the leaking well in order to properly intercept it in the next phase.

Phase 5 - Intercept & “Kill” the Well: In Phase 5, SoCalGas will continue drilling another 500 feet to install the casing to about 50 feet from the target well. While this is a relatively short distance, this phase will also be one of the longer phases because this 500 feet will be drilled in progressively shorter intervals with ranging and surveying being conducted at each interval to ensure the drill maintains the proper position. The last 50 feet of pipe will be installed just short of the leaking well at about 8,600 MD. After preparations for the “kill” attempt have concluded, the team will cut through one side of it and begin pumping heavy fluids and drilling mud to outweigh the gas pressure flowing up from the reservoir. As soon as the flow of gas has been stopped, SoCalGas will pump enough cement to displace the fluids and mud and leave a thick seal of cement to effectively shut off the target well from the reservoir, stopping the leak at its source.

Permanent Sealing: After an investigation of the circumstances surrounding the leak, SoCalGas will pump more cement into the well, leaving it permanently sealed.

For more information, please call the SoCalGas Aliso Canyon hotline at 818-435-7707 or email us at AlisoCanyon@SoCalGas.com.