The Granite Wash formation presents several challenges in drilling the build section from a vertical open hole to form a lateral. The formation is hard and abrasive, and it is difficult to anticipate downhole rock properties. The erratic nature of the formation results in unpredictable performance by the steerable drilling assembly and drill bits. In most cases, the target build rates are not achieved, forcing multiple trips. An innovative drilling system has been developed that provides a dependable kickoff ramp and a firm beginning for initiating the build section without having to rely on the fulcrum point of the drilling bottomhole assembly (BHA) in a single trip downhole.

Challenges
The complex Granite Wash formation (Fig. 1) presents many drilling challenges, particularly beyond 12,000 ft, specifically when building a curve to horizontal at 14°/100 ft.

One of many formation-related challenges was to reduce the number of trips. The conventional sidetracking technique for the open hole has been to run and set a whipstock/anchor assembly at the kickoff point in a separate trip using a different BHA. Once the whipstock was secured, the directional-drilling assembly was run to initiate and finish the curve and reach the landing point. The extra trip, however, needed to be eliminated.

The erratic nature of the formation also makes it difficult for the driller to use the offset to optimize bit selection to drill the highly abrasive formation efficiently. The driller usually selects a proven tricone bit dressed with abrasion-resistant cutters. Despite that, the bit’s cutting structure wears prematurely, forcing the operator to make multiple trips downhole with a new polycrystalline-diamond-compact (PDC) bit to finish the curve.

Solution: Innovative Drilling System
The most prevalent sidetracking technique in an openhole application has been to set a cement plug and time drill with controlled rate of penetration (ROP) with a directional-drilling assembly. The cement-plug method generally required 3 to 5 days to get a plug set and dressed off in an oil-based mud. The cement-plug method was replaced by a conventional but reliable whipstock/anchor system, which required a separate trip.

An innovative technical solution was required to remove the uncertainties associated with the cement plug and the conventional directional tools used for curve building. To solve the challenge, an initiative was launched and a comprehensive technical solution was proposed that included innovative tools, technologies, and procedures designed specifically for the openhole sidetracking operations to establish a reliable kickoff structure and to produce a curve free of doglegs in a single trip downhole.

The innovative drilling system used for this application is shown in Fig. 2. Starting from the bottom, the key components and their features and functions are

- Expandable anchor: The anchor slips when hydraulically activated and set, providing a three-point firm grip in the pilot-hole wall to counteract any rotational tendency that may occur from BHA rotation.
- Steel ramp: The 2° sloped face of the ramp provides a firm beginning of the curve and

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This article, written by Editorial Manager Adam Wilson, contains highlights of paper SPE 163534, “Innovative Drilling System With a Built-In Kickoff Ramp Allows Dependable Curve Building in Granite Wash Formation,” by G.A. Bruton, SPE, and J. Talkington, Chesapeake, and P. Desai, S. Swadi, SPE, and J. Kelley, Schlumberger, prepared for the 2013 SPE/IADC Drilling Conference and Exhibition, Amsterdam, 5–7 March. The paper has not been peer reviewed.
subsequently supports the directional-drilling BHA in curve building and lateral drilling.

Diamond-impregnated bit: A light-set medium-profile special bit was selected to achieve higher buildup rate (BUR). The bit is mechanically attached to the top of the ramp with a shear bolt to facilitate separation from the drilling BHA once the ramp is oriented and the anchor is set.

Turbodrill: A turbodrill with a multistage power section and a directional bearing package was selected instead of a conventional positive-displacement motor (PDM). The turbodrill delivers improved wellbore quality and reduces downhole vibrations significantly compared with a PDM. The turbodrill was equipped with a 2° double-bend housing to reduce the effective bit-to-bend distance, allowing the BHA to achieve a higher BUR. Also, the turbodrill was temporarily locked to facilitate the setting of an expandable anchor.

Field Run and Results
A field run took place in May 2012 in Beckham County, Oklahoma. The drilling system was run in the hole, and the deflector was hydraulically set with a kickoff point at 12,520 ft. The drilling assembly was disengaged from the deflector and properly oriented for subsequent curve building.

After drilling for 605 ft and building an inclination of 73.20°, the drilling assembly was pulled out of the hole because of a decrease in the ROP. Field examination revealed that the impregnated bit was rung out and had some shoulder damage, which is common in applications for this area.

The planned landing point was reached with the next drilling assembly, which consisted of a turbine and long-gauge impregnated bit. No problems were encountered while pulling the first drilling assembly out of the hole or when tripping in with the next lateral-drilling assembly back to the bottom of the hole. The trouble-free tripping operations indicated that the curve was smooth and did not have any undesirable ledges. Therefore, hole reaming was not required.

The next lateral-drilling assembly drilled from the previous bottom of 13,125 ft to 14,956 ft while completing the inclination to 92.20°. In summary, the system was successfully run, hydraulically set, and anchored for subsequent drilling operation, all in a single trip, as planned. The drilling assembly with the turbine and the impregnated bit drilled a smooth curve without undesirable ledges. The landing point was approximately 120 ft short, but the distance was made up by the next lateral-drilling assembly.

The operator realized a substantial cost savings because of the success-
ful field run of the innovative drilling system. The cost savings resulted from (1) not having to make a special trip for setting a cement plug; (2) eliminating uncertainties of using a cement plug for curve building; (3) running a deflector and drilling system in a single trip, thereby saving trip time; (4) not having to ream the hole because of excellent hole quality; and (5) flawless overall system performance.

**Conclusions**

The field-run results validated the following key objectives and system features:

- The innovative drilling system eliminates the need for an extra trip to set the whipstock/anchor assembly.
- Having an integral deflector secured in the pilot hole provides a reliable kickoff point for the directional-drilling assembly.
- Using a turbodrill and an impregnated bit in the drilling assembly substantially improves hole quality in the hard and abrasive formation while reducing or eliminating the need for reaming.
- The innovative drilling system results in substantial overall project cost savings, mainly by accomplishing the directional objectives in fewer trips.

![Directional-drilling plan](image-url)