Air casters ease move of towering oil well drill rigs

Technology is changing the face of one of the world's most critically important industries. Long the stuff of movie drama, the petroleum industry has moved miles beyond those outdated images of geysers of crude oil gushing from the earth to drench roughneckers trying to contain its erupting "liquid gold." Around the world some of that move into the future has been made on a cushion of air.

Today the site of an oil well drilling operation may in fact look like anything but what you may expect. On downtown Hollywood's Pico Boulevard, yards from wealthy residences and neighborhood shops, an oil well pumps away inside a structural shell that looks to the world exactly like an office building. It's been there for the last ten years.

On islands off of Long Beach, California, a large oil production operation dubbed THUMS (for Texaco, Humble, Union, Mobil and Shell) operates multiple sites, some styled as attractive architect-designed towers, and at least one featuring water cascading down its front like a modernistic fountain display.

One of the most unusual drilling sites is right in the heart of the southern California harbor town of Wilmington, on San Pedro bay. With over 50,000 residents, a dozen schools, and small and large industry, Wilmington is like a lot of other modest sized towns, except it's in the middle of what oil industry geologists have called the Bloomington Upthrust, said to be the largest reservoir of oil in the lower 48. On a single block, in and among the businesses and residences, Warren Energy and Production are deploying an unusual oil production complex with space for up to 500 wells situated each just six feet apart in two staggered underground rows in nearly invisible underground vaults or "cellars." The only significant surface structure rising above the concrete aprons running along the well rows below is to be a mobile drilling rig designed to move from wellhead to wellhead.

Designed by consulting engineer, Ron Tinkham, of Solano Beach, California and manufactured by Ron Voorhees' Voorhees Rig Company of Houston, Texas, the Wilmington rig will move along the twin parallel rows of wells on AeroGo air casters gliding on a near frictionless film of air. The giant rig is to be propelled by four AeroGo custom-designed traction drive assemblies pinned to the drilling rig's skid structure.

The whole drilling rig assembly is 180 feet high, has a foot print of about 80 x 50 feet, and weighs some 625 tons—greater than the weight of some of the largest steam locomotives ever built.

To mate their air casters to the drilling rig, AeroGo built four special ladder-like frameworks to be installed underneath the rig. Air casters slip into each framework where they are connected by a manifold system allowing air compressor access to the entire system at one end of the rig. The frameworks allow easy insertion of individual air casters so they can be readily reinserted in varying configurations that keep air caster contact with the concrete median or pad whether the rig moves ahead along one row of wells or traverses diagonally to wells in a parallel row.

The huge drill rig, manned by four or five operators, will normally be moved on an average of once every ten days. Drill pipe, as much as 10,000 feet of it, is stored internally in vertical racks within the rig, to avoid the labor of taking it down and storing it and retrieving it from elsewhere each time the rig is moved to another well. Movement of the rig is irregular, dictated by drilling requirements, and controlled by an AeroGo-created computer program that can direct the traction drive units to precisely center the rig as it is moved from wellhead to wellhead. Rig movement is easily controlled with a radio remote pendant much like a remote controlled car or industrial crane as the air casters enable complete mobility in any direction operators and programming dictate.

The AeroGo traction drive assemblies each mount a central drive wheel capable of swiveling and steering the drive unit. A large central hydraulic cylinder provides from 5,000 to 30,000 pounds of downward force on the drive wheel to maintain traction. In the four drive Wilmington application, each drive provides 10,000 pounds of force for a total of 40,000 pounds of force to move the oil rig. A hydraulic steering motor enables each drive to be turned and steered much like driving a car, but with a speed of some 2 mph and exquisite controllability and coordination among the drives for precision rig-to-wellhead positioning.

The sophisticated computer control system coordinating each of the four independent drives enables them to act and be controlled as single unit with simple steering commands, providing perfectly synchronized precision steering and placement of the heavy rig which can now move in any direction as well as rotate around its center. The AeroGo system allows additional drives to be added and connected to the control system to move even larger loads—AeroGo earlier built a six-unit drive system to move a 1,500 ton submarine.

While the air casters under the rig themselves float the giant structure on a cushion of air and are thus subject to minimal wear, the concrete pad over which they move was also machine sanded and sealed for smoothness. Where joints occurred in the concrete, an additional special epoxy sealant insured they wouldn't blow out as the rig was moved over them. In cases where air caster replacement may eventually be required, Tinkham describes the maintenance procedure as an uncomplicated slip-out, slip-in task. "It's really simple to do," he says. "The air caster just slides into a 3.75 inch slot."

Tinkham contrasted the AeroGo air caster drill rig moving system with another method called "clawing" used in a similar underground well array. "The rig would be sitting on big beams with slots in them sunk into concrete. A matching set of beams on the rig would sit on top of them and the rig would actually skid back and forth on those skid beams, pulled by hydraulic cylinders that hook into the holes. They kind of claw their way up and down the beam. With air casters it would be quicker and you don't have to have all that steel in the concrete. It's complicated to get all that steel in the ground and only the air casters with their multidirectional mobility allow us to go from cellar to cellar and even cross over the end without having to have additional steel."

Tinkham was inspired to use AeroGo air casters for the Wilmington rig, by rig builder and petroleum industry veteran, Ron Voorhees, who'd used them years before to meet an unusual challenge in a far different environment. In the oil business since he was 14, Voorhees has traveled the globe from Alaska to Norway to Kuwait and Libya for the last 54 years. It was in frigid Prudhoe Bay where he seized on the idea of using air casters to move a drilling rig. "It was 1970, 71 and 72," he relates. "It was dark. Forty to fifty below zero. We had to have

some kind of track to run it on, something relatively smooth, so we built an ice pond in front of the rig and moved it on air casters on the ice. At that time we were moving the rigs about 240 feet. We also found out when we moved the rig on air casters that you can't dump 14 inches of water and expect it to freeze immediately because the first top two inches freeze and then the rest of it takes several hours.

Voorhees didn't forget the experience when he was commissioned to build the Wilmington rig that would also move on air casters. While it was tailored specifically for the job, it also began life as an Arctic rig that Voorhees bought from Alaska because it was insulated for cold weather, which made it equally usable for deadening sound, perfect for its new urban environment in populous and sunny southern California. No need for ice ramp technology there, but for both Voorhees and Tinkham, AeroGo air casters were still a must for the job.

Further information on AeroGo air casters in petroleum industry and other heavy equipment moving applications is available at www.aerogo.com.

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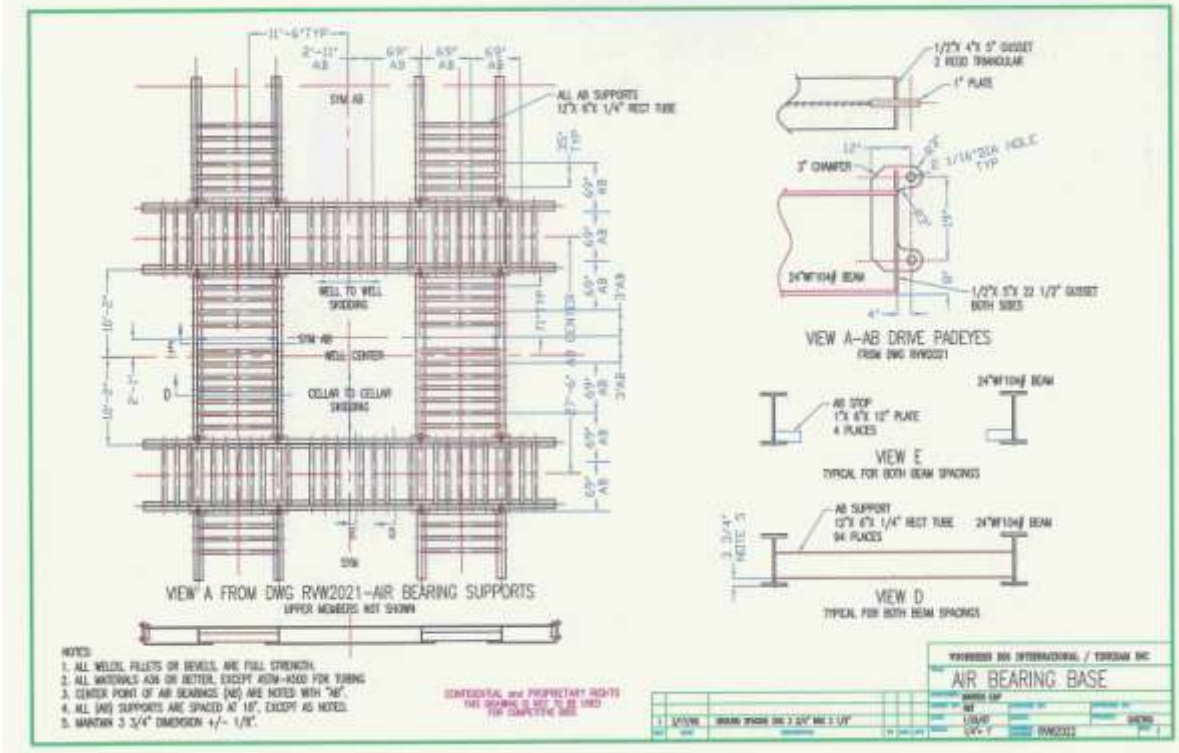
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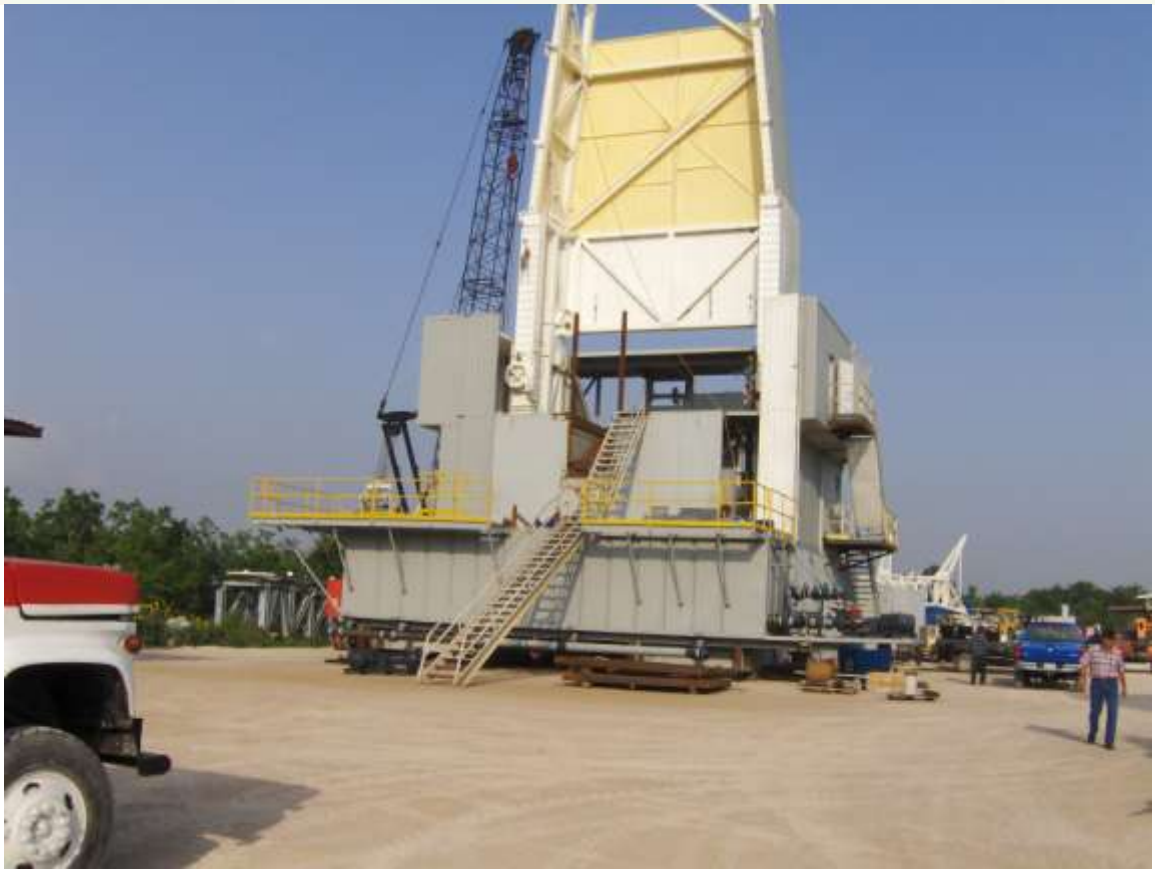
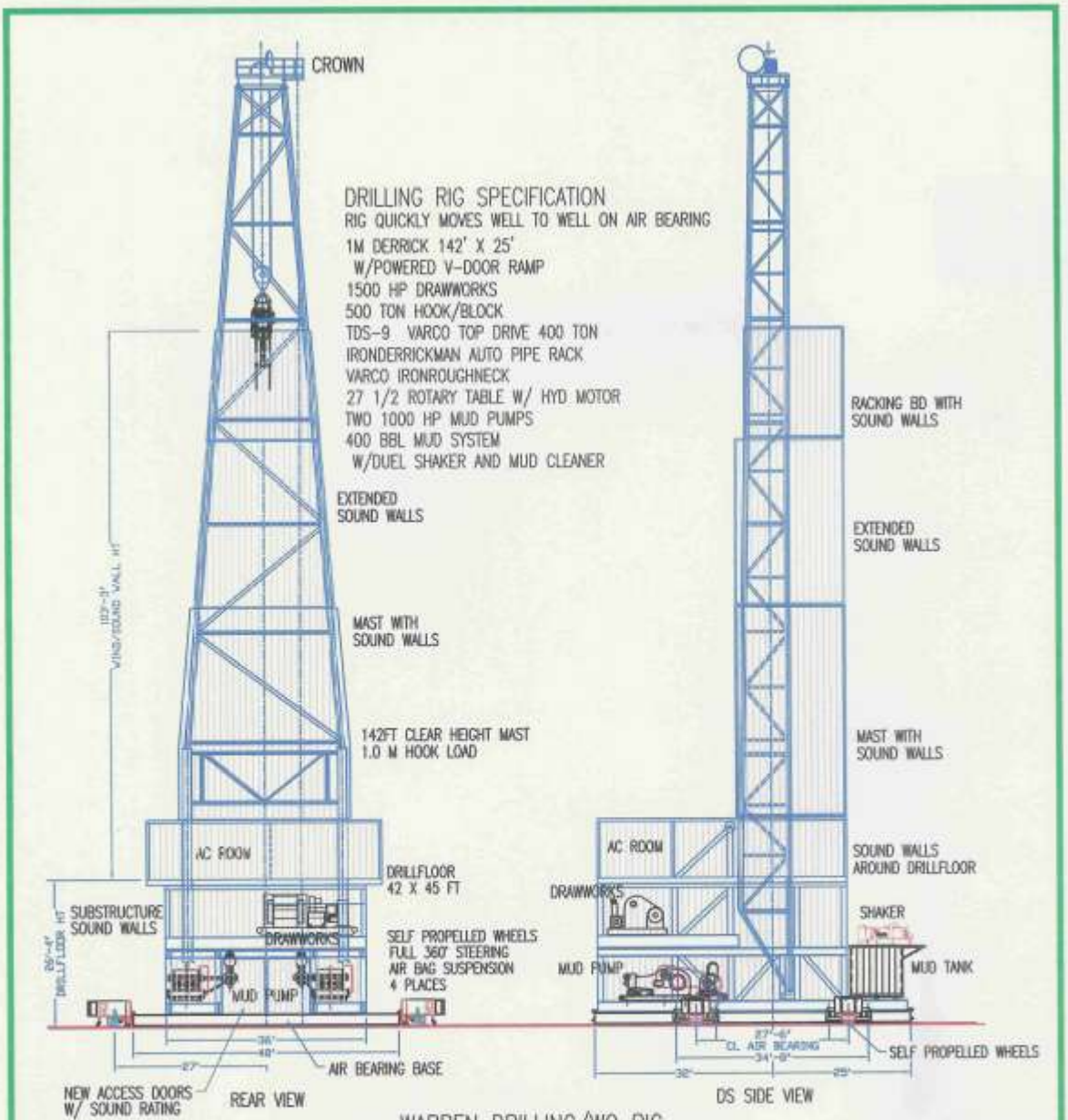
VIEW A-AB DRIVE PADEYES
VIEW E
VIEW D
AIR BEARING BASE





WARREN DRILLING/WO RIG

AIR BEARINGS CARRY THE LOAD – WHEELS PULL/STEER THE RIG

NOTE
1. THE DRILLFLOOR, THE SUBSTRUCTURE & THE RACKING BOARD WALLS WILL HAVE A SOUND RATING OF STC-25 OR BETTER.
2. ANCILLARY EQUIPMENT WITH NOISE POTENTIAL, WILL HAVE SOUND BARRIERS, AS POSSIBLE.

REV	DATE		CHK	APP
3	5/28/08	ADDED RIG SPEC		
2	4/28/08	UPDATED SOUND WALL REQUIREMENTS.		
1	1/16/08	UPDATED WITH LOWER LEVEL REMOVED		

VRI VOORHEES RIG INTERNATIONAL, INC

TITLE: WARREN DRILLING/WO RIG

CUSTOMER:

DRAWN BY:	CHECKED BY:	APPROVED BY:
RBT		
DATE: 12/22/07	QUOTE:	PROJECT:
SCALE: FULL	DRAWING NUMBER: VRW3000	REV: 3