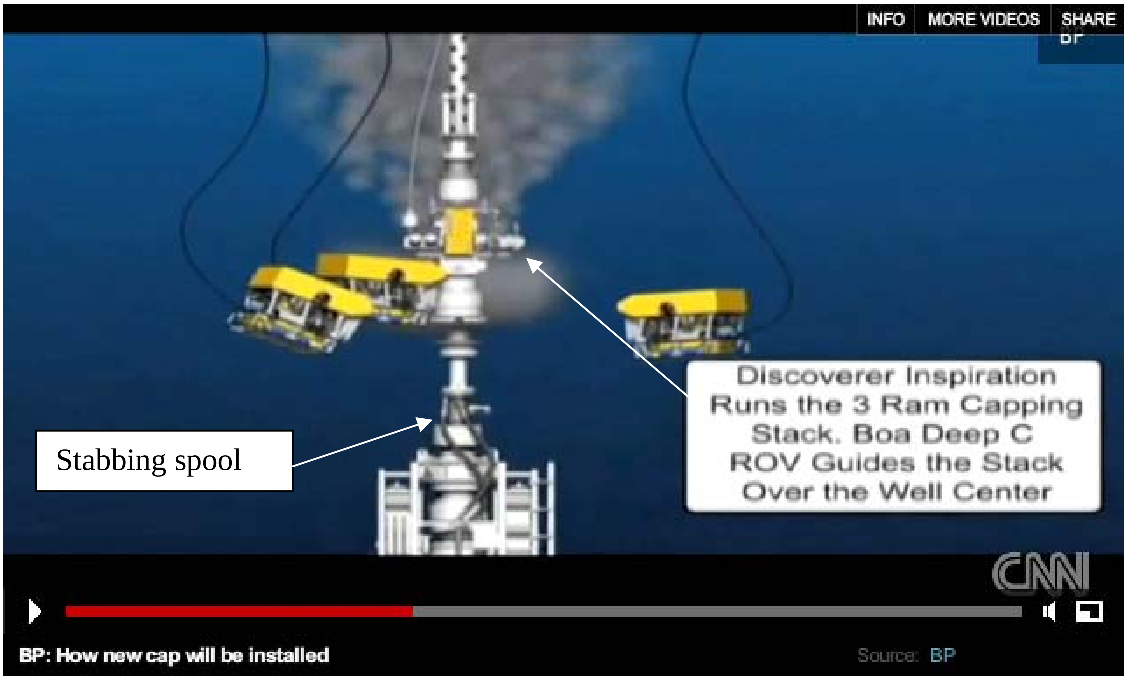
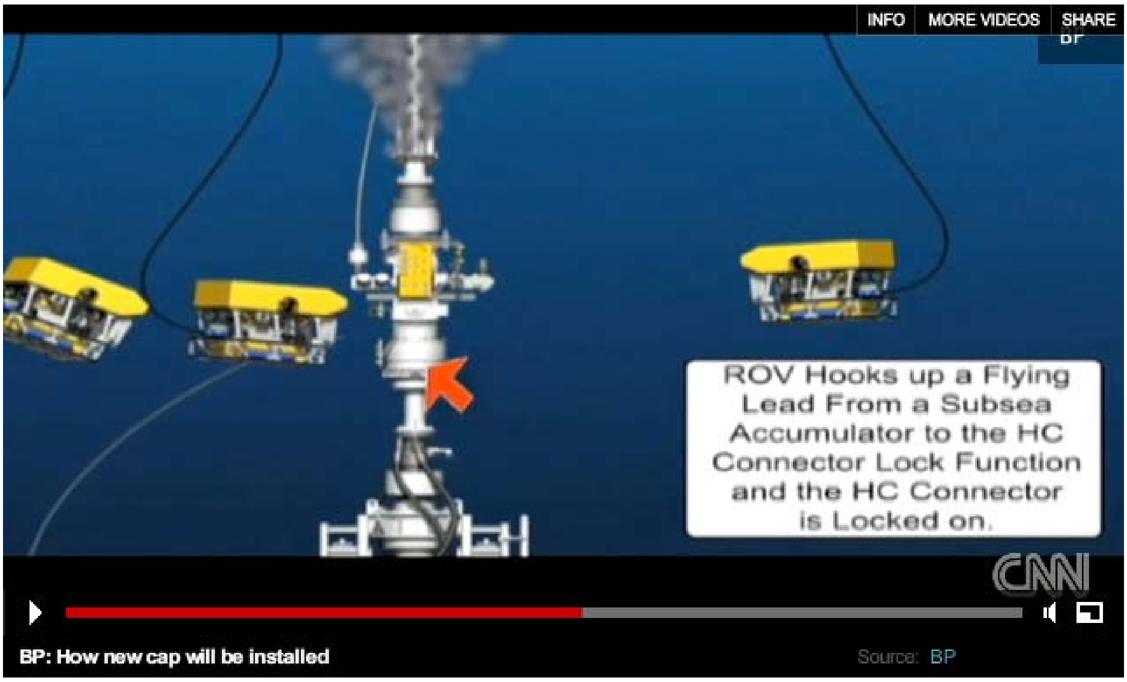
# Use of Copper Beryllium in Stopping the Macondo Well Oil Spill.




After the LMRP cap and the irregular casing pipe projecting from the flexible connection on the top of the BOP, a stabbing spool was installed on the Macando well and bolted in place. This made the top of the well look "normal" so the 3-ram capping stack could be locked onto the spool. The 3-ram capping stack is a stack of valves which can effectively shut of the well if it can be securely attached to the top of the well.

Obviously it is essential that the 3-ram stack be securely attached to the top of the well with no leaks, not only so the oil spill can be contained, but so the well itself can later be permanently “killed” using relief wells.  If the blown out well bore will not hold pressure, then efforts to kill it with mud and cement are not likely to succeed.




In order to attach the 3-ram stack securely to the top of the well at the stb spool, a device called a high-capacity (HC) collet type connector is used . One of the critical attributes of the HC Collet-type Connector shown by orange arrow is that it clamps around the pipe projecting upward from the stab spool, locking the 3-ram capping stack securely onto the pipe carrying all the oil, preventing any leaks.

Following cut-away drwg shows the basic configuration of a Cameron collet-type connector when it is unlocked (right half of schematic) and locked (left half of schematic).

## High Capacity Collet Connector

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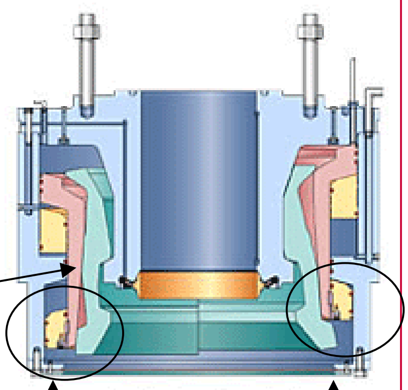
The HC Collet Connector is similar to the popular Model 70 Connector but is designed to provide greater preload to withstand higher separating forces.

**Features:**

Actuated by annular hydraulic cylinder which provides substantially higher clamping preloads than the Model 70. Secondary unlock available. Locks to mating hub via pivoted locking segments/fingers which form a funnel to guide the connector into position. Metal-to-metal sealing AX gasket standard. Greater clamping force due to segment and hub geometry and large actuating piston area.

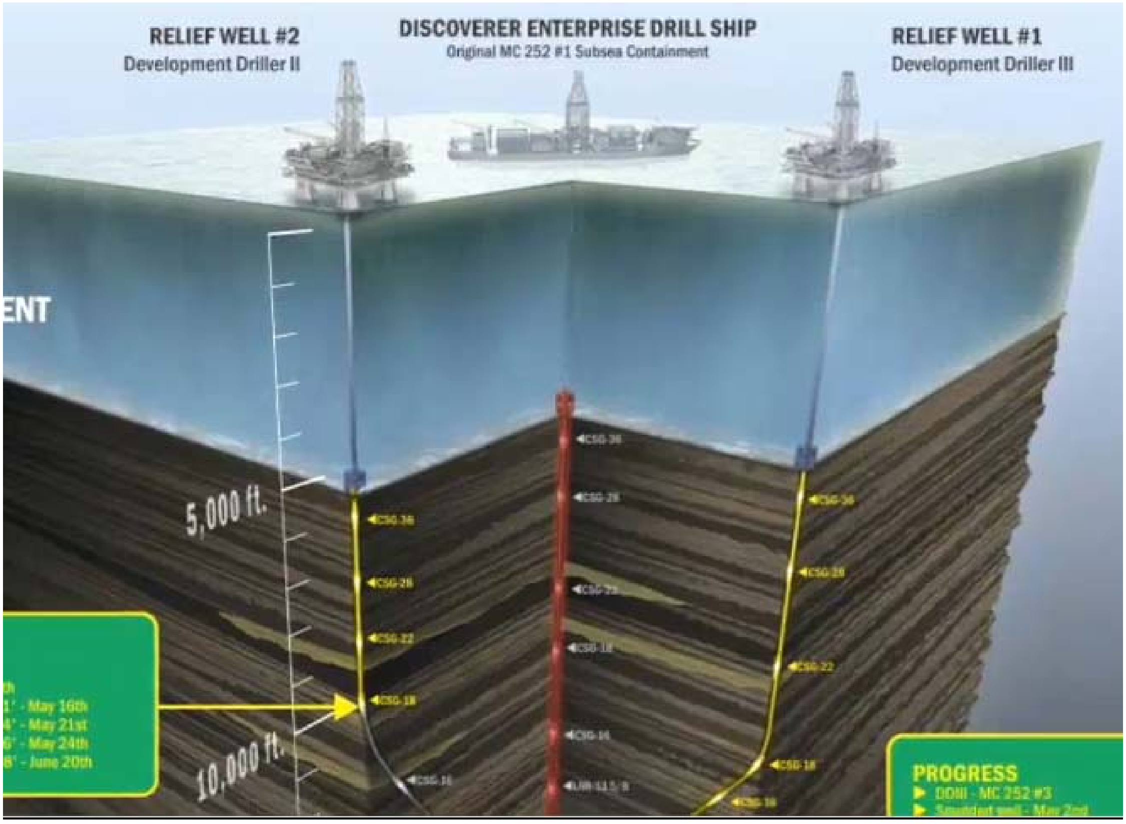


High Capacity (HC) Collet Connector (Locked and Unlocked)

Direction of locking motion

This large diameter forged ring (pink) is made of Alloy 25 Cu-Be 140 ksi yield strength, 6% ductility. It is the only material with sufficient strength, “slippery-ness” to a avoid getting stuck to the other metals it touches when it slides over them, and also has sufficient resilience to deform such a large amount ELASTICALLY so that it will maintain full spring force inward after being deformed clamping the 3-ram capping stack onto the stab pool pipe.

Note how much the locking ring bends when it is moved from unlocked position (right side of dwg) to locked position (left side of dwg.

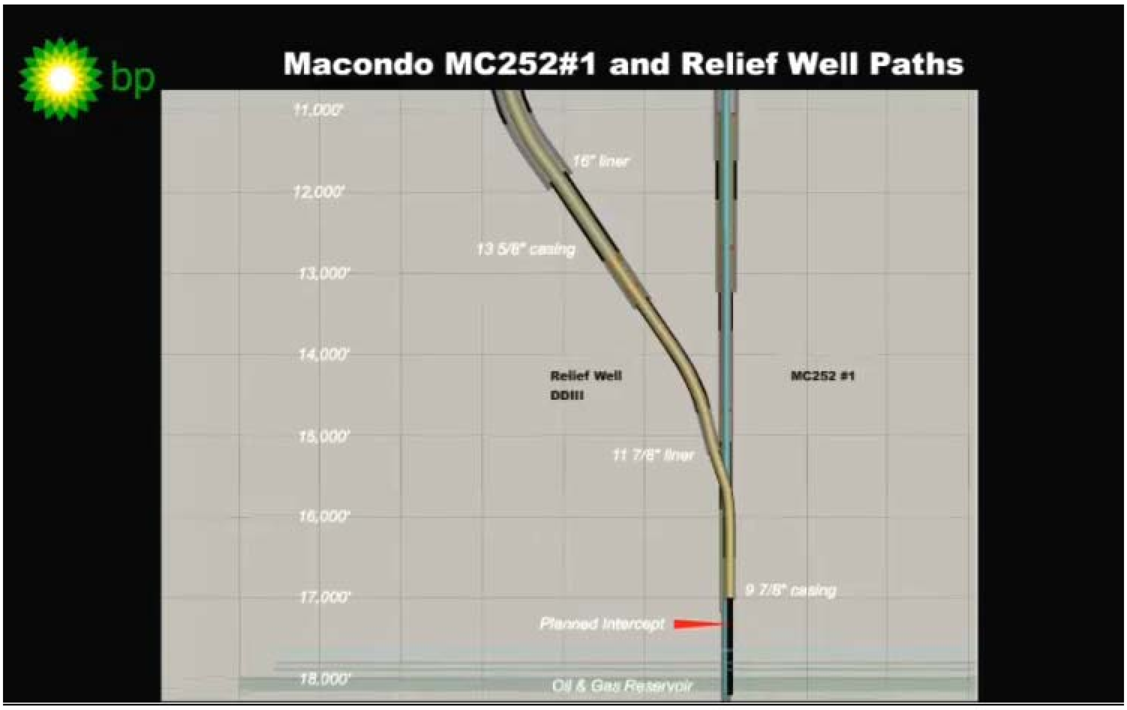



The relief wells which will shut the Macondo well for good obviously have to be directional wells as shown above. Directional drilling depends on our materials which are used inside the bottom sections of the drilling string to house the instruments and their power supplies to determine the location and orientation of the drill bit as well as the formation it is drilling in, send the data in real time to the driller, and operate mechanisms inside the drill string which will steer the drill bit in the proper direction. Materials in the “smart” section of the drill string must be obviously of very high strength and must not create any magnetic or other electrical interference with the signals being transmitted into the formation or collected back as responses from the formation or the earth’s magnetic field. Alloy 25 CuBe is the only material which provides all of these essential properties especially in pieces of equipment which are so large.

The techniques and hardware used to actually locate the blown out well and place the relief well bore precisely in the formation below the sea bed surface are also dependent on Alloy 25 CuBe with strength as high as 180 ksi YS. Vector Magnetics produces a magnetometer tool used for what is known as Magnetic Ranging. When the relief well gets within about 250 ft of the anticipated location of the target well, drilling is suspended and a special instrument is lowered into the relief well. This tool "looks" for the target well. Basically a high powered electrical current is "broadcast" from the tool. When it finally makes contact with the target well bore steel pipe, the electrical field induces a magnetic field which is "broadcast" back by the target steel pipe. An instrument inside the magnetic ranging tool detects this magnetic field which allows precise determination of the relative locations and orientations of the two well bores (the relief well and the target well.) The relief well drilling commences again, the relief well being brought closer to the target. Drilling stops and the magnetic ranging tool is used again. This process is repeated until the relief well gets very close to the target well.

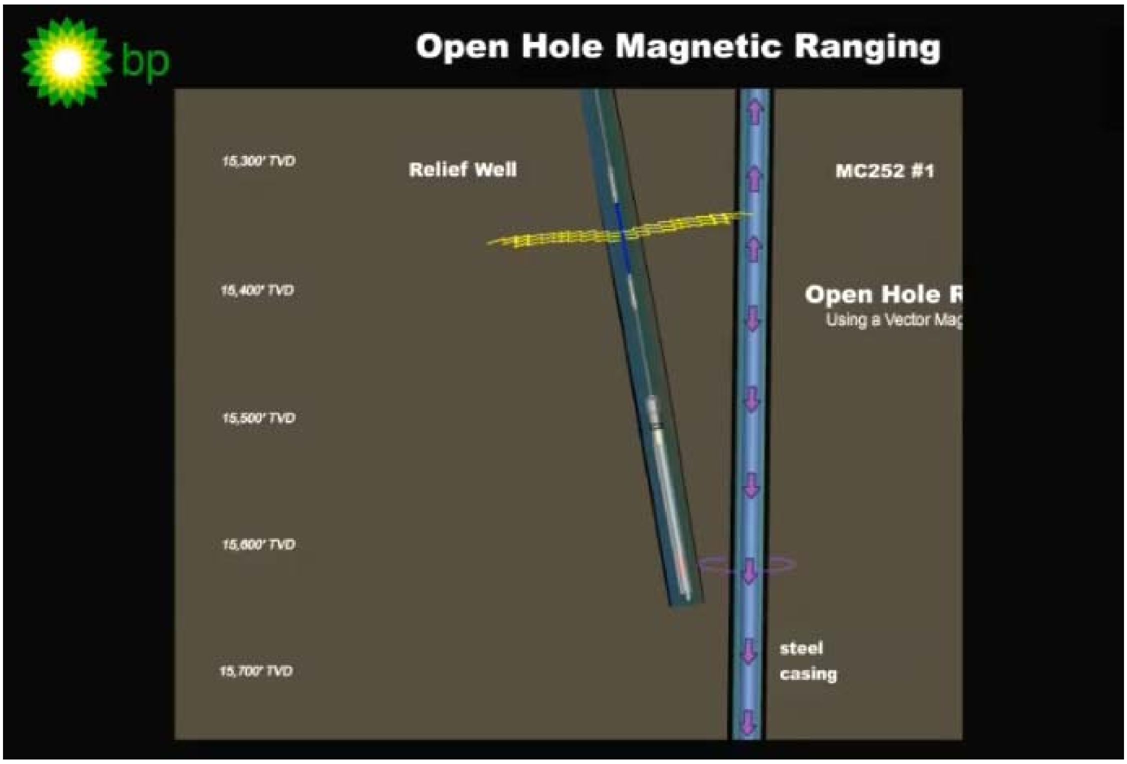
See the progressive steps in photos that follow.

Once the relief well gets very close to the target well, the ranging tool is actually encased inside the drilling tool so that ranging and drilling may be done simultaneously. In addition, other instruments inside the lower sections of the drill string are also operated to allow directional drilling as discussed previously. Again, none of these operations would be possible without Alloy 25 Cu-Be which must be of very high strength and flexibility AND (obviously) non-magnetic or "transparent to magnetic fields."

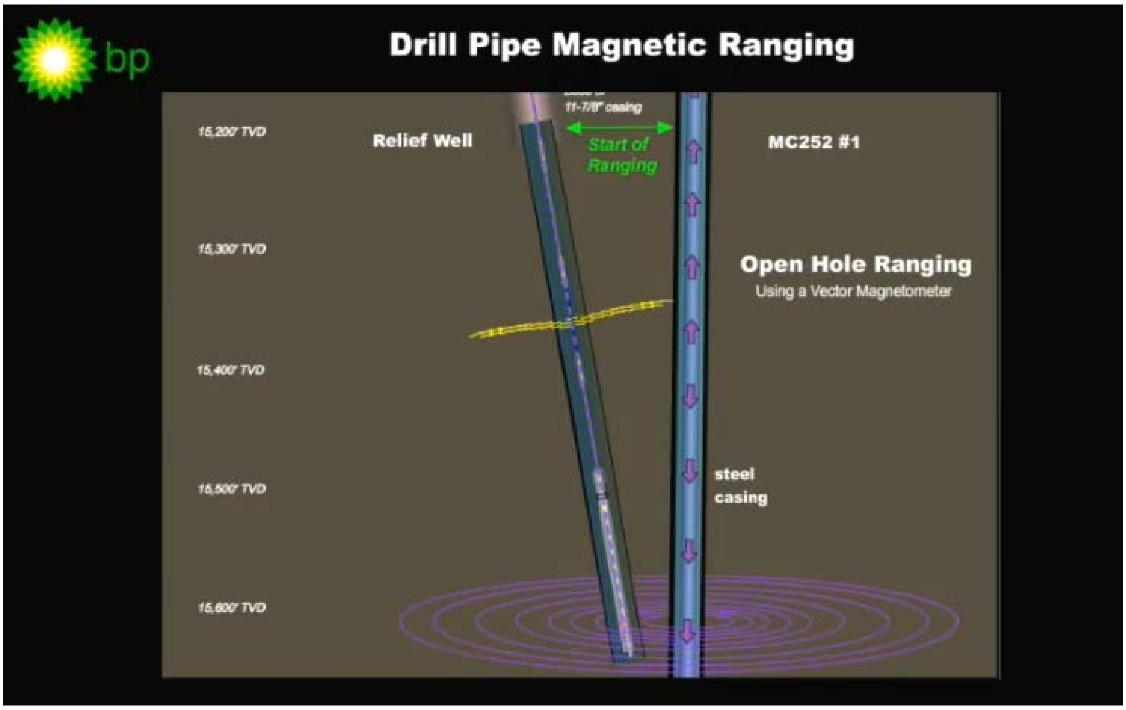


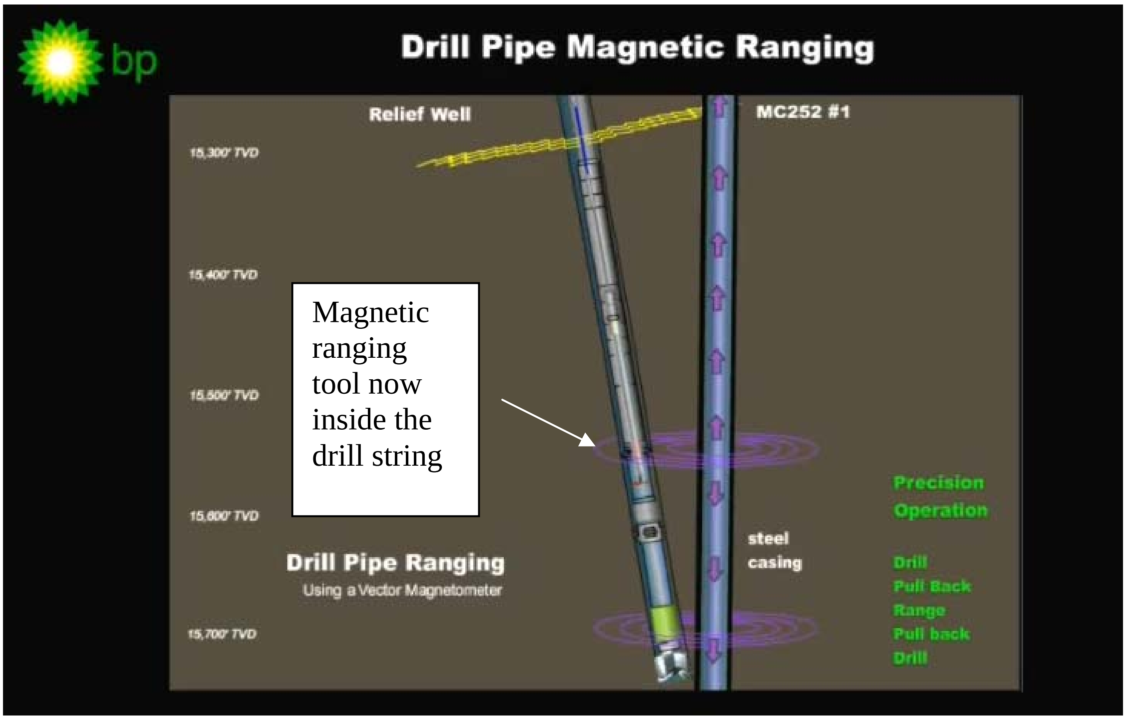


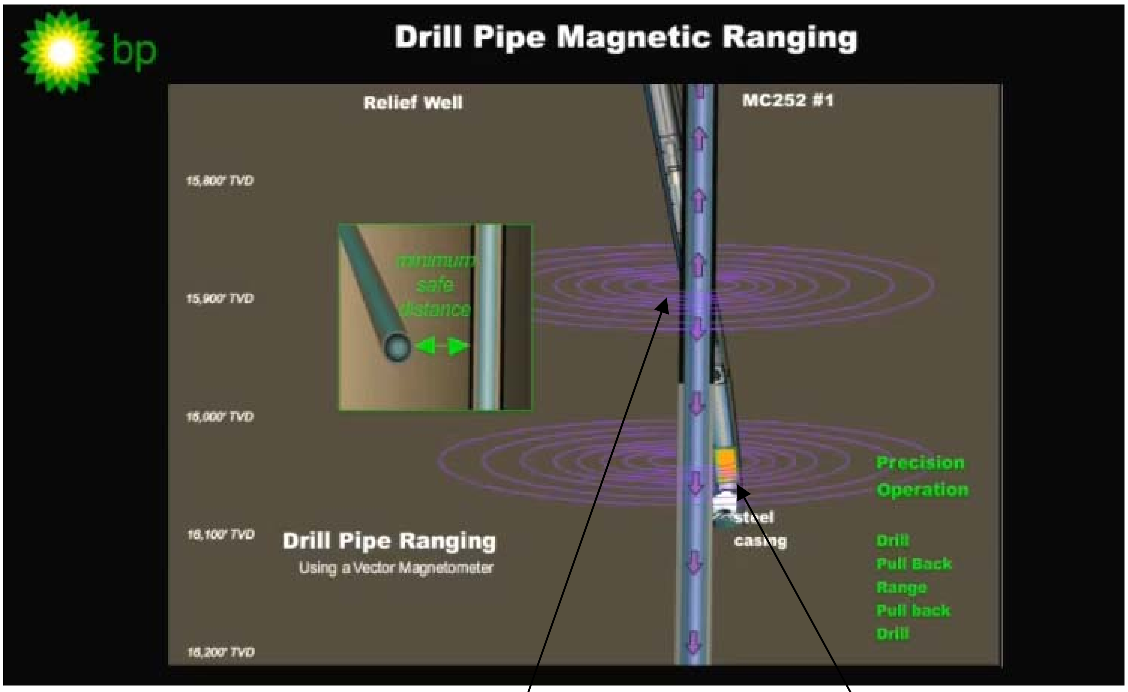
The electrical inductor, magnetic detector and instruments of the ranging tool are all encased in Alloy 25 Cu-Be.



Open Hole Magnetic Ranging
15,300' TVD
15,400' TVD
15,500' TVD
15,600' TVD
15,700' TVD
Relief Well
MC252 #1
Open Hole R
Using a Vector Mag
steel
casing


bp
Drill Pipe Magnetic Ranging
15,200' TVD
Relief Well
11-7/8" casing
Start of Ranging
MC252 #1
15,300' TVD
Open Hole Ranging
Using a Vector Magnetometer
15,400' TVD
15,500' TVD
steel casing
15,600' TVD


bp
Drill Pipe Magnetic Ranging
Relief Well
MC252 #1
15,300' TVD
15,400' TVD
Magnetic ranging tool now inside the drill string
15,500' TVD
Precision Operation
15,600' TVD
steel casing
Drill Pipe Ranging
Using a Vector Magnetometer
Drill
Pull Back
Range
Pull back
Drill
15,700' TVD




Magnetic ranging and directional drilling combine to make a precise intersection of the two well bores.

The electromagnetic ranging tool is run on wireline and consists of a sensor to measure the magnetic field and an electrode that injects current into the surrounding formations. If the current is picked up on the target well casing/drillstring, it creates a magnetic field that can be measured using the ranging-tool sensor. The sensor data indicate the direction and distance to the target well (Kuckes et al, 1984).The amount of current that will be picked up on the target casing/drillstring, and consequently the signal strength measured on the sensors, depends on many factors, such as distance to the target well, formation type and mud properties.