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Expert Testimony - Geology and Reservoir Engineering at Trial and Administrative Hearings

Ed R. Norwood

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EXPERT TESTIMONY -
GEODESY AND RESERVOIR
ENGINEERING AT TRIAL AND
ADMINISTRATIVE HEARINGS

Ed R. Norwood
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AT TRIAL AND ADMINISTRATIVE HEARINGS

Arkansas Bar Association
40th Annual Natural Resources Law Institute
February 21-24, 2001

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Houston - Midland, Texas
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I. SCOPE OF THE ARTICLE

This article will present certain basic principles of petroleum geology and reservoir engineering used to determine the location, size, distribution, and value of hydrocarbon reservoirs. These determinations are critical to the resolution of many implied covenant cases and administrative hearings. The article will also consider the admissibility at trial of expert testimony as to issues of petroleum geology and engineering.

II. BASIC PRINCIPLES OF PETROLEUM GEOLOGY

Geology is the science dealing with the history of the earth and its life forms—especially as that history is recorded in rocks. Petroleum geology is the use of the principles of geology in the search for, and development of, oil and gas accumulations.

A. Origin of the Earth and its Early History

The earth is thought to have formed from the coalescence of a nebula of cosmic dust; the earth is approximately 5.5 billion years old. It is comprised of an extremely hot and dense iron inner core approximately 800 miles in radius, a dense molten outer core approximately 1,370 miles thick, a mantle of less dense solid material approximately 1,800 miles thick, and a rocky solid thin crust at its surface, approximately 30 miles thick in mountainous regions to 5 miles thick on the sea beds.

The intense heat of the earth in its very early life probably drove off its free water and atmosphere. The earth’s present hydrosphere and atmosphere were generated by later volcanic action. As the earth cooled, it shrunk causing the crust to fold and buckle. The earth’s first rocks were all igneous; they were formed by the solidification of molten magma.

These igneous rocks were then eroded by the action of the wind and water in the atmosphere and hydrosphere. The sediments generated by the erosion were then transported by the wind and
B. Deposition of Sediments

As the earth's igneous rocks were weathered and eroded, the eroded sediments were transported and deposited in sedimentary basins called geocynclines. The original sediments, particles resulting from this weathering and erosion, were all derived from igneous rocks. Each bed of sediments, or strata, was then overlain by yet other beds of sediments; such that, the first beds deposited, i.e., the deepest beds, were compacted by the pressure of the overlying beds to become sedimentary rocks—such as shale, sandstone, and limestone. These sedimentary rocks, in turn, were uplifted, and then eroded, producing yet more sediments which were deposited in sedimentary basins thereby continuing the cycle of erosion and sedimentation.

Some sedimentary rocks in the lowest reaches of the sedimentary basins were subjected to tremendous pressure and heat and were transformed into metamorphic rocks. Often these metamorphic rocks were further subjected to sufficient heat to transform them into magma, which upon cooling formed igneous rocks.

These igneous rocks, when and if lifted to the surface, were then eroded and new sediments were formed and deposited thereby completing the "rock cycle." This rock cycle has been repeated countless times during the history of the earth.

Contrary to popular belief, there are no "rivers of oil" flowing underground. Oil and gas are found in the tiny spaces between grains of sandstone, in tiny pores in limestone, or in tiny fractures or crevices. Virtually all commercial accumulations of oil and gas occur in sedimentary rocks; those that occur in metamorphic, or igneous, rocks are thought to have migrated there from sedimentary rocks. Consequently, the study of sedimentary rocks and the process of sedimentation is very important in petroleum geology.
gas. These marine plants died and settled to the ocean, or lake, floor and were then entombed in the sediments of the ocean bed and preserved from decomposition. As a result of biochemical activity on this organic residue, and the heat and pressure generated by the later deposited overlying sediments, in time, petroleum was formed. It is the majority view that shales often form the source rocks in which petroleum was generated and from which petroleum migrated into the more porous and permeable reservoir rocks such as sandstone and limestone.

B. Reservoir Rocks

The reservoir rock of a commercial accumulation of petroleum must be *porous* and *permeable*. Sandstones and carbonates (principally limestones and dolomites) are, by far, the most common type of reservoir rocks. One study estimates that, of the world’s largest oil and gas fields, 59% of the production of petroleum is from “sandstones” and 40% of the production of petroleum is from “carbonates.”

1. **Porosity of the Reservoir Rock**

The reservoir rock must contain sufficient void space—pores—to hold large volumes of petroleum. The *porosity* of a reservoir is stated as the percent of the rock’s total volume that is comprised of pore space. The symbol for porosity is the Greek letter phi (Φ). Sandstone reservoir rocks have a porosity generally ranging from 5% to 35%. Figure 2 is a schematic of a cross section of a sandstone.

2. **Permeability of the Reservoir Rock**

In addition to porosity, the reservoir rock must be permeable, *i.e.*, the pore spaces must be connected; such that, fluid can flow through the pore spaces of the reservoir rock to the wellbore. The permeability of a reservoir rock is its ability to conduct fluid and is similar in concept to the term “electrical conductivity.” The unit of measurement of a reservoir rock’s permeability is the “darcy”
C. **Movement of the Earth’s Crust**

The earth’s crust is, and has been, subjected to many complex forces that have caused the earth’s crust to move up, down, and horizontally. This movement has caused the folding and faulting of sedimentary beds and the lifting of mountains. The earth’s crust is comprised of separate plates, which move relative to one another. The separation of plates created oceans and is creating new sea floor area. The collision of plates lifts the earth’s crust forming mountains, causes volcanic action, and creates oceanic trenches, and, in general, reduces the area of the earth’s crust. At depth, as a result of the heat and the pressure, the earth’s crust is rendered capable of plastic flow. The plates, therefore, float on the more dense plastic rocks below and move over geologic time. The earth’s crust is, therefore, a dynamic system, and the study of the present geologic processes acting on the earth is the key to understanding the past.

III. **ACCUMULATION OF HYDROCARBONS**

Commercial accumulations of hydrocarbons require a porous and permeable strata ("reservoir rock"), a source of oil and gas to enter the reservoir rock, and a trap that prevents the further migration of the oil and gas from the reservoir rock. Traps are either formed by structural, or stratigraphic, features or a combination of both.

A reservoir is that portion of a trap which contains hydrocarbons as a single hydraulically-connected system. Often, hydrocarbon reservoirs are hydraulically connected to water bearing portions of the reservoir rock called aquifers. In large sedimentary basins, several reservoirs may be hydraulically connected to a common aquifer.

A. **Source of Hydrocarbons**

The origin of petroleum is subject to much debate. The most widely accepted view is that marine microscopic plant and animal residue are the probable source for most of the world’s oil and
water and deposited in the earth’s valleys, lakes, and oceans.

The first life on earth did not appear for hundreds of millions of years. The first simple plants and animals, invertebrates, appeared in the very late Precambrian era, or early Cambrian period, approximately 620 million years ago. By the early Paleozoic era, at approximately 550 million years ago, marine life, except vertebrates, was abundant. For point of reference, prehistoric man first appeared only 2 million years ago. The evolution of life since the Precambrian era can be traced by the fossil remains of the life found in the successive strata of rock deposited on the earth’s crust. Radioactive dating of minerals, and carbon dating of organic matter, has enabled geologists to approximate the duration, in years, of the various geologic eras. Figure 1 is a geologic time chart.

Figure 1

Geologic Time Chart

<table>
<thead>
<tr>
<th>Era</th>
<th>Period</th>
<th>Epoch</th>
<th>Duration (millions of years)</th>
<th>Dates (millions of years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cenozoic</td>
<td>Quaternary</td>
<td>Recent</td>
<td>0.01</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pleistocene</td>
<td>1</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>Tertiary</td>
<td>Pliocene</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Miocene</td>
<td>14</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Oligocene</td>
<td>15</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Eocene</td>
<td>20</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Paleocene</td>
<td>10</td>
<td>70 ± 2</td>
</tr>
<tr>
<td>Mesozoic</td>
<td>Cretaceous</td>
<td></td>
<td>65</td>
<td>135 ± 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jurassic</td>
<td>30</td>
<td>165 ± 10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Triassic</td>
<td>35</td>
<td>200 ± 20</td>
</tr>
<tr>
<td>Paleozoic</td>
<td>Permian</td>
<td></td>
<td>35</td>
<td>235 ± 30</td>
</tr>
<tr>
<td></td>
<td>Pennsylvanian</td>
<td></td>
<td>30</td>
<td>265 ± 35</td>
</tr>
<tr>
<td></td>
<td>Mississippian</td>
<td></td>
<td>35</td>
<td>300 ± 40</td>
</tr>
<tr>
<td></td>
<td>Devonian</td>
<td></td>
<td>50</td>
<td>350 ± 40</td>
</tr>
<tr>
<td></td>
<td>Silurian</td>
<td></td>
<td>40</td>
<td>380 ± 40</td>
</tr>
<tr>
<td></td>
<td>Ordovician</td>
<td></td>
<td>70</td>
<td>460 ± 40</td>
</tr>
<tr>
<td></td>
<td>Cambrian</td>
<td></td>
<td>90</td>
<td>550 ± 60</td>
</tr>
<tr>
<td>Precambrian</td>
<td></td>
<td></td>
<td>4,500 ± 1</td>
<td></td>
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fluid is petroleum or salt water. If the reservoir fluid is salt water, the zone will have a low resistivity and high conductivity since salt water is an excellent electrolyte. If the reservoir fluid is oil, or gas, the zone will have a high resistivity and low conductivity, because oil and gas are poor conductors. The resistivity curve is deflected to the right as the resistivity of the strata increases.

For many sandstone reservoirs, with the data from the I.E.S. log, Archie’s Equation, assuming a cementation factor of 2, may be solved to calculate the porosity and water saturation of the reservoir rock. Archie’s Equation, under the aforesaid assumptions, is shown in Figure 4.

Figure 4

Archie’s Equation

\[ \Phi = \sqrt[3]{\frac{R_w}{R_o}} \]

\[ S_w = \sqrt[3]{\frac{R_o}{R_t}} \]

Where:
- \( \Phi \) = Porosity of formation
- \( S_w \) = Water saturation of formation
- \( R_o \) = Resistivity of formation at 100% water saturation
- \( R_w \) = Resistivity of formation water calculated from I.E.S. log or actual water analysis
- \( R_t \) = Resistivity of formation under analysis read from I.E.S. Log

C. Core Analysis

Often, an operator will cut a full core through a zone by replacing the drill bit with a core barrel, which full core is called a “conventional core.” The core barrel is basically a hollow tube with cutting edges on the bottom rim of the tube. This coring technique is slower than drilling with a rock bit and is, therefore, expensive. If the geologist is fortunate enough to have a conventional core of a zone, he can determine the porosity and the permeability by laboratory testing of the core, measure the dip of the reservoir bed, measure the reservoir fluid properties, and possibly determine the depositional environment of the zone.

When circumstances will not justify conventional cores, operators generally take “side wall”
from the permeable sands and to compare and to correlate zones encountered in different wells. In the late 1920s, the S.P. log was invented by the Schlumberger brothers of France. It was the first well log to come into widespread use in the industry, and its almost immediate popularity and success helped launch the Schlumberger well logging international conglomerate.

b. Resistivity Logs

The right most curves on the I.E.S. log measure the resistivity and conductivity of the rock strata found in the wellbore. The purpose of this measurement is to determine whether the reservoir
increase the reservoir's permeability in the immediate vicinity of the wellbore. thereby, increasing the well's capacity to produce oil and gas.

3. The Science of Petrophysics

Petrophysics is the study of the porosity, the permeability, and the fluid saturations of the reservoir rock, under static and flowing reservoir fluid conditions. The engineer relies on many tools to evaluate the reservoir rock and its fluid properties, including mud logging records, core analysis (full core and side wall cores), well logs, including electrical logs, nuclear logs, sonic logs, thermal logs, and laboratory testing of reservoir fluid samples. Generally, the geologist qualitatively analyzes well logs in connection with his mapping; whereas, the petrophysical engineer quantitatively analyzes the well logs and core data to calculate the reservoir rock's average porosity, water saturation, and permeability. Reservoir fluid samples are also analyzed in the laboratory at reservoir temperatures and pressures to quantify the properties of the reservoir fluids.

A standard well log run on the Texas Gulf Coast is called the Induction Electric Survey (I.E.S.). To run this log, the I.E.S. tool is lowered on an insulated wire line to the bottom of the bore, and the bore hole is logged as the tool is pulled out of the hole. The log impulses are recorded in the logging truck, and the graphic display of these impulses is called the well log. Figure 3 shows an I.E.S. log.

a. Spontaneous Potential Log

The left most curve of the I.E.S. log is the spontaneous potential log (S.P. log); it measures the spontaneous potential (natural current flow) generated in the wellbore adjacent to each bed encountered in the wellbore. The deflections to the left on the S.P. log indicate that the rock at that measured depth is relatively permeable and porous. The S.P. log does not quantitatively measure the permeability, or porosity, of a zone. The S.P. log is used to differentiate impermeable shales
named in honor of the French scientist Henry Darcy’s Law of the flow of water through sand filter beds.

Figure 2
Cross Section of a Sandstone

The symbol for permeability is the letter “k.” The permeability of commercial reservoir rocks varies from 1/1000th of a darcy, called a millidarcy, to several darcies. The rocks which comprise a reservoir are rarely, if ever, homogeneous. There is an almost imperceptible variation in the reservoir rock’s mineral content, clay content, grain size, sorting of the grains, angularity or roundness of the grains, and distribution of the porous and permeable part of the total section within the gross reservoir interval. These variations cause the reservoir rock to be heterogeneous, and its rock properties to vary substantially throughout the reservoir.

Often wells completed in tight low permeability reservoirs are hydraulically “fractured” to
b. **Fault Traps**

A fault is a rock fracture that results in the displacement of the strata on the two sides of the fracture. In a fault trap, non-permeable rock on one side of the fault is adjacent to porous and permeable rock, containing hydrocarbons, on the opposite side of the fault. Figure 7 shows a fault trap.

Faults are created by the shearing forces set up in the earth’s crust possibly by gravitational loading due to sedimentation, continental drift, or salt, or other diapiric, intrusion or movement of basement rocks. The fault plane is often a complex fracture surface—not a smooth flat plane surface. The “throw” of a fault is the vertical displacement of the fault blocks. The fault “dip” is the angle the fault makes with the horizontal. Fault dip varies from almost horizontal in some thrust faults to
d. **Nuclear Logs**

There are several nuclear logs used in the oil industry, including the gamma ray log (used to determine lithology); neutron—density log (used to determine porosity); neutron—gamma log (used to differentiate water zones from hydrocarbon zones); and neutron—lifetime log (used to determine the presence of hydrocarbons). The nuclear logs can be run in the cased hole.

Certain logs are more reliable and accurate in certain circumstances; the petrophysicist must review all the available logs, cores, and other data on the formation to properly evaluate that formation. It necessarily involves the experience, judgment, and interpretive skills of the engineer.

C. **Traps**

Traps block the further migration of hydrocarbons in the reservoir rock; such that, commercial quantities of petroleum are accumulated in the trap. Traps are structural or stratigraphic or some combination of both.

1. **Structural Traps**

Most of the world’s largest petroleum accumulations are found in structural traps. Structural traps are created by uplifting, folding, or faulting of the reservoir rock. Common structural traps are anticlines, fault traps, and structural traps created by the intrusion of salt domes into overlying sedimentary beds.

a. **Anticline**

An anticline is an arch of stratified rock in which the strata bends downward in opposite directions from the crest. Many of the world’s great fields are located on anticlinal structures, which structures account for approximately 75% of the world’s oil and gas fields. Figure 6 depicts an anticline.
almost vertical in some normal or lateral faulting.

Figure 7
Fault Trap

Faults may extend to the surface but, as they relate to petroleum reservoirs, are generally "deep seated." A very simple classification of faults is the normal fault, reverse fault, thrust fault, and lateral fault. Movement is up or down in normal and reverse faults and mainly horizontal in thrust and lateral faults. A combination of horizontal and vertical movement is possible in all faults.

c. Salt Domes

Salt domes form the trapping mechanism for some of the important early oil fields discovered
core samples in zones of interest. By this method, during the normal logging of the well, the well logging contractor lowers a core gun into the hole. The gun is positioned next to the zone of interest, and, upon electric signal, the gun fires; explosive charges propel hollow metal bullets into the side of the wellbore. Each bullet remains connected to the core gun by way of a metal spring attached to the gun and the base of each bullet. The core gun, and the spent bullets containing the core sample, are then pulled from the hole. From these rather small “side wall” cores, the geologist can determine the lithology, porosity, permeability and fluid content of the zone and whether the core has any “oil or gas shows.” Side wall core samples are most commonly taken in areas, such as the Gulf Coast, where the rocks are relatively young and are generally loosely consolidated.

These side wall cores are, unfortunately, subject to fracture and contamination upon recovery at the surface. But, in all, they generally furnish reliable and important data—especially when used in conjunction with the analysis of drill cuttings and other well logs. Figure 5 shows a side wall core analysis report for the depths 10,908 through 12,064 feet.

Figure 5

Side Wall Core Analysis Report
IV. RESERVOIR FLUIDS

The pore spaces of the reservoir rock are filled with fluids, either in the vaporous (gaseous) phase, or the liquid phase, or commonly both phases. The reservoir fluids in petroleum reservoirs are water, oil, and gas. These fluids are under pressure in the reservoir. A fluid is a substance, liquid, or gas, that will flow or conform to the outline of its container. The phase of the reservoir fluid—either a liquid, gas, or a mixture of both—depends upon the temperature and pressure of the fluid in the reservoir. The phase (state) of the fluid in the reservoir generally changes with production as a result of the decrease in reservoir pressure; the reservoir temperature remains
on the Texas and Louisiana Gulf Coast—Spindletop, Sour Lake, Humble, West Columbia, Mont Belvieu, and Jennings—to name but a few. Salt domes are the result of the plastic flow of salt beds at great depths under pressure and temperature into the heavier overlying sediments. In essence, the less dense salt, was rendered capable of plastic flow by overburden pressure and high temperature, and rose through the heavier overburden sediments. In some domes, the salt rises to within 80-150 feet of the surface; these domes are called “piercement domes.” The intrusion of the salt, in pillar like fashion, lifts the overlying sediments creating anticlines and causing faulting thereby creating structural traps. Other salt domes come only to within several thousand feet of the surface; these are called “deep seated” domes. Several of the giant Middle Eastern oil fields are domal in structure and are thought to be the result of deep seated salt intrusion. Figure 8 depicts the salt dome structure of the Spindletop Field, Jefferson County, Texas.

Figure 8
Salt Dome Structure
2. **Stratigraphic Traps**

Stratigraphic traps are traps caused by varying permeability. The migration of oil or gas may be stopped, or trapped, in the reservoir rock just as effectively by an adjacent low permeability rock as it can by one of the structures discussed in the preceding paragraphs. Examples of stratigraphic traps are reefs, lenticular sands, and truncated reservoir rocks beneath an unconformity. Stratigraphic traps are more difficult to find, because they generally do not give any surface indication of their presence. Stratigraphic traps include the East Texas Field, many of the West Texas fields, and many of the great Middle Eastern fields.

a. **Reefs**

The sea life of ancient seas created porous and permeable reef structures, which reefs were later overlain by impervious sediments, creating a reef trap. Figure 9 is a schematic of reef structures.

![Figure 9](image)

**Figure 9**

Idealized Cross Section Showing a Series of Reefs
b. **Lenticular Sands**

As the result of changes in the sediments available for deposition, sands were deposited over limited areas, followed by the deposition of clays, or fine silts. These sands were then overlain by other impervious rock to form lenticular sand traps. Figure 10 is a schematic of a lenticular sand.

**Figure 10**

Lenticular Sand

![Figure 10: Lenticular Sand Diagram](image)


c. **Unconformity**

An unconformity results when sediments are folded and raised, and the sediments, including the reservoir rock, are eroded. The eroded surface is then sealed by the later deposition of impermeable sediments. Many large accumulations of petroleum have been found in this type trap, including the East Texas Field. Most of these accumulations are located beneath beds of shale, dense limestone, or chalk, that were deposited on the eroded and truncated reservoir bed during a subsequent submergence of the truncated reservoir bed. Figure 11 is a schematic of an
substantially constant during production.

The properties of the oil or gas observed on the surface are vastly different from those of the same oil and gas at reservoir conditions. In an oil reservoir, some or all of the gas associated with that accumulation is forced into solution in the oil, much as carbon dioxide under pressure is forced into solution in a Coke or other soft drink. A barrel of oil at reservoir conditions (high temperature and pressure) contains a significant volume of gas in solution. A barrel of oil, at reservoir conditions, when produced actually shrinks in volume as its pressure and temperature are reduced to stock tank conditions and the solution gas thereby evolves from the crude oil. Reservoir engineers quantify this phenomenon by the use of the term "Oil Formation Volume Factor" or "Bo." The Oil Formation Volume Factor is the volume that one stock tank barrel of oil, at atmospheric conditions of temperature and pressure, would occupy at reservoir conditions of temperature and pressure with its entrained gas. The Oil Formation Volume Factor is, therefore, always a number greater than one and ranges in value from one in shallow, low pressure reservoirs to two, or more, in deep, high-pressure reservoirs.

The gases in the gas cap of an oil reservoir, or the gases in a gas reservoir, are greatly compressed at reservoir conditions of high pressure and temperature; such that, their volume at reservoir conditions is much smaller than their volume at the surface at atmospheric pressure and temperature. Reservoir engineers quantify this phenomenon by use of the term "Gas Formation Volume Factor" or "Bg." The equation for the Gas Formation Volume Factor,Bg, is as follows:

\[ B_g = 0.00504 \frac{ZT}{p} \text{Reservoir Barrels/Standard Cubic Foot} \]

Where:
- \( Z \) = gas compressibility factor for non ideal gases at reservoir conditions
- \( T \) = temperature in degrees Rankin at reservoir conditions
- \( p \) = pressure in p.s.i.a. at reservoir conditions

\( B_g \) is always a number less than one. At a reservoir pressure of 5,000 p.s.i.a. and 300° F, the
associated reservoir.

D. Reservoir Fluid Distribution

Gravity segregates the reservoir fluids in the reservoir—gas over oil, and oil over water. The oil/water contact, or gas/water contact, in a gas reservoir is a limiting feature of the petroleum accumulation. The location of this boundary by the geologist, or reservoir engineer, is very important, because a well drilled and completed at a depth below the oil/water contact will be water productive, or wet. Unfortunately, many times the oil/water contact can only be established by drilling “step out” wells. The oil/water contact is not a geometric plane through the reservoir; it is actually a transition zone from all water, to part oil and water, to all oil and connate water. The location of the oil/gas contact is also important since a well drilled and completed above the gas/oil contact will produce gas only and eventually “blow down” the gas cap and greatly decrease the reservoir drive energy available for the production of oil. Figure 12 is a schematic of the relative positions of gas, oil, and water in the reservoir rock.

E. Reservoir Pressure

The reservoir fluids are under pressure in the reservoir. The original reservoir pressure, and reservoir pressure at various stages of depletion, are perhaps the most important basic data for the calculation of reservoir performance. The most accurate method of measuring reservoir pressure is by a bottomhole pressure gauge that is lowered into the well on a wire line. After the gauge is lowered to bottom, the well remains “shut in” for a period of time, and the bottomhole pressure is measured, and the gauge is retrieved from the well.

In a normally pressured reservoir, the reservoir rock is an “open system” in which the reservoir rock fluids are in communication with the surface, either by a surface out crop of the reservoir rock or by faulting through the reservoir rock. In such a normally pressured reservoir, the
B_g would be about 0.0008. At proportionately higher pressures, the B_g would be an even smaller number.

A. **Connate Water**

Salt water is found as a reservoir fluid in virtually all reservoirs, because the sediments forming the reservoir rock were deposited in a marine environment. Even though oil has migrated into the reservoir, and has displaced much of the salt water, a portion of the pore space of the reservoir rock remains filled with salt water. This water is called connate interstitial water or just connate water. “Connate” is a Latin word, meaning “born or originating together.” As noted above, the petroleum does not displace all the water in the reservoir rock; a film of adsorbed water remains on the surface of the sediments of the reservoir rock thereby reducing the pore space available to hold hydrocarbons. This phenomenon is called water “wetting” of the reservoir rock. This adsorbed water can never be flushed from the reservoir rock and is called the “irreducible water saturation” of the reservoir. Oil and gas occupy the pore spaces between the water envelopes; which envelopes adhere to the grains of the reservoir rock.

B. **Oil**

Petroleum in the reservoir is comprised of a mixture of hydrocarbon compounds. Oil may be classified as paraffin based with a high hydrogen content in relation to the carbon content; asphalt based (napthenic), with low hydrogen content in relation to the carbon content; or mixed base—a mixture of paraffin based and asphalt based compounds.

The paraffin based crudes are generally of low density and, upon refining, leave a paraffin wax residue. These crudes include those found in Pennsylvania, the Near East, Africa, and the North Sea. The asphalt based crudes are generally of higher density and, upon refining, leave a semi-solid, or solid, asphalt residue. These crudes include those found in California, on the U.S. Gulf Coast,
and in Venezuela. The mixed based crudes are common in Illinois, Kansas, Oklahoma, and Texas—other than on the Gulf Coast.

At reservoir conditions oil contains natural gas in solution and is under pressure and high temperatures. The dissolved, or solution, gas makes the oil in the reservoir less dense and less viscous and greatly enhances its ability to flow to the wellbore.

C. Natural Gas

Natural gas contains approximately 90% to 100% methane gas, small percentages of the higher paraffin series hydrocarbon compounds, *i.e.*, ethane, propane, iso-butane, normal butane, isopentane, normal pentane, hexane, heptane, octane, nonane, and decane, and other non hydrocarbon gases such as carbon dioxide, nitrogen, hydrogen sulfide, and, in some instances, small amounts of helium.

The dissolved gas in oil is called *solution gas*. Free gas in an oil reservoir occurs as a gas cap above the oil accumulation. Many deeper reservoirs contain gas only, *i.e.*, the gas is not associated with an oil accumulation. In such gas reservoirs, the gas occurs above the water bearing part of the reservoir. In an oil reservoir, the solution gas and gas cap, if present, provide important energy sources for the primary production of oil from the reservoir.

Many heavy hydrocarbon compounds which are liquids at surface conditions, are found in the gaseous state in the reservoir as a result of reservoir pressure and temperature. As these gases are produced, and their pressure and temperature decrease, they condense to the liquid phase at surface conditions. These produced liquids are commonly known as *condensate*.

Natural gas occurring in an oil reservoir as a free gas cap is called "associated gas." The ratio of produced gas to oil at surface conditions is known as the gas oil ratio (G.O.R.) and is expressed in units of cubic feet of gas per barrel of oil. An oil accumulation with a free gas cap is called an
Abnormally pressured reservoirs are relatively common on the Gulf Coast—at depth. Their abnormal, and often unexpected pressure, is a serious hazard during the drilling, and operating, of wells in such reservoirs. But, the energy contained in the hydrocarbons, in abnormally pressured reservoirs, often permits commercial production from reservoir rocks otherwise of too low permeabilities to produce at commercial rates.

V. RESERVOIR DRIVE MECHANISMS

Reservoirs, once penetrated by a producing well, are generally classified as to the type of drive mechanism by which oil and gas is displaced from the reservoir into the wellbore and produced to the surface. The drive mechanism is classified based upon the type of reservoir energy available to produce the hydrocarbons. This classification consists of depletion drive, water drive, or combination drive reservoirs. Unfortunately, all of the oil or gas originally in place in the reservoir cannot be produced and saved at the surface. The percentage of the oil or gas originally in place that is actually produced from the reservoir is called the reservoir recovery factor. Recovery factors range from 2% to 90% depending, in most part, upon the type and efficiency of the reservoir drive mechanism, the quality of the reservoir rock and the properties of the reservoir fluids.

A. Depletion Drive

A depletion drive reservoir is one that is a volumetric, or a closed system, i.e., there is no water influx into the accumulation as oil or gas is produced. The drive energy is provided by the gas in solution in the oil or from solution gas, and the free gas cap, if one is present. Reservoir pressure declines rapidly in depletion drive reservoirs, and the recovery factors—the ratio of produced oil to original oil in place—are low generally in the range of 5% to 30%. Generally, such oil reservoirs have a short primary life and must be placed on the pump or some other form of artificial lift.

Gas reservoirs are often volumetric, i.e., closed and not in communication with an aquifer;
D. Gravity Drainage

If the reservoir is steeply dipping, the oil may flow from the reservoir into the wellbore under the influence of gravity. Several prolific Middle Eastern oil fields are gravity drainage fields.

E. Pressure Maintenance of the Reservoir and Secondary Recovery

Water, gas, or other fluids, may be injected in the reservoir to prevent excessive pressure decline in the reservoir with production, thereby, prolonging the producing life and increasing ultimate recovery. Arresting pressure decline by such injection is called pressure maintenance. The ultimate recovery of oil from a reservoir may be greatly enhanced by pressure maintenance, because more gas will be held in solution in the oil, reducing the oil’s viscosity, increasing the formation volume factor, thereby reducing the actual amount of oil left in a reservoir when it is depleted, reducing the G.O.R. and reducing lifting costs. Water injection is the most common method of pressure maintenance in oil reservoirs. It is also a convenient means of disposing of the salt water produced with oil.

In certain gas reservoirs, pressure maintenance enhances ultimate recovery of the natural gas liquids contained in a reservoir. A common pressure maintenance method for a gas reservoir is cycling the gas, i.e., producing the gas, processing the gas in a plant to recover the liquid hydrocarbons in the gas, and injecting a large portion of the dry gas into the reservoir. When the gas cycling project has been completed; such that, its liquid content has been substantially extracted, the gas remaining in the reservoir may be produced and sold. This final stage of the process is known as “blowing down” the reservoir.

When the reservoir pressure has declined such that the reservoir will not produce under its primary depletion drive mechanism, water, or some other fluid, may be injected to displace the oil from the injection wells to the producing wells. In a water injection program, after the oil reservoir
reservoir pressure will be the same pressure as exerted by the hydrostatic head of a column of salt water from the surface to the depth of the reservoir. The pressure gradient for salt water is commonly .465 pounds per square inch in the Gulf Coast. Thus, the reservoir pressure in a normally pressured Gulf Coast reservoir at 5,000 feet depth would be 2,325 psi (5,000 ft x .465 psi/ft).

In an abnormally pressurized reservoir, the reservoir is not "an open system." That is, the reservoir rock is not hydraulically connected to the surface. Rather, the reservoir rock is completely surrounded by impermeable formations. The reservoir rock, and reservoir fluids, are subjected to the extreme weight and pressure of the overlying beds. The pressure gradient for the overlying beds is on the order of 1 psi/ft of overburden—compared to a pressure gradient of .465 psi/ft for salt water.
volumetric gas reservoirs have high recovery factors generally in the range of 65% to 85%.

B. Water Drive

Water drive reservoirs are reservoirs in which there is water influx from an aquifer as oil and gas are produced from the reservoir. This water influx is the result of the expansion of the water in the aquifer and the rock compressibility of the aquifer as the reservoir pressure is reduced by production. When the oil and gas accumulation is small in comparison to the water bearing portion of the reservoir, the aquifer, the water drive will be active.

In an active water drive reservoir, water influx substantially equals voidage due to production of oil and gas. As a result, the reservoir pressure decline with production will be slight. If reservoir voidage from production substantially exceeds water influx, the reservoir pressure will decline substantially with production. The water drive may be further described as edge water, or bottom water, drive. If the oil reservoir is underlain by a large aquifer; so that, the water influx is almost vertical, it is called a bottom water drive.

With production of oil and gas from the edge water drive reservoir, the water encroaches both vertically and horizontally from the structurally lower areas to the structurally higher areas of the trap. The down structure wells will begin to produce water first, and the lowest wells structurally will “water out” first. Eventually, water will be produced by all wells. An active water drive is an efficient reservoir drive mechanism, and recoveries range from 35% to 60% of the original oil in place in the reservoir.

C. Combination Drive

Many reservoirs have a combination depletion drive and water drive. An example is a gas cap—oil reservoir, hydraulically connected to a large aquifer. Reservoir engineering calculations are complex for these combination drive reservoirs.
reservoir; and $B_g =$ volume factor correcting the gas at reservoir pressure and temperature to standard pressure and temperature.

4. The Distribution of Reservoir Rock Beneath Various Tracts

Based upon the net pay isopachous map drawn on the reservoir, the engineer can calculate the acre feet of reservoir rock beneath a tract of property. This calculation is important in determining whether a tract is being drained, or properly developed, and in determining unit participation factors in voluntary units or in forced pooling situations. Of course, if the reservoir is not homogenous, the acre feet of bulk reservoir rock beneath the tract in issue should be weighted by the pressure, the porosity, the permeability, or the water saturation, in determining the relative quality of the reservoir underlying the tract.

The accuracy of the volumetric calculation of original oil and gas in place depends upon the well control available, *i.e.*, the number of wells penetrating the reservoir in relation to the size and the complexity of the reservoir and the quality of the data obtained from those wells. It is only by the volumetric method that the distribution of reservoir rock beneath a tract can be calculated. Consequently, for many legal disputes, a volumetric calculation of gas, or oil, in place is necessary. In all but the simplest of fields, the process of accumulating the necessary well logs and well data, correlating the logs, making net pay picks, porosity and water saturation calculations, and drawing the required maps, is time consuming and very expensive.

B. Material Balance Calculations of Original Oil and Gas in Place

If well control is lacking so that porosity, water saturation, or bulk reservoir rock volume, cannot be calculated with reasonable accuracy, the *material balance* method may be used to calculate the original oil and gas in place in the reservoir. The material balance method is independent of the volumetric method and is calculated based upon the production history of the reservoir—the volumes
reservoir; the contour lines connecting points of equal sand thickness are called isopach lines. Figure 13 represents the relationship between an idealized structure map, cross section, and isopachous map.

Figure 13

Relationship Between an Idealized Structure Map, Cross Section, and Isopachous Map
The geologist or reservoir engineer then takes the net sand isopachous map and structural contour map showing the oil/water contact, the gas/oil contact, and the location of any faults. and draws a net hydrocarbon pay isopachous map. From the net pay isopachous map, the engineer calculates the area on the net pay isopachous map between the various isopach lines, and using principles of solid geometry, calculates the acre-feet of net productive reservoir rock, which volumes are known as bulk reservoir rock volumes. In effect, the net pay (oil or gas) isopachous map is a two dimensional scale drawing of the reservoir from which the engineer calculates the bulk volume of the reservoir rock. Reservoir rock volumes are stated in units of acre-feet (an acre of rock—one foot thick). One acre-foot of volume is equivalent to 43,560 cubic feet.

2. **Formation Evaluation to Determine Porosity and Water Saturation**

From the quantitative petrophysical analysis of well logs and core samples, the engineer calculates the average reservoir porosity ($\Phi_{ave}$) and average water saturation ($S_w{ave}$). These values are used to determine the net volume of the bulk reservoir rock volume available to hold hydrocarbons.

3. **Calculation of Oil or Gas in Place Using the Volumetric Method**

Once the engineer has determined the reservoir rock volume, and average reservoir porosity and average water saturation, he then determines how much of that bulk rock volume is available for holding hydrocarbons. The volume of gas in place in a gas reservoir may be calculated by the following equation:

$$G = 43,560 \times V_b \times \Phi_{ave} \times (1-S_w) \times B_g$$

Where $G$ = the standard cubic feet of gas originally in place in the reservoir; $V_b$ = acre feet of bulk volume of hydrocarbon bearing reservoir rock determined from mapping; $\Phi_{average}$ = volume weighted average of reservoir porosity; $S_w$ = volume weighted average of water saturation of the
fills up with water, there is an increase in oil production from the producing wells, followed by
combined oil and water production from the wells. The proportion of water gradually increases until
the cost of injecting the water exceeds the value of the produced oil. Water injection is an efficient
form of secondary recovery and is most efficient when used in depletion drive reservoirs.

VI. CALCULATING THE ORIGINAL OIL AND GAS IN PLACE IN THE RESERVOIR

The geologist and reservoir engineer must calculate the original oil and gas in place in the
reservoir to make the many, and varied, decisions necessary to properly develop the reservoir and
to efficiently produce the wells completed in the reservoir. The volume of original oil and gas in
place in the reservoir can be calculated by the volumetric method or by the material balance method.
Each method of calculation is independent of the other. When possible, it is good engineering
practice to use both methods and to compare the results of each method as a check on the accuracy
of the calculations.

A. The Volumetric Method

1. Mapping of the Reservoir to Determine Bulk Reservoir Rock Volume

A subsurface structural contour map is drawn on the top of the reservoir. This map is drawn
on the reservoir top in the same manner as a surface topographic map is drawn on the earth’s surface.
This map is drawn based upon the correlation of well logs from the electrical, or nuclear logs, run
on the wells that penetrate the reservoir. If correlation of the well logs show the presence of faulting,
the geologist will draw a fault plane map.

The geologist, or engineer, will then determine the net feet of reservoir rock penetrated by
each well, called “net sand picks.” Using these “net sand picks” in each well penetrating the
reservoir, he then draws an isopachous map of the reservoir. This map is a net thickness map of the
reservoir. The contour lines on the isopachous map depict points of equal net sand thickness in the
opinion that, under the circumstances, a reasonably prudent operator would have sought an exception, and that the AOGC would have granted an exception had the operator applied for such an exception;

e. The date the reasonably prudent operator would have drilled the protection well and the date a reasonably prudent operator would have had the protection well on production;

f. The plaintiff lessor has been damaged as a result of the defendant’s failure to drill a protection well; and

g. The amount of such damages, based upon the present value of the royalty the plaintiff would have received had the protection well been drilled and placed on production as a reasonably prudent operator would have done, plus prejudgment interest.

2. Development

The expert evidence and exhibits would be the same as for a drainage case, as above, except that there is no testimony or exhibits necessary to prove that drainage is occurring, only that a reasonably prudent operator would drill a development well; the measure of damages is the same as in a drainage case—the royalty measure of damages. Even if the tract in issue has produced, or will produce, its share, or more than its share, of the reservoir without further development, if a reasonably prudent operator would drill, the operator is obligated to drill additional development wells. Under the legal rule of capture, it would be an unusual operator that would forego the drilling of a profitable well just because the operator might recover more than its share of the original oil or gas in place in the reservoir.

3. Imprudent Operations

In these type cases it must be shown that the lessee has acted, or failed to act, in a manner that has reduced the ultimate recovery of oil and gas from the reservoir. That is, that the plaintiff has not,
d. Stratigraphic cross-section through the tract in issue to the draining tract—with the zone in issue colored for easy viewing;

e. A chart showing the quality of the electric logs of the draining well, or wells, compared to any wells on the tract in issue that penetrate the zone in issue;

f. Calculations showing the projected income stream from the proposed protection well, the present worth of the proposed protection well, and its time to “payout,” rate of return, and multiple that its profit exceeds costs; and

g. Calculations showing the royalties, by month, and by total, that the lessor, plaintiff, would have received had the well(s) been drilled at the time and in the location that a reasonably prudent operator would have drilled the wells, plus prejudgment interest calculated on each month’s royalty amount, and totaled.

Based upon the foregoing analysis and exhibits, the expert must opine that:
a. The zone is present beneath the tract;

b. The zone is being drained by adjacent production and that such drainage is substantial;

c. Based upon his calculations, the proposed protection well would return a sufficient profit, over and above the costs of drilling, completing, equipping, and operating the well, to justify the risk of drilling the well, i.e., a reasonably prudent operator would drill the well;

d. The surface location of the proposed protection well; the choice of surface location should be sufficiently flexible to allow its being drilled in a given specific area rather than one exact location. Note: The rules and regulations of the Arkansas Oil & Gas Commission (“AOGC”) should be checked to make sure that the proposed protection well location complies with the AOGC’s spacing rules; if not, the expert must be prepared to render his
To prove that the zone in issue is present beneath the tract being drained, the geologist or engineer expert witness generally must prepare a structural contour map of the zone in issue. He must also prepare an isopachous map of the net pay thickness of the zone in issue to prove that the reserves of gas and/or oil contained in the zone are sufficiently large to justify drilling for the reserves, that the drainage is substantial, and that a reasonably prudent operator would drill a well or wells on the tract in issue. A well which a reasonably prudent operator would drill is a well which would return sufficient revenue to the operator to repay all the costs of drilling, equipping, operating, and producing such well and return sufficient profit over and above the costs to justify the risk of drilling such well. He must further give the location of each well that a prudent operator would have drilled to afford protection from drainage, and he must specify the time that each well should have been drilled in order to protect the tract in issue from drainage. The expert witness, geologist, or engineer must then calculate the damages as a result of such drainage. Those damages are measured based upon the royalties each such well would have yielded, discounted to present value, had each protection well been drilled at the time and place that a reasonably prudent operator would have drilled each well.

The lessee defendant, of course, would introduce controverting expert testimony, and other controverting evidence, to refute each such element. A representative list of exhibits supporting such expert testimony for the plaintiff in a drainage case might include:

a. Surface map of area;

b. Structure map drawn on the strata being drained, showing faulting, oil/water contacts, or other reservoir bounding features, with the proposed location for each protection well shown on the map;

c. Net sand and net pay isopachous maps of the zone being drained;
existing wells, or undertaking other projects.

VIII. THE VALUATION OF RESERVES

Once the volume of the oil and gas reserves has been estimated, the reservoir engineer may be called upon to place a value on these reserves. The present value of oil and gas reserves is a function of the rate at which the reserves will be produced in the future, the unit value of the oil and gas when produced and the true value of money. In valuing reserves, an income stream must be projected for the reserves based upon a projected rate of production and a projected price for the oil and gas less the costs of operation. Once an income stream has been projected, it is discounted to its present value. The relative profitability of a well, or project, can then be expressed as (1) the time it takes for the project to return the investment in the project—the "payout;" (2) the discounted cash flow rate of return on the investment; or (3) the multiple that projected profits exceed the projected expense of the project. All proposed drilling, or other major operations, are generally analyzed by a geologist, or engineer, to insure that the projected profit of those operations will sufficiently exceed the expense of the project and justify the risk of the project.

IX. GEOLOGIC AND RESERVOIR ENGINEERING PRINCIPLES COMMONLY USED BY ATTORNEYS

The calculations discussed above are often made, and presented, by experts in resolving legal disputes as to oil and gas properties. The attorney representing a party in such disputes should be familiar with the geologic and engineering calculations and, often, must assist the geologist, or engineer, in putting the results, and methods, of his calculations in terms that are clear to a jury, judge, or administrative hearings examiner. Listed below are several types of disputes that, invariably, require expert geologic, or reservoir engineering, analysis and testimony.

A. Oil, Gas and Mineral Lease Implied Covenant Cases

1. Drainage
testimony. However, the following general discussion of the recent authorities, observations, and forms, may be helpful to the practitioner in selecting and preparing an expert and in objecting to the testimony of an opponent’s expert witness.

A. **Rule 702 of the ARKANSAS RULES OF EVIDENCE - Testimony of Experts**

The admissibility of expert testimony is governed by Rule 702 of the ARKANSAS RULES OF EVIDENCE, which provides that:

> If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise. (Emphasis added).

1. **Qualification of the Expert**

To offer expert opinion testimony, the expert must, of course, be qualified in his particular field. An expert is qualified under Rule 702 if (i) the expert has the necessary knowledge, skill, experience, training or education and (ii) the expertise of the expert will assist the trier of fact to understand and to determine the disputed fact issue. The expert must possess skills, knowledge or experience not possessed by the average lay person and must possess skills, knowledge, or experience in respect of the very matter on which the expert proposes to testify. As a practical matter, in most oil and gas cases, the first prong of the qualification test is easily met, *i.e.*, the fact disputes almost always involve technical geologic or engineering issues, the analysis well beyond the skills and experience of the average person. The second prong can be met if the expert was properly selected, *i.e.*, the expert has the education, training and experience as to the very matter on which the expert will testify. By way of example, a petroleum engineering expert may not be qualified to testify, if his area of expertise is reservoir engineering, and he is attempting to offer opinion evidence as to deep, high pressure drilling—even though he holds an M.S. or Ph.D in Petroleum Engineering. The practitioner should thoroughly examine a prospective expert’s
from the first well to show that the reservoir is not large enough to include the formation underlying the second well; and

g. Pressure build up tests to show that the first well is near a fault or some other form of permeability bearer.

Base upon these exhibits, a geologist and engineer, could opine and show that the two wells were in different reservoirs, and obtain a second allowable for the new well.

X. THE ADMISSIBILITY OF EXPERT TESTIMONY OF GEOLOGISTS AND ENGINEERS

In most jurisdictions, the standard for the admissibility of expert testimony has been, as a practical matter, raised substantially. The trial judge has now been assigned the role of “gatekeeper” as to the admissibility of expert opinion testimony. That is, the trial judge, upon proper objection, must, outside the presence of the jury, screen all expert testimony for relevance and reliability. If the proffered evidence is not relevant and reliable, the trial court must exclude the evidence.  

*Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (1993); *General Electric Co. v. Joiner*, 522 U.S. 136 (1997); and *Kumho Tire Co., Ltd. v. Carmichael*, 526 U.S. 137 (1999); *see also, Farm Bureau Mutual Insurance Company v. Foote*, 14 S.W.3d 512 (Ark. 2000). Gone are the days when an expert, with the proper credentials, *i.e.*, the proper education, training or experience, could opine on virtually any issue within the purview of his area of expertise. The old practice, although based on a supposedly higher standard was, in effect, more liberal and resulted in a proliferation of what is popularly called “junk science.” *Daubert*, and its progeny, have, in practice, greatly restricted the admissibility of expert testimony at trial and have spawned an expanded pretrial hearing practice as to the admissibility of expert testimony.

It is beyond the scope of this paper to fully analyze and discuss the nuances of *Daubert*, Rule 702 of the *ARKANSAS RULES OF EVIDENCE*, and the Arkansas cases, as to the admissibility of expert
If there is objection to the application, or the AOGC is in doubt as to the merits of the request, the AOGC will set the matter for hearing at the next regularly scheduled hearing. Generally, offset operators, and the AOGC staff, will appear at the hearing for the second allowable and offer evidence in opposition to the application for a second allowable.

The applicant for a second allowable must, therefore, prove that the formation it wishes to produce is not hydraulically connected to the stratigraphically equivalent formation already being produced by a well in the unit. Obviously, that proof requires expert geologic and engineering testimony.

Exhibits in such a hearing would include:

a. Surface map of area;

b. Structure map drawn on the formation in issue, showing faulting, oil/water contacts, or other reservoir bounding features, with particular emphasis shown on the manner in which the new well is separated from the reservoir already productive in the unit (color coded);

c. Net sand and net pay isopachous maps of the formation showing the wells in separate reservoirs;

d. Stratigraphic cross section through the formation in issue showing that the formation in issue is in separate reservoirs under the unit in question;

e. Pressure comparisons showing the virgin pressures in the first well, the present reservoir pressure in the first well, the formation pressure in the new well (from formation tester) showing that the new well's pressure is near virgin pressure and much higher than the current reservoir pressure as measured in the first well; therefore, the wells are not in the same reservoir;

f. Material balance calculations of the original gas in place in the reservoir producing
or will not, recover the royalties he would have recovered but for the lessee’s imprudent operations. An example would be a field in which the operator produced too much gas from the gas cap of the field; such that, the gas cap shrank in volume thereby permitting the oil to invade the gas cap, resulting in a vastly lower ultimate oil recovery from the field and lease in issue. Once the oil invades the gas cap, a certain percentage of it can never be produced thereby reducing the oil reserves and damaging the lessor.

B. Additional Allowable Hearings Before the Arkansas Oil & Gas Commission

When an operator drills a well in Arkansas in an existing proration unit, and proposes to produce from a reservoir, the operator will not be assigned an allowable for that well if there is already a well in the unit producing from that same reservoir. If, however, the operator can prove to the AOGC, after a full evidentiary hearing, that the new well is not in the same reservoir as the existing well, the AOGC will assign the operator an allowable for the new well. That is, even though both wells are completed in the same formation, they are in separate reservoirs, and the unit is entitled to an additional or a “second allowable.” The AOGC rules state that before it will consider requests for an additional allowable by administrative procedure, the applicant must submit the following information with the application:

a. letter of request for an additional allowable within a drilling unit including summary findings;

b. approval of all offset operators;

c. structure map (color coded);

d. isopach map of subject reservoir;

e. cross section; and

f. pressure data (including initial and current pressure of all pertinent wells).
background with the fact issues in dispute including requesting that the expert provide the dates, times, and places, of specific jobs, or assignments involving the same, or similar, fact issues as the one in litigation. It is better to spend the time, in the initial stages of the dispute, finding the truly qualified expert than spending the time immediately prior to trial trying to polish the expertise of the expert. Generally, in oil and gas disputes, there are many well educated and experienced experts in virtually every phase of the business. Once a properly qualified expert is selected, the problem then becomes: will the expert’s opinion be admissible in view of the theory and methodology upon which the expert bases his opinion?

2. **Daubert - The Reliability of the Expert’s Methodology and the Relevance of His Opinion**

   Even a qualified expert will not be allowed to testify unless the science and methodology of his analysis is reliable and is relevant to the very fact in issue. *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, *supra*; *General Electric Co. v. Joiner, supra*; and *Kumho Tire Co., Ltd. v. Carmichael, supra*; see also, *Farm Bureau Mutual Insurance Company v. Foote, supra*. The **Arkansas Rules of Evidence**, and those of most jurisdictions, are based upon the **Federal Rules of Evidence**; hence, federal cases—particularly U.S. Supreme Court cases, are very persuasive in interpreting the Arkansas rules. Virtually every jurisdiction in the United States, including Arkansas, has adopted the *Daubert* standard for the admission of expert scientific evidence. Most jurisdictions have also adopted *Kumho Tire* and require that the same reliability and relevancy principles of *Daubert* apply to all experts—not just scientific experts. Thus, the recent decisions of *Daubert* and *Kumho Tire* must be studied and addressed to effectively deal with expert testimony at trial.

   In *Daubert*, the plaintiffs, two minor children and their parents, brought suit for damages against Dow Pharmaceuticals, Inc ("Dow"). The plaintiffs alleged that the children had suffered serious birth defects as a result of the mothers’ prenatal ingestion of the drug Bendectin marketed by
scientists. The trial court’s “gatekeeping” duty applies not only to scientific testimony but to all expert testimony. Rule 702 does not distinguish between “scientific” knowledge and “technical” or “other specialized” knowledge. In determining the admissibility of an engineering expert’s testimony, the trial court may consider one or more of the specific Daubert factors. The Daubert factors do not constitute a definitive checklist or litmus test. Rather, the trial court’s gatekeeping inquiry must be tied to the particular facts of the case at hand. The engineer in Kumho Tire was qualified, and the question was not his methodology, in general, but whether that methodology could reliably determine the cause of the failure of the particular tire at issue. Of course, the engineer claimed that his method was accurate, but the Court stated that:

[A]s we pointed out in Joiner, nothing in either Daubert or the Federal Rules of Evidence requires a district court to admit opinion evidence that is connected to existing data only by the ipse dixit of the expert.

In most oil and gas cases, the geologic or engineering theory underlying the expert’s opinion is likely well developed and accepted in the industry. The problem is generally whether the expert has properly applied the theory or methodology. If the expert is using a proven theory, or methodology, in a new or unusual way, it will be subject to a challenge under Daubert and Kumho Tire.

4. Arkansas Has Adopted the Holding in Daubert as to the Admissibility of Expert Testimony Under Rule 702 of the Arkansas Rules of Evidence

In April 2000, the Arkansas Supreme Court adopted the holding in Daubert in determining the admissibility of expert testimony under Rule 702 of the Arkansas Rules of Evidence. Farm Bureau Mutual Insurance Co. v. Foote, supra. In Foote, the Footes’ home was destroyed by a fire; they filed a claim under their homeowners insurance policy with Farm Bureau Mutual Insurance Co. (“Farmer Bureau”). After an investigation, Farm Bureau determined that the fire was the result of arson and denied coverage; the Footes filed suit on the insurance policy for damages. At trial, Farm
Court enumerated the following factors appropriate to the testimony at bar:

a. Whether the theory, or technique, in question can be, and has been tested;

b. Whether the theory, or technique, has been subjected to peer review and/or publication;

c. Its known or potential error rate; and

d. Whether it has attracted widespread acceptance within a relevant scientific community.

The trial judge is to focus his inquiry only on the reliability and relevance of the scientific theory or methodology—not on the conclusions that the theory or methodology generate.

3.  *Kumho Tire*: Daubert Applies to All Experts Not Just Scientific Experts

In *Kumho Tire*, the U.S. Supreme Court held that *Daubert* applied to all experts—both scientific experts and experts relying only upon skill or experience. In *Kumho Tire*, the plaintiffs brought a damage suit as a result of a tire blowout that caused the vehicle to turn over killing one passenger and injuring the driver and other passengers. The plaintiffs case was based upon the expert opinion of an accident reconstruction engineer who opined that a defect in the tire’s manufacture, or design, caused the blowout. That opinion was based upon a visual and tactile inspection of the tire and upon the theory that, in the absence of at least two of four specific physical symptoms indicating tire abuse, the tire failure in issue was necessarily caused by a defect. The defendant moved to exclude the testimony of the engineer. The trial court held that the *Daubert* factors applied and excluded the expert testimony. The Eleventh Circuit reversed the trial court and held that *Daubert* was limited to scientific evidence and did not apply to the engineer’s testimony, which the Court characterized as based on skill or experience. The Supreme Court reversed the Court of Appeals and held that the *Daubert* factors apply to the testimony of engineers and other experts who are not
Dow. The trial court entered summary judgment for Dow ruling that the plaintiffs’ expert testimony was not admissible. The plaintiffs’ expert had testified that Bendectin had caused the birth defects. The trial court held that the evidence was inadmissible, because it did not meet the applicable “general acceptance” standard for the admission on expert testimony. The plaintiffs appealed. The Court of Appeals affirmed the trial court, citing Frye v. United States, 293 F. 1013 (1923), holding that expert opinion, based upon scientific technique is inadmissible unless the technique is “generally accepted” as reliable in the relevant scientific community. In reversing the courts below, and remanding to the trial court, the Supreme Court held that Rule 702, not Frye, controlled the admissibility of expert scientific testimony. The Court rejected the rigid “generally accepted” standard in favor of the more liberal and relaxed approach embodied in the Rules, in general, and Rule 702 in particular. The Court further held that the Rules, and especially Rule 702, place limits on the admissibility of proffered expert scientific testimony by assigning to the trial judge the duty of ensuring that the expert’s testimony rests both on a reliable foundation and is relevant to the issue which is the object of the testimony. By using the term “scientific ... knowledge,” Rule 702 requires that the expert’s opinion be grounded in science’s methods and procedures. The expert’s method, and his application of that method, must be reliable. Further, the Rule’s requirement that the testimony “assist the trier of fact to understand the evidence or to determine the fact in issue” requires that the expert testimony be relevant to the issue in dispute. The Court further held that when an expert’s opinion was proffered, the trial judge, pursuant to Rule 104(a), must conduct a preliminary assessment, outside the presence of the jury, to determine whether the testimony’s underlying reasoning or methodology is scientifically reliable and whether that methodology is properly applied to the facts at issue. The Court held that many factors may bear on the trial court’s determination; the test is flexible and no given set of factors will be pertinent to all proffered expert testimony. The
Bureau offered the expert testimony of Trooper Estes, an investigator of the Arkansas State Police, that his specially trained dog, Benjamin, had detected the presence of accelerants in the burned out home. Farm Bureau proffered Estes' testimony that the dog was better able to detect the presence of accelerants than the laboratory equipment used by the investigating chemist. Farm Bureau, therefore, offered the testimony to explain why the dog had made five "hits" while the chemist had only detected measurable amounts of accelerants in two samples. The trial court denied the admission of the proffered expert testimony based upon the holding in Daubert. In affirming the trial court, the Arkansas Supreme Court held that:

The trial court denied admission of the proffered testimony based on the holding in Daubert, 508 U.S. 579. This court has not previously adopted the holding in Daubert. We do now. (Emphasis Added).

The Court also cited Prater v. State, 820 S.W.2d 429 (1991) wherein the Court had previously adopted what it characterized as a strikingly similar approach to Daubert in determining the admissibility of novel scientific evidence. Opponents of Daubert will, doubtless, argue that Foote is limited to the offer of "novel" scientific testimony, but it seems likely that Arkansas will follow Daubert and Kumho Tire as to the standard for determining the admissibility of all types of expert testimony. In any event, the careful practitioner must assume that Arkansas will follow Daubert, and its progeny, or will risk the exclusion of the proffered evidence or, if the evidence is admitted, will risk having the evidence excluded on appeal.

As to the application of Daubert to hearings at the Arkansas Oil & Gas Commission, it should be noted that Article 15-71-111(a) of the ARKANSAS NATURAL RESOURCES CODE, provides that:

The Commission shall prescribe its rules of order or procedure in hearings or other proceedings before it under this act, but in all hearings the rules of evidence as established by law shall be applied. However, the erroneous ruling by the Commission on the admissibility of evidence shall not of itself invalidate any rule, regulation, or order.
trial judge has many detailed and difficult questions of the experts. The exclusion of a party's expert, immediately before trial, is, of course, devastating to that party. *Daubert* challenges have become a major part of the trial of most cases involving complex expert testimony. The trial attorney must be well versed in this practice or risk complete disaster for the client.

**XI. CONCLUSIONS**

The proper resolution of legal issues relating to oil and gas properties requires that the attorney have an understanding of the basic principles of petroleum geology and reservoir engineering. In many instances, the law with respect to the matter in issue will be relatively straight forward. The analysis of the facts, however, is most often difficult and expensive, requiring a geologist's, or an engineer's, analysis. Without a firm grasp on the basic elements of petroleum geology and reservoir engineering, the attorney is severely handicapped in providing the necessary direction to his experts and in presenting that expert testimony, if necessary, to the judge, jury, or administrative hearings examiner.
As a practical matter, the rules of evidence in AOGC hearings are more relaxed, but since the
above quoted section requires that “in all hearings the rules of evidence as established by law shall
be applied,” to the extent Arkansas Court’s adopt Daubert, it, technically, applies as to the
admissibility of expert testimony at AOGC hearings. If the expert is not qualified in the very area of
his offered testimony, or that testimony does not meet the reliability or relevancy requirements of
Daubert, as adopted in Arkansas in Foote, the admissibility of that testimony should be challenged
prior to its admission. Of course, an error as to the admissibility of such challenged expert testimony
will not “of itself” invalidate any rule, regulation or order of the AOGC.

5. Method of Raising and Preserving a Daubert Objection to Expert Testimony

To properly object to the testimony of an expert, the opposing party should either (i) file a
pretrial motion and seek a pretrial hearing under Rule 104, as to the admissibility of the challenged
expert testimony or (ii) object at trial upon the offer of the expert testimony. Daubert makes specific
reference to Rule 104 as the vehicle to address a challenge to an expert’s testimony. It is very
important to note that once an opposing party has timely challenged the proffered expert testimony,
the offering party has the burden of going forward with the evidence necessary to support the
admissibility of the proffered testimony. Clearly, the careful practitioner will not merely rely on
argument but will want to present testimony, and possibly documentary evidence, in support of the
reliability and relevance of the proffered expert testimony. If the proffered testimony is complex, the
hearing on the challenge may take several hours or even several days. The Third Circuit has held that
the trial court must offer the parties a full opportunity, pursuant to Rule 104, to be heard on the
1999). If the objection comes in a jury trial, most trial judges are very reluctant to take the necessary
time to properly hear and dispose of a Daubert objection—particularly if the hearing interrupts the trial
for several hours—let alone a full day or more. The safer practice is to raise objections to expected expert testimony by a pretrial motion and to request sufficient time to adequately hear the motion. In all events, the objection must be made at trial and prior to the beginning of the challenged testimony. Most jurisdictions will not allow the complaining party to challenge the expert testimony on appeal under the guise of a no evidence or an insufficiency of the evidence argument—even if the unreliable expert testimony is the only basis of the judgment below. *E.g.*, *Marbled Murrelet v. Babbitt*, 83 F.3d 1068 (9th Cir. 1996), *cert. denied*, 117 S. Ct. 942 (1997); and *Maritime Overseas Corp. v. Ellis*, 971 S.W.2d 402 (Tex. 1998), *cert. denied*, 119 S. Ct. 541 (1999).

6. **Standard of Review of the Trial Court's Rulings on Admissibility of Expert Evidence**

As with evidence rulings generally, the determination of the admissibility of challenged expert evidence is left to the sound discretion of the trial court. The trial court's ruling on the admissibility of expert evidence will not be disturbed on appeal unless the trial court has abused its discretion. *Kumho Tire Co., Ltd. v. Carmichael*, *supra*, and *General Electric Co. v. Joiner*, *supra*.

B. **Daubert Motion - Forms**

Attached as Appendix 1, 2, and 3, for review and consideration, but provided with no warranty, are several *Daubert - E. I. duPont de Nemours & Co. v. Robinson*, 923 S.W.2d 549 (Tex. 1995) (Texas Supreme Court case adopting *Daubert*) motions. These motions are representative of the type of *Daubert* motions being filed in Texas Courts.

The practitioner should carefully analyze Rule 702, as interpreted by *Daubert, Kumho Tire, Foote*, and their progeny, before retaining an expert. Further, the practitioner should be prepared to challenge any unreliable expert testimony and should be prepared to meet a challenge to the practitioner's expert. *Daubert* challenges are very focused and intensive "mini trials" held on the eve of trial in which the contending experts are examined and cross examined at great length. Often, the
not operating the Leases. That is, by Carnes’ calculations, the defendants have stolen almost 1 \( \frac{1}{2} \) times more gas than has been reported as produced to the Railroad Commission of Texas ("Commission"). Carnes bases his damage opinions and calculations upon his novel engineering theory he calls the "recalculated p/z" method. By his "recalculated p/z" method, he purports to have calculated the volume of gas allegedly stolen from the Leases during the relevant period.

Carnes’ purported expert testimony is inadmissible and should be excluded under Rule 702 of the Texas Rules of Evidence and under the holding of the Texas Supreme Court in Robinson and its progeny.

II. CARNES’ RECALCULATED P/Z METHOD AND ITS UNRELIABILITY

Carnes uses what he calls his "recalculated p/z" method to opine that the defendants have stolen at least 92 billion cubic feet of gas from the Leases. The problems with Carnes’ "recalculated p/z" method are manifold, but he has admitted in his depositions that:

1. He has never used the "recalculated p/z" method before this case;
2. He had never used the "recalculated p/z" in any other of his engineering work;
3. He has never seen anyone else use this method to quantify the volumes of unaccounted for, or stolen, gas;
4. He has never seen any technical papers, textbooks, or publications, that use, or approve of, this use of the "p/z" method; and
5. He has very limited experience in the Sawyer (Canyon) Field, having done only reserve calculations for Oakridge Energy, Inc. on the Leases by using standard production decline curve analysis - not "p/z" graphs - for estimating gas reserves.

The standard p/z method of predicting gas reserves is limited in its application to homogenous, permeable, volumetric gas reservoirs. The p/z method of calculating the original gas in place is not applicable to the Sawyer (Canyon) reservoirs underlying the Leases, because such
NO. 3326

SANDRA PAUTSKY, SARA HUDSON § IN THE DISTRICT COURT OF
WORTHAM, HERSCHEL WORTHAM,
JIMMY NOEL PAUTSKY, HOLLI-
TEX SUPPLY CO., NOEL PAUTSKY,
TRUSTEE FOR NOEL PAUTSKY, JR.,
AND NOEL PAUTSKY, AS EXECUTOR
FOR THE ESTATE OF NORMAN
PAUTSKY

vs. § SUTTON COUNTY, TEXAS

ENSERCH EXPLORATION PARTNERS,
LTD., EP OPERATING COMPANY,
ENSERCH EXPLORATION, INC.
AND LONE STAR GAS COMPANY,
An Unincorporated Division of
ENSERCH CORPORATION § 112TH JUDICIAL DISTRICT

DEFENDANTS' ROBINSON MOTION TO EXCLUDE THE PURPORTED EXPERT
TESTIMONY OF PLAINTIFFS' WITNESS, PEYTON S. CARNES

TO THE JUDGE OF SAID HONORABLE COURT:

COME NOW, Enserch Exploration Partners, Ltd., EP Operating Company, Enserch
Exploration, Inc., and Lone Star Gas Company, an unincorporated division of Enserch Corporation,
defendants herein, and file this their motion to exclude the purported expert testimony of plaintiffs’
Witness, Peyton S. Carnes, Jr., and, in support of such motion, defendants would respectfully show
the following:

I. THE NATURE OF THE CAUSE OF ACTION AND THE MOTION BEFORE THE
COURT

This is an oil and gas case, and this is a Robinson\(^1\) motion. In this action, the plaintiffs are
seeking actual and, punitive damages, for the defendants’ alleged negligent measurement of gas, and

\(^1\) *E.I. duPont de Nemours & Co. v. Robinson*, 923 S.W.2d 549 (Tex. 1995)

APPENDIX 1
APPENDICES

1. Defendants’ *Robinson* Motion to Exclude the Purported Expert Testimony of Plaintiffs’ Witness, Peyton S. Carnes

2. Defendant’s Motion to Exclude Expert Testimony

3. Pool Company and Pool Company (Texas) Inc.’s Motion to Exclude Causation Testimony
their alleged conversion of gas, produced and saved from four (4) oil, gas and mineral leases under which the plaintiffs own an overriding royalty interest. The plaintiffs collectively own a 5/6th of 1/16th of 8/8th overriding royalty interest in four (4) leases located in the Oakridge Field, Sutton and Edwards Counties, Texas ("Field"). The leases are the Miers "B," the Miers "C," the Wallace, and the Stewart ("Leases"). During the period of time relevant to this suit, defendant, EP Operating Company ("EPO"), owned the Leases, and defendant, Enserch Exploration, Inc. ("EEI"), was the managing general partner of EPO and operated the leases. Lone Star Gas Company ("Lone Star"), a division of Enserch Corporation, purchased the gas pursuant the terms of a standard gas purchase contract.

During the period from 1974 through December 1988, as a result of such alleged negligent measurement and conversion of the gas produced from the Leases, the plaintiffs contend that they were not properly paid all of the royalties due them. Plaintiffs seek actual damages for such unpaid royalties in the amount of $9,877,133. The plaintiffs also seek an unspecified amount of punitive damages.

The plaintiffs' alleged damages of $9,877,133, are based entirely upon the opinions of Mr. Peyton S. Carnes, a petroleum engineer from Wichita Falls, Texas. Mr. Carnes was not hired until 1996, after the case was set for trial. By the time Carnes was hired in 1996, the case had been on file for almost 9 years. Based upon his so called "scientific" engineering analysis, Mr. Carnes has testified in deposition, and is prepared to testify at trial, that the defendants have stolen a huge volume of gas from the Leases, i.e., 92 billion cubic feet of gas. The reported production for the entire life of the Leases, through the latest reporting date, has been approximately 67 billion cubic feet of gas, which includes the ten year period 1989 to the present - during which ten years, EEI was
C. Methodology That Is Unreliable and Speculative Is Inadmissible Under Rule 702 and Robinson

Carnes' damage opinions based upon his flawed and unreliable methodology are inadmissible under Robinson. In Robinson, the Supreme Court identified the following non-exclusive factors as being important for the trial court to consider when evaluating the reliability of proffered scientific testimony:

1. the extent to which the theory has been or can be tested;
2. the extent to which the technique relies upon the subjective interpretation of the expert;
3. whether the theory has been subjected to peer review and/or publication;
4. the technique's potential rate of error;
5. whether the underlying theory or technique has been generally accepted as valid by the relevant scientific community; and
6. the non-judicial uses which have been made of the theory or technique.

923 S.W.2d at 557; Accord, Merrell Dow Pharmaceuticals v. Havner, supra; Broders v. Heise, supra; and United Blood Services v. Longoria, supra.

Factors 1, 3, 4 and 5 require the use of the scientific method for testing the expert's hypothesis, while factors 2 and 6 are directed at the expert's objectivity, and particularly whether the expert has formed opinions solely for litigation. Application of the Robinson factors reveals that Carnes' testimony is, to put it charitably, unreliable and inadmissible. Not only was his method fashioned only for litigation, he has never used the "recalculated p/z" method before this case, he has never used the "recalculated p/z" method in any other of his engineering work, he has never seen anyone else use this method of quantifying the volumes of unaccounted for, or stolen, gas, he has never seen any
reservoirs are lenticular, low permeability, heterogeneous reservoirs. Further, each well on the Leases produces from multiple, lenticular reservoirs - not a single reservoir. Stated simply, Carnes first selected a reservoir engineering method, i.e., the p/z method, that was inapplicable to the Sawyer (Canyon) reservoirs that are productive on the Leases. He then perverted that inapplicable method by modifying it into what he calls his “recalculated p/z” method. Specifically, Carnes calculates the volume of gas allegedly unreported, or stolen, by using his novel “recalculated p/z” method for only six (6) so called “representative” wells. The Leases cover more than 18,000 acres upon which acreage the defendants have drilled at least 69 producing wells. Undaunted, Carnes calculates, with his “recalculated p/z,” the volume of allegedly stolen gas from only six (6) wells; they are:

1. Miers B-9;
2. Miers C-2;
3. Miers C-10;
4. Wallace 2-1;
5. Wallace 25-1; and

By his method, Carnes graphs his “recalculated p/z” for each of the six wells, and arrived at an average volume of stolen gas of 1,336,667 Mcf per well. Significantly, his “recalculated p/z” method calculated that EEI reported to the Commission 550,000 Mcf more gas as having been produced from the Miers C-10 than Carnes calculated as originally being in place, i.e., EEI did not steal gas from the C-10. Rather, EEI actually produced more gas than Carnes calculated as possible. This “anomaly” in Carnes’ calculation speaks volumes as to the unreliability, and the unscientific
Rule 702 of the Texas Rules of Evidence allows the Court to admit "scientific... knowledge" to be presented by expert witnesses if it "will assist the trier of fact to understand the evidence or to determine a fact in issue." Robinson adopts the interpretation of the language of Rule 702 given by the United States Supreme Court when it interpreted the corresponding Federal Rule of Evidence in its landmark decision Daubert v. Merrell Dow Pharmaceuticals, Inc., 113 S.Ct. 2786 (1993), wherein the United States Supreme Court held:

The subject of an expert's testimony must be "scientific... knowledge." The adjective "scientific" implies a grounding in the methods and procedures of science. Similarly, the word "knowledge" connotes more than the subjective belief or unsupported speculation. The term "applies to any body of known facts or to any body of ideas inferred from such facts or accepted as truths on good grounds." Webster's Third New International Dictionary 1252 (1986). (emphasis added)

113 S.Ct. at 2795.

Robinson requires that the party offering the expert testimony establish its relevance and reliability once a proper objection to the testimony is made. Id. at p. 557. Robinson encourages trial courts to address the admissibility of scientific evidence in pretrial proceedings, and held that the Robinson’s burden of proof was invoked by DuPont’s motion to exclude Dr. Whitcomb’s testimony. This encouragement is based on Rule 104 of the Texas Rules of Evidence, which recommends that a court screen testimony subject to an objection out of the presence of the jury. In Robinson, the Texas Supreme Court encouraged the use of pretrial hearings that would compel the attendance of the challenged expert witness so that the trial judge could “freely ask questions.” Id. at p. 558.

Defendants submit that once the Court has an opportunity to hear the challenged testimony of Carnes on his damage calculations based upon his “recalculated p/z” method and has the opportunity to freely ask questions of Carnes, the Court will readily see that his opinions are not admissible under
nature, of Carnes’ method. That is, by his science, one well of the six wells that he used in his study disproves his hypothesis, i.e., that the “reconstructed p/z” method shows that gas has been stolen from the Leases. Stated differently, his “recalculated p/z” method, has an unreliability factor of 1/6 (.1667) - as shown by his own calculations! Nonetheless, he then multiplies his average stolen gas of 1,336,667 Mcf/well by the 69 wells drilled by EEI on the Leases and, thus, calculates a total volume of 92,230,023 Mcf of gas stolen between 1974 and March of 1989, when EEI relinquished operations of the Leases. As will be shown below, Carnes’ opinions based upon his “recalculated p/z” method are inadmissible under Rule 702 of the TEXAS RULES OF EVIDENCE and Robinson.

VI. ARGUMENT AND AUTHORITY

A. The Plaintiffs Have the Burden of Establishing That the Challenged Testimony Is Relevant and Reliable

Robinson requires that, if raised, the trial court must evaluate the relevance and reliability of expert testimony. In Robinson, the Supreme Court held that:

[i]n addition to showing that an expert witness is qualified, Rule 702 also requires the proponent to show that the expert’s testimony is relevant to the issues in the case and is based upon a reliable foundation.

923 S.W.2d at 556; Merrell Dow Pharmaceuticals, Inc. v. Havner, 953 S.W.2d 706 (Tex. 1997); Broders v. Heise, 924 S.W.2d 148 (Tex. 1996); See also, United Blood Services v. Longoria, 938 S.W.2d 29 (Tex. 1997); and Purina Mills, Inc. v. Odell, 948 S.W.2d 927 (Tex. App.- Texarkana 1997, writ denied).

Thus, the plaintiffs have the burden of showing that Carnes is qualified as an expert in calculating gas reserves in a field such as the one at bar, that his opinions are relevant, and that they are based upon a reliable foundation. As is obvious from his deposition testimony, Carnes’ opinions do not pass muster under Rule 702 and Robinson and should be excluded by this Court.

B. Rule 702 Sets A Standard of Relevance and Reliability
NO. 52,152

LIBERTY COUNTY OFFICERS ASSOCIATION § IN THE DISTRICT COURT
§ VS. § LIBERTY COUNTY, TEXAS
§ § 75TH JUDICIAL DISTRICT

DEFENDANT'S MOTION TO EXCLUDE EXPERT TESTIMONY

TO THE HONORABLE JUDGE OF SAID COURT:

COMES NOW, Liberty County, Texas, ("Liberty County"), defendant in the above entitled and numbered cause, and files this its Motion to Exclude Expert Testimony of Ronald DeLord ("DeLord"), Larry Watts ("Watts"), Mike Kirkpatrick ("Kirkpatrick"), and Charles J. Morris ("Morris") because Liberty County objects to the relevance and reliability of such testimony.

I. INTRODUCTION

1. Plaintiff, Liberty County Officer's Association ("LCOA") has designated DeLord, Watts, Kirkpatrick and Morris as expert witnesses in this case. However, neither DeLord, Watts, Kirkpatrick or Morris are qualified to give expert testimony as to this matter. Their testimony and purported "expert opinions" should, therefore, be excluded.

II. NATURE OF THE SUIT

2. This is an adversary proceeding brought by the Liberty County Officers Association ("LCOA"), under Tex. Local Gov't Code Ann.§14, et. seq., commonly known as the Fire and Police Employee Relations Act (the "Act") for this Court to "declare the compensation" and "other conditions of employment" for the affected sheriff's deputies.

3. By Plaintiff's First Amended Petition, the LCOA also purportedly seeks to have this Court issue a Writ of Mandamus and a Permanent Injunction. The LCOA contends that Liberty

APPENDIX 2
(Tex. 1996). It is the trial court’s responsibility to make the preliminary determination as to whether the proffered testimony meets the criteria of Rule 702. *E.I. du Pont de Nemours & Co. v. Robinson*, 923 S.W.2d 549 (Tex. 1995). In order to testify as an expert witness, a party must demonstrate that its witness is qualified, the expert’s testimony is relevant to the issues in controversy, and the expert’s testimony is based upon a reliable foundation. Rule 702 articulates what is required for an expert to testify:

> If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training or education, may testify thereto in the form of an opinion or otherwise.

Tex. R. Civ. Evid. 702.

7. Rule 702 of the *Texas Rules of Civil Procedure* allows the court to admit “technical or other specialized knowledge” to be presented by expert witnesses if it “will assist the trier of fact to understand the evidence or to determine a fact in issue.” *Robinson* adopts the interpretation of the language of Rule 702 given by the United States Supreme Court when it interpreted the corresponding Federal Rule of Evidence in its landmark decision *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 113 S.Ct. 2786 (1993), wherein the United States Supreme Court held:

> The subject of an expert’s testimony must be “scientific...knowledge.” The adjective “scientific” implies a grounding in the methods and procedures of science. **Similarly, the word “knowledge” connotes more than the subjective belief or unsupported speculation.** The term “applies to any body of known facts or to any body of ideas inferred from such facts or accepted as truths on good grounds.” Webster’s Third New International Dictionary 1252 (1986). (emphasis added)

113 S.Ct. at p. 2795

Moreover, the party offering the challenged testimony is required to show that the testimony will assist the fact finder, and that the testimony is relevant. *Robinson* requires that the party offering the expert testimony establish its relevance and reliability once a proper objection to the testimony is
County's privatization of the Liberty County Jail constitutes an illegal lock-out, that various acts of Liberty County purportedly constitute evidence of anti-union animus and bad-faith bargaining and union-busting.

III. NATURE OF THESE WITNESSES' PURPORTED AREAS OF EXPERTISE AND ANTICIPATED TESTIMONY

4. The LCOA has designated DeLord, Watts and Kirkpatrick to offer expert opinion evidence of the public and private sector compensation levels for law enforcement personnel similarly situated as plaintiffs, which plaintiffs contend should be "judicially enforced" in the case at bar. Moreover, DeLord, Watts and Kirkpatrick each attempt to opine regarding the ultimate conclusions of law to be drawn from their understanding and their review of what they believe the "facts" to be in the case at bar. The LCOA has designated Morris to offer expert opinion evidence on the legislative history of the Act and the application of the Act in a collective bargaining situation including issues surrounding collective bargaining in Texas and on the Federal level. Simply stated, the LCOA attempts to have Morris "instruct" this Court regarding the meaning of the Act and how he intended it to be applied to the facts in issue in this case.

5. Neither DeLord, Watts, Kirkpatrick, or Morris are qualified to give expert testimony as to the matters before this Court, nor or any of their anticipated opinions grounded upon a reliable and trustworthy foundation. Moreover, the anticipated "expert" testimony regarding the meaning of the Act, is not relevant. Each of these purported expert's testimony should, therefore, be excluded.

IV. THE LCOA HAS THE BURDEN OF ESTABLISHING THESE EXPERT'S QUALIFICATIONS

6. The party offering the expert's testimony bears the burden of proving that the witness is qualified under the Texas Rules of Civil Evidence, Rule 702. Broders v. Heise, 924 S.W. 2d 148
technical papers, textbooks, or publications, that use, or approve of, this type use of the "p/z" method, and his method has an unreliability factor of, at least, 16.7%! Stated differently, of the six wells his method used to prove theft of gas, by his method, one of the six wells, the Miers C-10, actually reported 500,000 Mcf more gas than Carnes' method calculated as originally in place, which is, of course, a physical impossibility. It is precisely this type of opinion testimony that the Supreme Court, in Robinson and Havner, has sought to exclude, because it is so unreliable and prejudicial. This Court should, therefore, exclude the damage opinion testimony of plaintiffs' expert, Peyton S. Carnes.

IV. CONCLUSION AND PRAYER

The purported expert testimony of plaintiffs' expert, Peyton S. Carnes, is not admissible under Rule 702 and the holdings of the Supreme Court in Robinson and its progeny. After a full evidentiary hearing on this motion, this Court should exclude the purported expert opinions of plaintiffs' expert, Peyton S. Carnes.

WHEREFORE, PREMISES CONSIDERED, defendants pray that their motion be set for hearing, and that upon hearing of such motion, the defendants' motion be granted, and that the Court grant defendants general relief.

Respectfully submitted,
DeLord, Kirkpatrick and Watts each admitted that they had no knowledge of private sector law enforcement compensation levels, nor had they ever made any comparisons between public sector law enforcement jobs and private sector law enforcement jobs. Their reliance on hearsay indicates that their testimony is untrustworthy. The Texas Supreme Court holds that an expert cannot base his opinions upon inadmissible hearsay evidence. Moore v. Granthan, 599 S.W.2d 287 (Tex. 1980) Rule 703 requires that if an expert intends to base an opinion solely on hearsay evidence, then it must be of a type reasonably relied upon by experts in the particular field in forming opinions or inferences upon the subject. Whether experts in the field reasonably rely on such data is a matter for preliminary determination by the trial court. Tex.R.Civ.Evid. 104(a); Robinson, supra. DeLord, Watts and Kirkpatrick, however, are not qualified experts in the particular fields in which the LCOA has designated them as experts. They would not, therefore, know whether the type of hearsay evidence they have relied upon is of a type reasonably relied upon by experts in the field of employment comparability studies. Because DeLord, Watts and Kirkpatrick do not even have the understanding as to what experts in this field would rely upon to form their opinions, their testimony is untrustworthy and should be excluded accordingly. DeLord’s, Watt’s and Kirkpatrick’s lack of prior personal knowledge about the private sector compensation levels and comparability issues involved in this case and their sole reliance on hearsay and hearsay within hearsay information renders their testimony untrustworthy. Thus, DeLord’s, Watt’s and Kirkpatrick’s testimony do not meet the reliability factor necessary for an expert to testify.

VIII. EXPERT’S SPECULATION TESTIMONY SHOULD BE EXCLUDED

16. In order to constitute probative force, an expert’s testimony should rely upon more than mere possibility, speculation and surmise. Schaefer v. Texas Emp. Ins. Ass’n, 612 S.W.2d 199 (Tex. 1980) DeLord’s, Watt’s and Kirkpatrick’s reliance on speculation suggests that any testimony
VI. THE CHALLENGED TESTIMONY IS INADMISSIBLE AND IRRELEVANT


14. DeLord, Watts and Kirkpatrick, three of the expert witnesses on behalf of the plaintiff to which Liberty County objects, attempt to opine in areas beyond their expertise. As shown above, each of these witnesses admits that they have not done a comparability study nor made any study or compensation of the compensation and working conditions of the Liberty County Sheriff's deputies to any private sector employment. Moreover, Mr. DeLord specifically admitted that he had never before performed a job comparability study comparing public sector law enforcement jobs to private sector law enforcement jobs. Testimony regarding areas in which a witness is not qualified as an expert by "knowledge, skill, experience, training or education" is simply beyond the scope of Rule 702, inadmissible and irrelevant. Tex. R. Civ. E. 702. Testimony which is irrelevant is inadmissible.

VII. OPINIONS BASED EXCLUSIVELY ON HEARSAY ARE UNTRUSTWORTHY

15. Expert opinions based exclusively on hearsay are untrustworthy. DeLord, Kirkpatrick and Watts attempt to offer opinions that the affected employees of Liberty County were not compensated in accordance with the mandate of Tex. Local Gov't Code Ann.§174.021, yet
made. *Id.* at p. 557. *Robinson* holds that the tendering party’s burden of proof is invoked by a motion to exclude an expert witness’s testimony. The LCOA’s designated experts are not qualified, and their testimony is not based upon a reliable foundation, nor is it relevant to any issue before the Court. Accordingly, DeLord, Watts, Kirkpatrick and Morris each should be excluded from testifying as expert witnesses in this trial.

V. DELORD, WATTS, AND KIRKPATRICK ARE NOT QUALIFIED TO EXPRESS EXPERT OPINIONS IN THIS CASE

8. The Texas Supreme Court holds that an offering party must “establish that an expert has ‘knowledge, skill, experience, training, or education’ regarding the specific issue before the court which would qualify the expert to give an opinion on that particular subject.” *Broders, supra.*, at p. 153; *United Blood Services v. Longoria*, 938 S.W.2d 29 (Tex. 1997). “The focus ... is on the ‘fit’ between the subject matter at issue and the expert’s familiarity therewith....” *Broders, supra*, at p. 153 quoting *Nunley v. Kloehn*, 888 F. Supp. 1483 (E.D. Wis. 1995).

9. DeLord, Watts and Kirkpatrick each claim to have some expert knowledge in respect of comparing compensation and working conditions in private sector law enforcement to public sector law enforcement. Yet, not one of these witnesses has before prepared a comparability study directed at comparing private sector law enforcement to public sector law enforcement.

10. In respect of DeLord, he admitted that he has never undertaken a comparability study comparing private sector law enforcement employment to public sector law enforcement employment. (See DeLord Deposition P.98:5-12) Moreover, his testimony indicates that he has no personal knowledge of the duties, assignments, wage rates or other factors prevailing in comparable private sector employment. (See DeLord Deposition P.96:2-21). To date, all of the testimony has indicated that none of plaintiff’s purported expert witness have any personal
knowledge of any prevailing private sector compensation and conditions of employment in the labor market area in other jobs that require the same or similar skills, ability, and training and may be performed under the same or similar conditions. These purported experts admit that they have only hearsay knowledge of any private sector employment compensation levels and/or conditions of employment. (See Kirkpatrick Deposition P.67:3-21; P.69:4-P.72:24). Simply stated, there is no “fit” between DeLord’s, Watt’s or Kirkpatrick’s training, experience, background and knowledge and the subject matter at issue in this trial.

11. Moreover, any and all testimony by plaintiff’s purported experts, DeLord, Watts and Kirkpatrick, to the effect that: Liberty County did not provide the affected employees with compensation and other conditions of employment that are substantially equal to compensation and other conditions of employment that prevail in comparable employment in the private sector; and based on prevailing private sector compensation and conditions of employment in the labor market area in other jobs of that require the same or similar skills, ability, and training and may be performed under the same or similar conditions, is rank speculation on the part of each of plaintiff’s so-called expert witnesses.

12. The mere fact that these witnesses may have collectively bargained contracts for other public sector law enforcement agencies does not qualify these witnesses to testify as to the standards of private sector comparable employments and/or damages to be applied in this trial. The court should focus on whether the witness’s expertise goes to the very matter on which he is to give an opinion. Simply stated DeLord’s, Watt’s, and Kirkpatrick’s background, training, experience and hearsay knowledge do not support the conclusion that they are qualified to offer expert opinion evidence in this case. Their testimony, therefore, should be excluded.
At the time of the hose failure, the circulating system at the surface ran through two valves at a Halliburton manifold, the Halliburton flexible hose, many feet of Pool's steel line, a Pool manifold of multiple valves, then through a line to the drilling fluid pits. The pressure from the well bore was being controlled by one of the valves at the Halliburton manifold.

To date, all of the testimony has indicated that the Pool valves (at the Pool manifold downstream from the plaintiff's location) were left open before and after the Halliburton hose failure. The plaintiff, however, has speculated that the Pool valve was closed during the operation, and that this closure led to pressure building up in the line and causing the hose to burst. The only testimony the plaintiff offers in support of his position which purports to be something other than rank speculation is that of plaintiff's expert witness, Mr. Mike Chiles, who performed some calculations which led him to the belief and opinion that the Pool valve was closed and that it was that closure which caused the hose to fail. Based upon this opinion, Mr. Chiles and the plaintiff's other liability expert, Mr. Tommy Tighe, opine that a multitude of negligent acts took place which led to the Pool valve being closed, including an alleged failure by Howell to properly supervise the operations. Without the affirmative opinion testimony of Mr. Chiles, the plaintiff has no evidence that the Pool valve was closed, and thus no evidence that Howell or Pool were negligent.

II. PLAINTIFF HAS THE BURDEN OF ESTABLISHING THAT THE CHALLENGED TESTIMONY IS RELEVANT AND RELIABLE.

a. DuPont v. Robinson requires a Trial Court to Evaluate the Relevance and Reliability of Scientific Testimony:

In DuPont v. Robinson, 923 S.W.2d 549, (Tex. 1995), the Texas Supreme Court held:

[t]hat in addition to showing that an expert witness is qualified, Rule 702 also requires the proponent to show that the expert's testimony is relevant to the issues in the case and is based upon a reliable foundation.
Motion to Exclude Expert Witnesses Testimony and for such other and further relief to which Liberty County may show itself entitled to.

Respectfully submitted,
COME NOW Pool Company and Pool Company (Texas) Inc., (referred to herein after collectively as "Pool"), defendants in the above entitled and numbered cause, and file this their Motion to Exclude Causation Testimony of Mr. Mike Chiles and Mr. Tommy Tighe because Pool objects to the relevance and reliability of such testimony.

I. FACTUAL BACKGROUND

This case involves a personal injury suffered by Mr. Paul Kenney ("plaintiff") while he was performing services at the Duson No. 4 Well (the "Well") site owned by Howell Petroleum Corporation ("Howell"), co-defendant in this matter. Howell contracted with Pool Company (Texas) Inc., to provide the rig and rig-crew at the site. Howell also contracted with Halliburton, the plaintiff's employer, to perform certain cementing and pressure control operations on the Well.

Plaintiff was injured during "well-killing" operations, i.e., operations to circulate gas out of the well bore which was exerting unusual pressures at the surface. When the incident made a basis of the above entitled and numbered cause occurred, the plaintiff was straddling a Halliburton hose which he had inserted into the circulation system. The hose failed, striking the plaintiff in the leg.
they might offer is without probative force and should therefore be excluded.

IX. MORRIS’S TESTIMONY REGARDING LEGISLATIVE INTENT IS IRRELEVANT

17. Morris’s anticipated testimony regarding the intent of the Act, and the Act’s correlation to the National Labor Relations Act is irrelevant. A statute must speak for itself and be construed by itself. No single person can be heard to say what the meaning of the statute is. Morris’s anticipated testimony is therefore not relevant to any issue before the Court in this case. Commissioners’ Court of El Paso County v. El Paso County Sheriff’s Deputies Association, 620 S.W.2d 900 (Tex.Civ.App.- El Paso 1981, writ ref’d n.r.e.).

X. CONCLUSION

18. No expert testimony should be admitted unless it constitutes valid, reliable, and relevant knowledge. Such is not the case in respect of DeLord, Watts, Kirkpatrick or Morris. The facts conclusively established by DeLord’s, Watt’s and Kirkpatrick’s deposition testimony demonstrate that they do not have the particular knowledge, skill, experience, training, or education to testify to the relevant issues in this case. Simply stated they lack the necessary expertise in this area. They have no prior personal knowledge regarding the particular issues involved in this matter. They rely upon rank speculation and hearsay and third-party hearsay regarding the issues involved in this matter. Their testimony is not trustworthy, and will not assist the trier of fact to understand the evidence. DeLord, Watts and Kirkpatrick should not be permitted to offer expert testimony in this case. Moreover, in respect of Morris, his anticipated testimony is irrelevant to any issue before the Court. Accordingly, Morris should not be permitted to offer expert testimony in this case.

WHEREFORE PREMISES CONSIDERED, Liberty County prays that this Court grant its
assist the fact finder, that is, that the testimony is relevant.

Robinson requires that the party offering the expert testimony establish its relevance and reliability once a proper objection to the testimony is made. Id. at p. 557. Robinson encourages trial courts to address the admissibility of scientific evidence in pretrial proceedings, and held that the Robinson's burden of proof was invoked by DuPont's motion to exclude Dr. Whitcomb's testimony. This encouragement is based on Rule 104 of the Texas Rules of Civil Procedure, which recommends that a court screen testimony subject to an objection out of the presence of the jury. In Robinson, the Texas Supreme Court encouraged the use of pretrial hearings that would compel the attendance of the challenged expert witness so that the trial judge could "freely ask questions." Id. at p. 558.

III. THE CHALLENGED TESTIMONY IS INADMISSIBLE AND IRRELEVANT.

a. Testimony Beyond A Witness's Expertise Is Inadmissible:


Mr. Chiles, the key and primary expert witness on behalf of the plaintiff to which Pool objects, attempts to opine in areas beyond his expertise. In his deposition, Mr. Chiles admitted that his mechanical engineering background had not led him to a career in the oilfield, but rather into...
construction, design and testing of machinery and systems, some of which had applications in the oilfield. (See Attachment A to Exhibit 1, at 8-20) Mr. Chiles admitted that he had no oilfield or petroleum engineering background and, upon specific questioning, was unable to relate the meaning or significance of common oilfield terminology relevant to this case. (See Attachment A to Exhibit 1, at 140) Moreover, Mr. Chiles was unable, in deposition, to relate the very formulas upon which his testimony was based, noting that these calculations were made in his computer program. (See Attachment A to Exhibit 1, at 22) In addition, Mr. Chiles stated unequivocally that he was not qualified to answer questions on well control procedures - the exact type of procedure which was taking place at the time of the hose failure in issue. (See Attachment A to Exhibit 1, at 140)

Further, Mr. Chiles specifically admitted that he had never done a two-phase flow analysis before. (Attachment A to Exhibit 1, at 64) Mr. Chiles admitted that he never before had used one of the computer programs he employed to perform his calculations. (Attachment A to Exhibit 1, at 64-65) In fact, Mr. Chiles did not even run the computer program, or input the data, to derive his calculations. (Attachment A to Exhibit 1, at 64-65)\(^1\) Testimony regarding areas in which a witness is not qualified as an expert by "knowledge, skill experience, training or education" is simply beyond the scope of Rule 702, inadmissible and irrelevant. *Tex. R. Civ. E. 702.*

b. Testimony Which Is Irrelevant Is Inadmissible:

Under Texas law, testimony of causation is only relevant if it allows a jury to find that the proffered cause of a plaintiff's injury is the most likely one, that is, causation must be proven within

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\(^1\)Note that Mr. Gloynes, the person at Mr. Chiles's office who actually did the computer work, was not identified in response to Howell's or Pool's interrogatories as someone with knowledge of relevant facts or as an expert witness (consulting or testifying), despite the fact that Mr. Chiles was relying on his work.
reasonable probability. *Parker v. Employers Mutual Liability Ins. Co. of Wisconsin*, 440 S.W.2d 43, (Tex. 1969). Expert testimony will not support a finding of causation if such testimony merely supports one of several possible causes. *Fort Worth Steel & Mach. Co. v. Norsworthy*, 570 S.W.2d 132 (Tex.Civ.App.-Tyler 1978, writ dism'd). When a jury could not rely on expert testimony to find causation within a reasonable probability, the testimony is irrelevant. *Daubert v. Merrell Dow Pharmaceuticals*, 43 F.3d 1311 (9th Cir. 1995) (where expert testimony did no more than raise a possible link between Bendectin and birth defects, plaintiffs could not meet their burden to prove causation within reasonable probability under California law, and thus testimony was irrelevant).

Moreover, for expert testimony to be relevant, it must "fit" the facts of the case, i.e., proposed testimony is relevant only if it is sufficiently related to the facts of the case to assist the jury in resolving a factual dispute. *Robinson, supra* at page 556. Mr. Chiles offers opinions regarding oilfield operations and calculations, despite the fact that he has admitted that he ignored critical facts and the key scientific basis for the analysis of this case. Because of this, his testimony should be excluded.

Mr. Chiles' testimony is crucial to the plaintiff's case. Mr. Chiles provides the only testimony that rises above rank speculation that someone from Pool closed a valve downstream of the Halliburton hose that failed. Thus, the crux of plaintiff's case is centered of Mr. Chiles' calculations which, plaintiff asserts "prove" that someone closed the Pool valve. (Attachment A to Exhibit 1, at 51) Without Mr. Chiles' opinion, the plaintiff is left with no evidence beyond sheer conjecture, solely in the range of a "possibility," that someone closed a Pool valve on the system.

Under the *Robinson* test, however, Mr. Chiles' calculations are flawed and irrelevant to the case at hand. During his deposition, Mr. Chiles was asked if his analysis relied on single-flow or
The Supreme Court went on to opine that the use of experts is "widespread" and "the scientific theories about which these experts often testify have increased in complexity and have become more crucial to the outcome of the case." *Id.* at page 552-553. Such is the case when expert witnesses are used to prove causation in an oilfield personal injury case, such as the case at bar. Because of the heightened significance of expert testimony in most cases, more careful scrutiny of the testimony's validity is required because the Texas Supreme Court recognized the danger that jurors would accept an expert's testimony because of the aura of the expert's status. *Id.* at page 553. The *Robinson* court also doubted the facility of jurors to evaluate scientific evidence, expressing particular concern that jurors are asked to resolve complex issues on which not even the experts agree.

b. **Rule 702 Sets A Standard of Relevance and Reliability:**

Rule 702 of the *Texas Rules of Civil Procedure* allows the court to admit "*scientific* . . . knowledge" to be presented by expert witnesses if it "will assist the trier of fact to understand the evidence or to determine a fact in issue." *Robinson* adopts the interpretation of the language of Rule 702 given by the United States Supreme Court when it interpreted the corresponding Federal Rule of Evidence in its landmark decision *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 113 S.Ct. 2786 (1993), wherein the United States Supreme Court held:

The subject of an expert's testimony must be "scientific... knowledge." The adjective "scientific" implies a grounding in the methods and procedures of science. **Similarly, the word "knowledge" connotes more than the subjective belief or unsupported speculation.** The term "applies to any body of known facts or to any body of ideas inferred from such facts or accepted as truths on good grounds." Webster's Third New International Dictionary 1252 (1986). (emphasis added)

113 S.Ct. at p. 2795.

Moreover, the party offering the challenged testimony is required to show that the testimony will
two-phase flow of fluids through the piping assembly. (Attachment A to Exhibit 1, at 23-31) Two-phase fluid flow (gas and liquid) is radically different from single-phase flow (gas or liquids), and the behavior of fluids (gas and liquids) in two-phase flow is an incredibly complex area of science. Mr. Chiles stated under oath that his analysis applied only to single-phase flow, and that his analysis had no application to a situation involving two-phase flow. (Attachment A to Exhibit 1, at 25) When presented with undisputed testimony that the well was experiencing two-phase flow at the time of the hose failure, i.e., that gas was included within the stream of drilling fluids coming to the surface just before the hose failure, Mr. Chiles stated that because he could not measure the amount of gas in the system at the time, he chose to disregard the gas phase and accordingly, that he avoided a two-phase flow analysis. (Attachment A to Exhibit 1, at 30-31) In light of these admissions, Mr. Chiles was specifically asked:

Q: Your calculations then, since they don't take that [gas in the system] into account, don't truly depict and show [what] the condition of pressure at the various stages in this system were when Mr. Kenney was injured, do they sir?

A: I believe what you're saying is correct. (Attachment A to Exhibit 1, at 31)

This testimony leads to one simple conclusion - Mr. Chiles' analysis is not relevant to this case. Under a Robinson analysis, however, an expert's testimony must be both relevant and reliable. Because Mr. Chiles' testimony is not relevant, it should be excluded from presentation to the jury in this case.

C. Methodology That Is Unreliable And Speculative Is Incapable Of Proving Causation Within Reasonable Probability:

Not only is Mr. Chiles' testimony irrelevant, but it is also unreliable. Robinson identified the following non-exclusive factors as being important for trial court to consider when evaluating the
testimony is inherently unreliable and should be excluded from this cause. Further, Mr. Tighe's testimony, which is keyed on Mr. Chiles' calculations, is similarly unreliable.

d. Testimony Which Is Speculative Is Inadmissible:

Moreover, when the entire proof of a plaintiff's case is based upon circumstantial evidence, the Texas Supreme Court has held that any testimony of negligence, including that of an expert witness, cannot be based upon piling one presumption upon another. Texas Sling Co. v. Emanuel, 431 S.W.2d 538 (Tex. 1968). In this case, just like Emanuel, the plaintiff has no lay or factual testimony that the Pool valve was closed. Rather, plaintiff relies upon the irrelevant calculations and conjecture of Mr. Chiles to determine that the Pool valve was closed. From this conjecture, plaintiff next presumes that the Pool personnel were ignorant of the fact that they should not close the Pool valve, and form that conjecture plaintiff presumes that Howell and/or Pool had a duty to control the activities of the workers on the site and failed in that duty. This series of conjectures did not support a jury verdict in Emanuel as a matter of law, and should not reach the jury in this case.

IV. CONCLUSION:

Based upon the analysis provided above, and the testimony Pool will present at the hearing on this matter, the key underlying theory advanced by plaintiff's expert Mr. Chiles is both irrelevant and unreliable and should be excluded from the testimony in this cause because it fails to meet the evidentiary standards of Robinson. Moreover, because Mr. Chiles' and Mr. Tighe's expert opinions are necessarily based on Mr. Chiles' flawed hypothesis, Pool moves to exclude all testimony from both of these men.

Respectfully submitted,
reliability of proffered scientific testimony:

1. the extent to which the theory has been or can be tested;
2. the extent to which the technique relies upon the subjective interpretation of the expert;
3. whether the theory has been subjected to peer review and/or publication;
4. the technique's potential rate of error;
5. whether the underlying theory or technique has been generally accepted as valid by the relevant scientific community; and
6. the non-judicial uses which have been made of the theory or technique.

932 S.W.2d at p. 38. Factors 1, 3, 4 and 5 all implicate the employment of the scientific method for testing the expert's hypothesis, while factors 2 and 6 are aimed at the expert's objectivity, and particularly whether the expert has formed opinions solely for litigation. Application of these factors reveals that Mr. Chiles' testimony is unreliable.

The formula or theory advanced by Mr. Chiles as the basis for his analysis has been tested, but the tests of this theory show that it does not apply to two-phase flow. Even Mr. Chiles admits that his calculations do not truly reflect the pressures experienced at the well site. (Attachment A to Exhibit 1, at 31) Accordingly, the technique's rate of error may well be 100% in this application. Further, Mr. Chiles' theory, although generally accepted by the scientific community for single-phase flow analysis, is not accepted for two-phase flow analysis. Finally, Mr. Chiles' theory relies heavily upon his subjective determination that certain facts do not exist and that certain persons' sworn testimony or statements are false. (Attachment A to Exhibit 1, at 56-57) Accordingly, Mr. Chiles' testimony is unreliable.

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1676-32/KMN/PAM/MOT TO EXCLUDE CAU TEST

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2 As this Court is aware, an expert may not opine as to whether a witness is telling the truth or not.