The challenges for isotopes in the petroleum industry

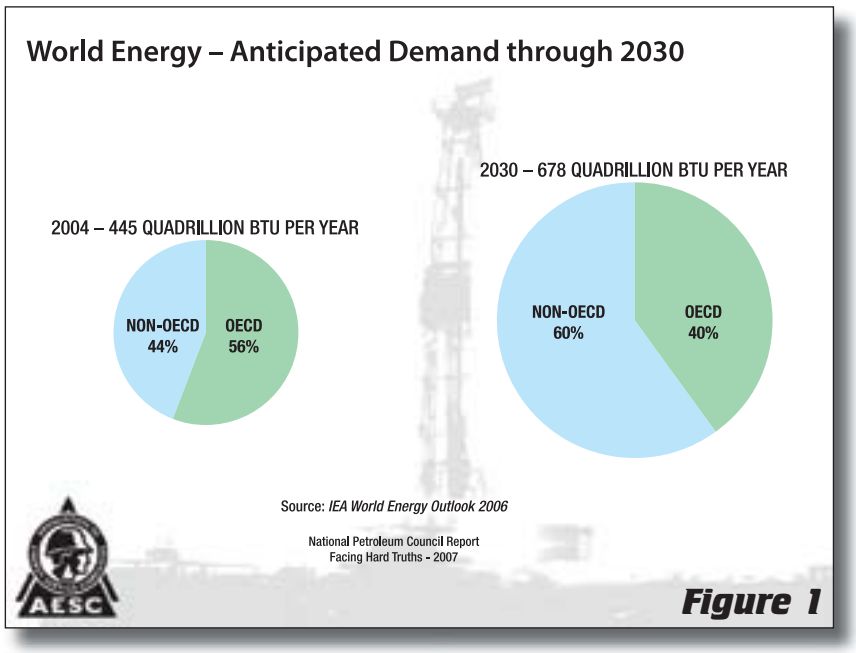

Figure 1

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"Communication is everyone's panacea for everything"
— Tom Peters (management guru)

We all know that communication stands in the very forefront of success in any endeavor. Conversely, time and time again the lack of communication is cited as a principle cause of failure. The AESC works diligently to communicate with its members, non-members and those who would, could or should impact our industry on issues that affect our lives and livelihood.

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Although it seems a daunting and never-ending task, the need to communicate with government is critical. The alternative is bleak — government regulation based on a formula of reasoning that is privy only to them and unfathomable to the rest of us. As each new challenge to our industry arises, we must rise to the challenge and once again, communicate, teach and enlighten.

The challenge

The directive for the reduction or elimination of all forms of radioactive materials in the petroleum and other industries by substitution of non-radioactive materials or techniques — that is our challenge.

In the wake of the events of September 11, 2001, federal government agencies, both old (USDOT, ATF, NRC, EPA) and new (Homeland), have decided that the acquisition and use of radioactive material from non-government entities is the most likely route to build a "Radiological Dispersal Device" (RDD) — or what the world has come to know as a "Dirty Bomb." The concept of

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radioactive materials acquisition in the petroleum industry, as well as the call for improved self-security has been discussed in previous *Well Servicing* articles (March/April 2006 and November/December 2002) as well as presented at several AESC annual meetings. It was this communication coupled with

the savvy lobbyists employed by the AESC that encouraged these governing agencies to seek and include input from the AESC on the impact of this directive to eliminate or mitigate the use of radioactive materials in our industry as well as others.

The importance and role

So, what *is* the importance and role of isotopes in the petroleum industry? First, a few definitions for those who may not speak the language:

- *Logging* – the process of taking geophysical and other wellbore measurements using electrical, magnetic, acoustic, nuclear and mechanical means. Can be performed during or after drilling operations or both.
- *Open hole* – freshly drilled well held open by the weight of the drilling fluid.
- *Cased hole* – casing pipe that is cemented into place after drilling to hold the well open.
- *Tubing* – removable smaller pipe that is used for the actual production of the oil and/or gas.
- *Production formation* – usually sandstone, limestone, dolomite and certain shales.
- *Porosity* (includes fractures and other voids) – the space between the solid formation materials that can hold oil, gas, water and/or clays and shales.

Now, let's start with the "importance" of isotopes. From **Figure 1** we can see that the anticipated demand for world energy is expected to be 678 quadrillion BTUs per year in 2030. That is over 1.5 times the demand in 2004 of 445 quadrillion BTUs, according to the IEA's Facing Hard Truths 2007 report. Where are we going to get that anticipated energy? Look at the recorded percentages from the various suppliers of these BTUs from 1988 and 2004 and the predicted percentages of contribution in 2030, shown in **Figure 2**.

You can see that the major contributor of BTUs past, present and future will be oil and gas. Furthermore, the relative percentages of contribution remain approximately the same, despite incentives and development of

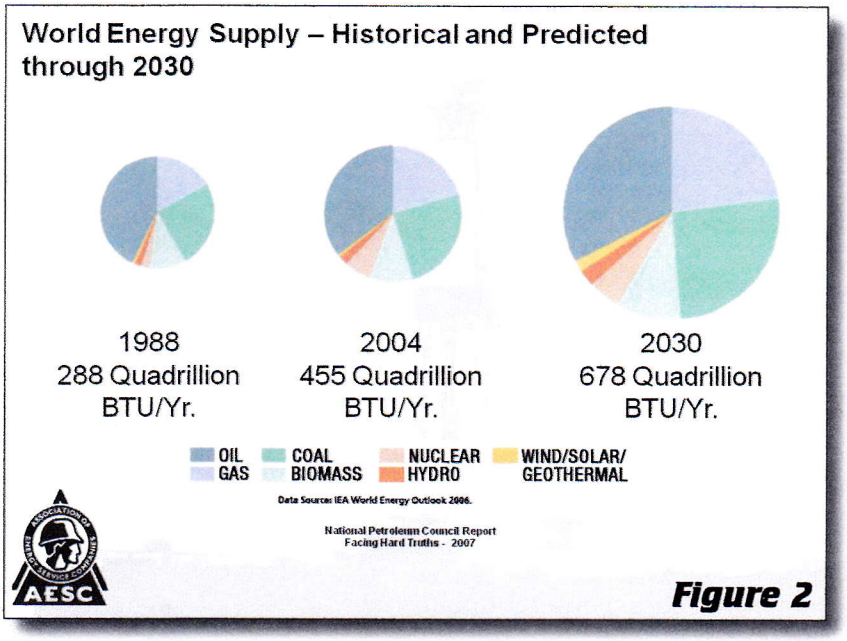

Figure 2

Bottom line: oil and gas is still the worldwide leader of supplied energy and is expected to remain the leader for decades.

other alternative energy sources like biomass, hydro, wind, solar and geothermal now and in the future. Bottom line: oil and gas is still the worldwide leader of supplied energy and is expected to remain the leader for decades. Furthermore, the world is going to need a lot more energy than we are using today. To keep up with this demand, we need to find more petroleum reserves by drilling more wells and by logging — specifically nuclear logging.

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The logging services are a vital part of every well! Every well requires formation evaluation and logging is a key component of this evaluation **(Figure 3)**. The quality and accuracy of data is key in determining if the well is a producer or "dry hole." This evaluation supports and drives production estimations, well economics, reserve calculations, corporate and government energy assets and the overall market fundamentals. In addition, logging also supports a producer's ability to commit to long-term projects with less than certain payback, provides support for filing a producing company's statement of reserves, and helps value royalty payments back to state and federal government and drives legislation. Most importantly, the U.S. is most affected as it has 50 percent of the world's activity, 25 percent of the world's consumption and less than 5 percent of the world's reserves. So there is the greatest need for an immediate continuity of supply, preferably out of the control of others not so friendly to our country.

Consider **Figure 4**, which are the equations for determining reserve estimates. The symbol phi (ϕ) is the symbol for porosity of the formation, which determines reserves ($$$$). It is the critical part of each equation. Porosity is more accurately determined by nuclear logging using sealed sources of radioactive material. Archie's equation uses porosity as another critical part of these reserve estimate equations in order to determine the water saturation (S_o) of the formation. Without nuclear logging in open hole, the ability

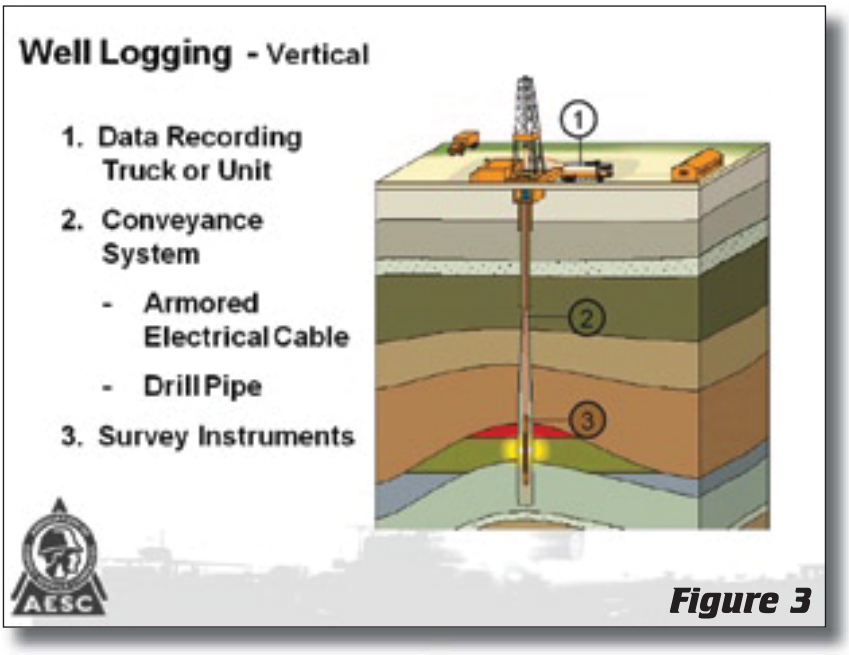

Figure 3

to determine the initial economic viability of a well and its potential reserves are greatly reduced.

By using radioactive material, we can now determine if a well is potentially economically viable and then run the casing. The use of radioactive material is now introduced to optimize the completion and production of the well in a wide spectrum of nuclear services. For example, radioactive fracture-tagging introduces unsealed radioactive isotope(s) into the pressure pumping operations to determine the performance of the induced fractures both horizontally and vertically. This nuclear service is widely used whenever formations need to be stimulated by fracturing.

During the life of the well other radioactive materials, sealed and unsealed, are utilized to keep the well working at peak efficiency and longevity. Radioactive tracers are utilized to determine flow of fluids inside and outside of the casing, injection profiles and finding leaks in the casing. Sealed source neutron logging can be used to confirm casing or liner placement in relation to the formations so that mechanical references like collars versus formation position can help with accuracy of perforator placements in shaly (a natural radioactive material itself) formations. Radioactive "pips" (small slivers of radioactive material) can be placed in the joints of casing to also determine mechanical positions of casing versus formations for accuracy of placement of subsurface tools or perforators. It is even possible to place radioactive "pills" in multiple-string completions to help point a radioactively oriented perforator away from the other strings of pipe. In storage operations, radioactive sealed sources can be used to determine the levels of fluids in a tank or a storage cavern. In testing operations, radioactive sealed sources are used to determine the mechanical integrity (thinning, fracturing, scale build up) of tubulars, pipelines, tanks and welds.

All in all, radioactive material plays a crucial role in almost every aspect of exploration, production, delivery and storage of oil and gas.

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Without radioactive material, the petroleum industry would be a much riskier business to invest in, have less opportunity to discover new reserves or improve the ones we already have, and be much more dangerous to work in. The variety of radioactive materials that are currently deployed in this industry have been proven to be the best method of finding oil and gas safely and efficiently for the energy needs of today and tomorrow. We as an industry recognize our obligations to protect these materials from misuse and have done so with admirable results through cooperative efforts with our nuclear regulators. We continue to improve security of our radioactive assets and should there be those who would use radioactive material for their cowardly acts, it won't be

Without nuclear logging in open hole, the ability to determine the initial economic viability of a well and its potential reserves are greatly reduced.

from our industry and it won't be on our watch. We know the value, importance and role of radioactive isotopes in the petroleum industry. And now, so do you.

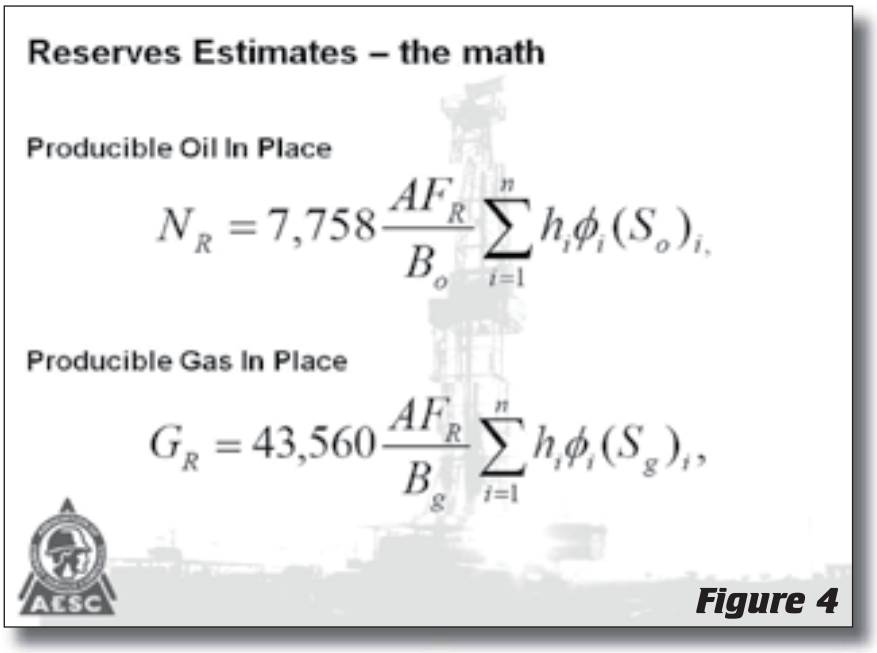

Figure 4

By using radioactive material, we can now determine if a well is potentially economically viable and then run the casing.

***ABOUT THE AUTHOR**: Eric L. Rosemann is the director of HSSE for Gray Wireline Service and serves as chairman of the Subcommittee for Radiation Safety and Security of AESC. Rosemann is a board-certified safety professional.*

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