WORKING THE PORE PRESSURE PUZZLE: Different languages, same goal

By Linda Hsieh, assistant managing editor

Pore pressure knowledge is critical when designing a well. It’s unlikely that anyone in this industry would argue with that. Pore pressure drives the casing design, which drives the well plan, including hole sizes and mud weight. An inaccurate pore pressure model could even lead to a well control event, causing financial losses or, worse, injuries or fatalities. This is an industry that respects pore pressure, as well it should.

However, if you ask how pore pressure data should be collected and interpreted when designing a well, your chances of finding an argument will go up considerably. Geologists, geophysicists, petrophysicists, geomechanists, drilling engineers – they all have a stake in the pore pressure model. Yet sharing their piece of the puzzle – whether it’s seismic velocity data, regional or local geologic data, offset well data, or any other data – is often not an easy task.

Pore pressure is an inter-disciplinary subject and requires many different experts of different backgrounds – people who, you might say, think in different languages – to work together. How can companies cross departmental or disciplinary boundaries? DRILLING CONTRACTOR spoke with three operators to find out how they’re achieving efficient information-sharing in order to complete the best-possible pore pressure model.
THE CONSENSUS? Communication, communication and more communication.

DEVON ENERGY
To get seamless communication regarding pore pressure at Devon Energy, cooperation between its corporate team (geophysicists, petrophysicists) and the divisions (six worldwide – Gulf of Mexico, international, Canada, Central US, Western US and Southern US) is a must.

When a division is notified of a well to be drilled, it knows it must immediately reach out to the corporate team to get the ball rolling on seismic data, said Marty Rolleg, drilling manager for Devon’s international division.

The corporate team doesn’t always know what wells are being planned or drilled, so it’s up to the division team to proactively bring the key players into the project and keep them informed throughout.

“It’s paramount that communication be made as early as possible. (The geophysicists and petrophysicists) are scientists who don’t necessarily keep up with rig schedules,” he said. It may take them six to eight months to prepare a velocity-driven pore pressure model, depending on the availability of seismic data. Then they may have to QC the data or recalibrate it. “We have to get them involved early on.”

At the same time, the division team will be working from the drilling perspective by looking at offset well data and leak-off test results to get a handle on fracture gradient trends. A five-man drilling engineering team works with both the Gulf of Mexico and international divisions at Devon. Together, the two teams will integrate all available data, complete a pore pressure analysis and create a final product.

“This is not an easy process. I promise you,” Mr Rolleg said. “It’s a lot of work to coordinate it, and it requires a lot of face-to-face communication.” But cooperation is a must, especially on today’s $100 million deepwater wells where spread rates run in the $700,000-$800,000 range. “We can’t afford a mistake,” he said.

Because you can never be sure about the pore pressures you’ll see until you actually drill into it, Mr Rolleg believes that, from a drilling perspective, leak-off tests are almost always a good idea.

“You can look at seismic and come up with the same numbers, but there’s a lot of subjectivity in the way data is interpreted and sometimes manipulated. Moreover, the data could be bad to begin with. If you used bad data to come up with the pore pressure model, it won’t be worth the paper it’s written on. But if you do a leak-off test, you get a finite number you can hang your hat on.”

Drilling without a pore pressure model would be like putting on a blindfold and driving – you can get in trouble really fast. My company would rather avoid costly mistakes by having a quality pore pressure program,” he said. “I wouldn’t say (inter-disciplinary communication) is a problem. It’s the way we do our day-to-day business.”

BP
For a company of BP’s size, communication about anything – not just pore pressure – can be a challenge, said Richard Keck, BP Gulf of Mexico drilling & completion technology manager. Just within the Gulf of Mexico region, BP has three business units (exploration, appraisal and production) that make up separate assets and separate teams. Getting these units to share general knowledge – best practices, lessons learned – can already be a daunting task. Not surprisingly, with something as complicated as pore pressure, the challenge of sharing gets even tougher. “Pore pressure hits a lot of different areas and crosses so many disciplines. It’s extra hard to make sure communication takes place, but also extra critical.”

Mr Keck pointed out that BP has implemented several initiatives to help its employees communicate with one another. For example, global discipline networks pull together employees with monthly teleconferences to share lessons learned, case studies, etc. Global functional conferences – akin to industry conferences but only for BP staff – also encourage cross-communications. Approximately 300 people attended BP’s drilling and completions conference in 2007 in Athens.

For multidisciplinary communication, BP has instituted two variations of “integrated teams” in its Gulf of Mexico deepwater operations, Mr Keck explained. The first and more traditional variation is the integrated asset team. This team includes experts such as geophysicists, reservoir engineers, drilling engineers, operations geologists, in-house subject matter experts and service company representatives. They stay within assets and follow wells through their entire life, thereby building up rich and deep knowledge about each particular asset.

Although this asset-based approach has worked quite well, a couple of years ago BP decided to tackle the integrated team concept in a second and complementary way – the Tiger Team. This is an integrated, multidisciplinary group similar to the asset integrated teams. It follows critical wells through from well planning to execution to lessons learned and goes from asset to asset.
Pore Pressure

The Tiger Team was initially created for exploration projects, he continued, but its success over the past couple of years has already prompted BP to create a second Tiger Team for the appraisal unit as well.

“It’s kind of a SWAT team approach. One of their mandates is to ensure communication, that people are talking to each other,” he said. “They look at integrated pore pressure/frac gradient predictions before we drill the well and also while we’re drilling, in addition to other things that cross disciplinary boundaries.”

For example, Mr Keck noted that BP is now drilling a rank wildcat where offset data is sparse, and the Tiger Team working on that well “is living and breathing” integrated pore pressure work.

The Tiger Team carries a significant depth of knowledge about the various disciplines, gathered by working on assets worldwide, but the trade-off is that they lack the asset team’s depth of understanding about the asset, he said.

Still, he noted that one well can have both teams working on it at the same time, so the two can cancel out the other’s deficiencies. “They’re meant to complement each other.”

PIioneer Natural Resources

At Pioneer Natural Resources, Steve Mamerow, vice president, worldwide drilling & completions, believes that communication about pore pressure and fracture gradient requires what he calls the 4 C’s: commitment, communication, coordination and cooperation.

The process starts with management commitment, he said: “You can say it, but if you’re not really committed to it, it just won’t happen.”

Pioneer approaches the communication process through a multidisciplinary team that adheres to the 4 C’s. From the beginning of the development of a prospect, experts from the different disciplines are pulled together to share what information they already have – seismic, geologic or offset – to begin discussions about pore pressure and fracture gradient trends and eventually form a pre-drill model. But the communication shouldn’t stop there, he said.

Disciplines such as geology, geophysics and petrophysics have to “be a part of the implementation phase to effectively achieve what we’re trying to get at,” Mr Mamerow said.

Even with careful planning, there are no guarantees, and what drillers run into while drilling can often be different from what was predicted.

“Who better to advise us when we see things different from what was planned than the people who helped us to plan it in the first place?” he asked. “They may be working on another prospect or developing a new drilling opportunity, but we keep them in the team as a resource as we’re drilling.”

Throughout the process, the operations geologist plays a critical role as the team tries to convert raw data into a pore pressure model, Mr Mamerow said. Seen as the transition person who works between the project geologist (who identifies and develops various prospects through seismic and geology) and people on the operations side, an operations geologist can be a buffer between abstract-thinking scientists and practical-thinking engineers.

“It’s sometimes a little more difficult to have engineers and project geologists thinking similarly. The operations geologist can understand what the project geologist is saying better than drilling people do sometimes. He understands our drilling needs, and we can understand what he’s bringing to the table,” Mr Mamerow said.

“So for example, the project geologist might map out the structure at a certain depth with a certain pressure and maybe map some faults. But the impact of what the faults might mean when we try to drill through them, that is better understood and communicated by the operations geologist.”

Another critical role in pore pressure communication at Pioneer is played by the life cycle document. “It’s a communication tool that pulls all the groups together. It establishes what each group expects to see in the well and what the range of uncertainties are. As you’re talking through the plan and implementing the program, it gives the team something to reference and guide the discussion,” he said.

Mr Mamerow said he believes that at a project’s very beginning, drilling engineers do take on some extra responsibilities for pulling the right information out of the right people. But each person still has an obligation to provide their portion of the data and help the team develop the best well plan possible.

“It is a joint effort, and this goes back to the 4 C’s I mentioned earlier. If you have commitment, communication will occur and you will get cooperation instead of having to drag information out of people,” he said.

Coordination is also absolutely necessary so that no piece of the puzzle gets left out when putting together the pore pressure model. All data and interpretations of the data are tools that can be used to make a more accurate prediction. The more tools there are, the closer they can get to predicting the true pore pressure. “We take all the information we can find, and, as a group, try to determine which of those we can really believe and which aren’t likely at all. But we never toss them completely because we need to keep it in the range of possibilities and develop contingency plans — in case the unlikely is true.”

In one example, he said, Pioneer drilled a well several years ago where high pressure was expected at 18,000 ft but showed up early at 17,000 ft — a scenario that one site-specific interpretation had predicted yet wasn’t adopted as the final pore pressure model. Awareness of this possible scenario during pre-drill planning allowed the company to be “somewhat prepared” and to avoid a well control event, he said. Any one piece of information could be the critical piece that makes the well a success or failure, which is what makes communication across disciplines so critical.

And what may be even harder than working together is understanding each other — whether through Engineer-speak or Physics-speak or Geology-speak.

Mr Mamerow said that the drilling and completions people at Pioneer try to include geoscientists in their well reviews. Discussion at these meetings can touch on how drilling could have been improved if certain geologic/seismic information had been made available to them.

“And it goes both ways,” he continued. “We try to get included when they have geologic reviews, for example, so we can see what motivates them to model the prospect the way they do. I think (information sharing) has always been something we all wanted, but a lot of the times, we didn’t speak the same language.”

Web exclusive: Get a service company’s perspective on the pore pressure communication challenge at www.drillingcontractor.org.