Marty Stetzer: Hi everyone, and welcome. I'm Marty Stetzer, president of EKT Interactive in Houston. We're proud to be the podcast sponsor with the Society of Petroleum Engineers, Gulf Coast Section. The section was founded in 1935 and now has over 11,000 members. It is a volunteer organization that provides member forums to upgrade and maintain professional competency. This podcast is one of a series and another learning resource available to the members. Numerous on-demand webinars can be accessed at www.spegcs.org.

Today, our topic is, as a facilities engineer… how to make your mark in a sustainable world. And I'll be speaking with Mr. Ken Arnold, with over 55 years in the upstream industry. We're really happy to have his input at this time of unprecedented challenges in our industry, especially those that affect the future of US natural gas supplies. Ken, thank you so much for taking the time today.

Ken Arnold: You're welcome, Marty. It's a pleasure to be here.

Marty Stetzer: Ken, when we planned this topic, we talked about the new efforts concerning sustainability and the focus on methane emissions, and how this will affect the challenges and careers faced by facilities engineers in the future.

We listed three major issues affecting the future of US oil and natural gas, including:

How are the new regulations imposed by Colorado and New Mexico, as well as the global EU methane strategy, going to affect the future of the oil and gas industry? Second, is methane leakage from improperly maintained equipment along the supply chain. And finally, continued routine venting and flaring in the field.

Let's start with, should the US oil and gas associations be more proactive in addressing these challenges… and have they been?

Ken Arnold: Okay. It's a great question. And I'd like to answer it in three different parts. First, I think I need to talk a little bit about the future of the oil and gas industry, and then about what that means as far as opportunities for facilities engineers, and finally get to the question itself, which has to deal with the proactivity of the industry. So let me start.

We all know that we have to do something to reduce the amount of greenhouse gases being emitted to the atmosphere. I think that most of us have agreed that by 2050, we should be neutral, in trying to do that… but we have to also understand that doesn't mean that oil and gas is going to disappear by 2050. We have to continue to produce oil and gas. The rate at which we're increasing the production of oil and gas is probably slowing and it will slow in the future over what it was in the past.

But we don't know exactly when the peak demand for oil and gas will be -- somewhere between 2030 and 2050? I guess it depends on a lot of activities that go on and what people do.

But as you know, just to stay steady, we have to continue to produce oil and gas. We have to find new fields. We have to develop new fields because the old fields are always in a state of decline. And so, we always have to go forward on some basis in doing more work, to get things done.

What I see happening to the industry is this slowdown in growth. And the fact that the growth is not going to be so much in developing oil in more hard-to- get places and more frontier areas, and

developing it from fields that are harder to produce. That's what happened through most of my life… is we were trying to figure out how to produce heavy oil, how to produce from the oil sand, how to go into ever-deeper water, how to do horizontal drilling and fracking. All of this had an impact on the facilities engineers during my 55 years.

I think what we're going to see is more of an emphasis on "How do we produce more efficiently? How do we produce in a way that's more sustainable? How do we use technology better to reduce the greenhouse gas emissions?" We have to reduce the greenhouse gas emissions from what we're doing today, what we're doing in the future.

And of course, we have to find ways of offsetting that because we just don't... It's not possible without huge technology changes and huge changes in supply… for us to replace all of the base load of nuclear energy, coal, oil, and natural gas in generating electricity very quickly. This is a long-term prospect. We're still going to be producing oil and gas far into the future, and far into the future of anybody who's alive today.

And we just have to be able to figure out how to do that, how to offset the emissions. And that means we have to make the emissions as small as possible. So what does that mean from the opportunities for facilities engineers?

I can see a future and it's here. It's upon us already. Back in the old days, we didn't have to worry about that. I actually started in the industry before there was much of an effort on protecting the environment. And in essence, you could fly over the Gulf of Mexico in a commercial airplane and see where every platform was, because you could look at the oil slicks in the Gulf, and they all started at a point. And all you saw was that little point – and that was the platform – because we weren't even aware of what we were doing to the environment.

We thought we were doing things right. We thought that… we were fishermen, we were hunters, I and we lived in the area. We thought everything would be fine, but we had to educate ourselves and we did. And we've gotten better with time and all that meant we had to come up with new challenges for the facilities engineers to handle.

There was a time when we thought, oh, my God, it's impossible that we could ever live with produced-water discharges of less than a hundred parts per million of oil and water. But we developed the technology and we developed the facilities and we learned how to operate and maintain them. And now, it's pretty often that much of the work that we do off shore, we are in the range of 15 to 25 parts per million of oil and water. This is a huge change from where we started.

And I can go on with other stories of that nature as well. Once upon a time, we had burn pits for every onshore facility in the marsh in south Louisiana. And we learned that that was a bad idea. You could, again, fly over the marsh in south Louisiana and see these big clouds of black smoke… where we were burning residual oil or slop oils in these burn pits. We've done away with all of those. We figured out that that was bad. And we've done away with that. We've come up with new facilities that are much more efficient than the old facilities. That was what we did in the past.

Now we have to look at, "How can we use other technology? How can we use better artificial intelligence?" There are big efforts going on to create what we call "digital twins" of our production facilities, so that we can actually monitor on our computers what's happening in the production facility.

And we can see things happening before they become a problem, and we can make the necessary changes. We can go from having failures of our equipment, to being able to predict when a failure will occur so that we can do preventative maintenance in a planned way that's much more efficient than waiting for something to break, and then trying to figure out how we're going fix it.

So I think with modern instrumentation, with modern ideas of artificial intelligence being inputted into the way we design and maintain our equipment. And with the increased expectation, in order to have the license to produce… the increased expectation that we're going to be safer, and we're going to be more environmentally sensitive, the opportunities that face our facilities engineers in the future are going to be many, to keep that going.

We have a long way to go as an industry, especially in our onshore industry, to improve the safety of our operations and much of that falls on the facilities engineers to come up with greater ideas of understanding how to manage the safety, how to create safety cultures in our operations, so that they'll work in a good way.

So, there is a future of oil and gas, it has to be, we're going to need oil and gas… as long as any of us are alive today, to do the things that require hydrocarbons. We will see a slowing down of increase in production and eventually a peak demand period – sometime in this 2030 to 2050 time range. But that doesn't mean that we're stopping new development. We got to continue to do new developments just to replace what we have and we have to do it smarter and that means there's a lot of opportunity for facilities engineers to get that done.

Now, finally the basic question is, "Should the US oil and gas associations be more proactive in addressing these changes? Especially the changes that have to do with sustainability and that have to do with greenhouse gas emissions?" The answer to that is absolutely yes… but the good news is if you look at the last five years, all of a sudden, the leaders of our industry have woken up. They understand that the license to operate is requiring us to not just be reactive, but to be proactive. Let me give you some examples from the past.

I have a good friend by the name of Allen Verret who for a long time was the executive director of the offshore operators committee. He used to get mad at me – because often I would bring up this comment that the offshore operators committee, which represents the operators who operate in the Gulf of Mexico, has never met a regulation that it liked. That it was always opposed to new regulations, but poor Alan could never give me an example of when I was wrong in that comment.

And that was our history… our history in the beginning of my career was always, "We know best, we want to do the right thing, we're all good guys, we don't need regulations, and the regulations are only going to hurt us." I think I've seen a change in industry.

We know that being able to fly over the Gulf of Mexico and pinpoint the location of platforms by where the oil slicks began is not a good idea. We changed that not because we were good guys: we changed that because of regulations. And I've been involved in industry response to the proposals for these regulations and in the past, we were always against them. We always thought that we wouldn't be able to live with them, that they would have such an economic impact, that it would cripple the oil and gas industry.

I actually wrote a paper about that once, and I believed it at the time I did the paper. The regulation was promulgated and we wound up living with it… to the extent that today we would be aghast if someone tried to develop an offshore platform without living within the regime of that particular regulation.

So in the past, we weren't so good. We did argue with the regulations, we thought that they were overbearing, but instead of working with the regulators to say, "Okay, we understand the intent. How can we get to the intent in a way that is efficient and the best way possible?"

In the last five years, I see a change in that. I see the major oil companies, especially the major European oil companies – but now even the US oil companies are getting on board – understanding the need for sustainability, the need for regulations that have to do with greenhouse gas emissions... and are actually investing money and time and effort in looking at different ways of offsetting the emissions that we have, as well as trying to reduce the emissions that we have.

For example, just recently the Academy of Medicine, Engineering, and Science of Texas, of which I'm a member, gave a $25,000 award to a researcher from Shell who has done some amazing research on how to sequester CO_2 in soils as a result of farming and ranching. This is work that's being supported by Shell in the US, in Brazil, in Indonesia, around the world. And it's just beginning, but it has huge potential.

So that, Shell knows that in the future, it's going to still have greenhouse gas emissions from its activities, there's no way around that, but they can offset those emissions by doing something else that will actually sequester it.

I worked part time for Oxy. Oxy has a project going on in the Permian basin today, on a project that is going to remove CO_2 from the atmosphere and use it to create a sellable product. That's a pilot plant being built today, being designed today, but will be built shortly and this is a big independent, but it's not an international super major… but they realize that in order to be able to survive in the future, they're going to have to do that. And of course, what they're building is right in line with what facilities engineers do.

It's stuff that is a new technology that eventually the young facilities engineers of today…this is an example of one of the technologies you guys are going to have to become familiar with and you guys are going to have to figure out how we can do that in a more efficient, cost-effective manner. So I see the industry becoming more proactive… we still have a lot of old guys like me around who fight this, who think, oh my God, there's no such thing as global warming and if there is so what, there's nothing we can do about it.

I see that change happening and I think that's a good change, and it's happening not just in greenhouse gas regulations, but in all the other regulations. I mean, many people don't stop and think about it, but onshore oil and gas operations are much more dangerous than they need to be.

It turns out if you were a worker working offshore in harsh offshore environments, even like the North Sea or off of Norway; you operate in a safer industry than if you were operating in West Texas. Now that's wrong.

There's a lot of things we need to re-think and re-do as an industry and people are beginning to understand that and beginning to work on it rather than fight it. So I think the short answer to your

question – this was a very long answer – but the short answer is in the past, we weren't proactive in addressing these challenges, but we're waking up. We are proactive and we need to be even more proactive and we're going to be, and that's going to provide opportunities for facilities engineers in the future.

Marty Stetzer: Thanks so much, Ken. I especially like your examples of the use of both engineering and IT technologies to manage industry transitions – it's been underway for years. Let's move on to methane leakage… Is it a big problem when you compare it to the enormous volumes of natural gas that are moved by pipeline in the US, and LNG cargoes that are moved around the world?

Ken Arnold: Well, the answer is… originally, I thought "No" and I got into an argument. I was on the engineering college advisory board for Cornell University and several years ago two Cornell engineers made a big pitch about producing electricity – when you look at the whole life cycle from natural gas, it actually creates more CO_2 emissions than producing it from coal.

Now the actual production of the electricity is much less if you have a gas turbine driving your generator than if you have a coal power plant, but they were basing their assumption based on the amount of methane emissions that were just going up in the atmosphere during the production and transportation of natural gas.

And I thought that was wrong, I couldn't believe it… and it turns they were wrong, but not totally wrong. They had misused some of the information; they had over-exaggerated the emissions problem. But if you look at it, you have to understand one thing.

Methane is a much more potent greenhouse gas than CO_2. Now it depends on the timeframe you're talking about. Methane has a very much lower half-life in the atmosphere than CO_2. CO_2 has a long, long half-life. So if we put a molecule of CO_2 in the air today, it's going to be there – we're going to have to deal with it for a long time. Because there is a CO_2 cycle, but its half-life is very long. Methane has a very much shorter half-life. If we look at the impact of methane on greenhouse gas emissions over the next year, then methane is 20 times, 30 times more powerful than CO_2 in terms of its greenhouse gas implications.

But if we stretch out and say, what about 20 years from now? What about 30 years from now? What about 50 years from now? Look at a different life span of the effect of methane we put in the air today. We find that it's not that much different, but now you have to talk about fifty to a hundred-year life spans.

And we're not worried about that. We're worried about what's going to happen in the next 20, 30 years. And so methane is important. Some of the studies that I've seen show that if we were to lose around 3 percent or three and a half percent of the methane that we produced to the atmosphere throughout the whole process of production, transportation, and generation of electricity, it would be about equivalent to using coal. So that's the magic number – we've got to get below that.

It turns out, when you look at methane; you have to look at it in two different ways. We have methane emissions from gas wells, and we have methane emissions from oil wells. When you look get the methane emissions from gas wells, it's a very small percentage of the amount of gas we produce. And it's way below the 3 percent.

And the reason for that is no one produces a gas well unless they have a pipeline in which to sell the gas, because that's their product. And the very facilities we use for gas production have much less leakage associated with them.

If you look at the methane that comes off of oil wells, that's our big problem. And we need to do more about that. Remember, oil wells we eventually get… we put them in tanks. And off-shore… decades ago, a ruling came down, regulation came down, that we had to have vapor recovery systems on our tanks. We couldn't just vent the methane off of our tanks. We didn't like that – we fought against the ruling. The regulation came down, we now live with it, and it works.

Onshore we don't have that. Often what you find in an old oil field onshore is that what's vented when the oil is flashed from a separator to a tank, then methane, ethane, the light ends of hydrocarbons get flashed off in that tank, and they're normally vented. It turns out that that's a big percentage of the amount of associated gas that's being produced with the oil, unless you recover it. Not only that, but there were many times, where in order to make the money producing the oil, we flare or vent the gas.

When we do that, we… how can I put this? We do that because we're not going to make much money off the gas, and it's going to cost us money to put a pipeline in so we can sell the gas. That's wrong. We shouldn't be doing that. We shouldn't be allowed to be doing that.

If you're in an offshore project in the Gulf of Mexico, you are not allowed to vent and flare the gas before…. in order to produce the oil. If you want to make the money off the oil, you've got to dispose of the gas properly. Well, that's a big problem. It's a big problem onshore when we have gauge hatches on our tanks and people just leave the gauge hatches open.

What we find is that when you do an inventory of methane emissions from a normal onshore production facility, like 5 or 10% of the methane emissions in an area, or 5 or 10% of the facilities in an area, represent 90% of the methane emissions, just because of the way in which they're designed.

One of the things we did in the past was, most of our instrumentation in these facilities was powered by natural gas. And we had instruments that leaked a little bit; they bled a little bit of methane. Now it's just a tiny little bit per instrument… but we have lots of level controls, pressure controls, temper controls, temperature controls, and flow rate control instrumentation in our facilities. And when we add that up, it comes out to be a reasonable problem, it comes out to be a big problem.

Well, a simple thing to do is to change out those bleeding instruments with what are called non-bleed instruments, and non-bleed instruments still bleed but not as much. And you can make a significant difference in the amount of methane leakage that occurs from the facility.

But even more important, and what eventually we're going to have to do, and we should be doing, is change out all the power fluid, the pneumatic fluid that's making the instruments work, and use air… use instrument air to make those systems work, rather than natural gas.

That requires a change in our facilities. It requires putting in air compressors and dryers for the air compressors, and making sure they're reliable, and switching out this old way of looking at it. Switching out how we handle flash gas throughout our facility to make sure that it's all captured and it's all put back in a pipeline eventually.

So, yeah, I think methane leakage is a big problem. I think we're waking up to the fact that it's a problem, and I'd like to see us be more proactive as an industry. We're not there yet… in trying to create regulations to force us to actually address this problem.

Just as the regulations helped us address the water-discharge problems in the past in the Gulf of Mexico and other offshore areas, we need to take the same effort in handling these methane leakage problems. And again, that's going to fall back on the facilities engineers to make the modifications necessary, to make that go.

Marty Stetzer: Ken, when you were talking about methane, you also brought up venting. What about flaring? How do you actually recover gas in a widespread geography like the Permian, as they're doing their drilling operations?

Ken Arnold: Yeah, this is another big problem that we have. We need to have the ability under emergency situations to remove natural gas quickly. And the only way we can do that is by either venting to remove the pressure, or flaring to remove the pressure.

When we vent, we're putting natural gas directly into the atmosphere, and as I said, methane is worse than CO_2, at least in the near term and the intermediate term. And that becomes a problem. If you look at most of our facilities onshore, we have relief valves on top of all of our pressured equipment – separators, and glycol dehydrators, and Amine units and every other piece of equipment we have that's under pressure – has a relief valve on it, it has to for safety reasons. We don't want those things blowing up.

Many times those relief valves have what's called a tailpipe on them. So if the relief valve opens, the natural gas – the pressure that's going on to be relieved – will go out a piece of pipe and directly looking up to the sky and directly out into the atmosphere. Those relief valves leak a little bit too. So we have some methane leakage through those relief valves.

If you go to an offshore platform, any modern offshore platform anywhere in the world, those relief valves are all tied in to a flare system, or a venting system. They're all piped together. And they go to a single point, where whatever's coming out – whether it's a leakage through the relief valves, or whether a relief valve opens, or sometimes for safety reasons we have to blow down a part of the facility, we have to remove the pressure, and so we have blow-down valves – they all go into this flare system, which goes to a flare somewhere, an elevated flare far away so we don't have to worry about it. We don't have to worry about the heat of radiation coming from the flare, and they're burned.

But when you burn the natural gas you mix it with air and what you get is CO_2 and water. And so you still have to get rid of that substance, but instead of getting rid of methane, you're getting rid of CO_2.

So we can go back, and I know, again, a company that I do a lot of work for, all their new facilities have flares on them, they don't have vents. And they even flare what comes off of their tanks, what comes off of their oil storage tanks, and the water storage tanks, the flash gas I talked about before… go through vapor combustion units. You don't really want to just put a flame at the end of a piece of pipe attached to a tank because you could suck that flame in and blow the roof off the tank. That's not a good idea. That's going to cause a lot more emissions if you do that. And it's a dangerous thing.

But there are devices called vapor combustion units that are built to take pressure at just a few ounces of gauge pressure, less than… maybe just a little bit more than atmospheric pressure, and safely burn those molecules and convert them very efficiently into CO_2. And that's a good thing. That's a case where CO_2 is better than methane. And so we need to get rid of these molecules, we need to get them somewhere under emergency conditions, better that we do it as CO_2 than we do it as methane or other light hydrocarbon.

So yeah, right now we do too much venting. We're allowed to do flaring in order to produce oil. New Mexico has just passed a law to try and make it harder for us to do that, but they're phasing it in over a long period of time, I don't know why they can't be more aggressive at doing that. Not too long ago I landed in an airplane in Hobbs, New Mexico, and I was astounded by the number of flares I saw as we were landing, within just a small radius of the airport. There's just no excuse for that. That should not be allowed. We should be capturing that gas and not flaring it.

But we still need flares for emergency situations, but we need to control them, and we need to make sure they're efficient. Many of the flares that the industry is using are out of date… they don't create complete combustion. If you don't create complete combustion, then you're still getting some methane into the air, and some of it is being converted into CO_2 – and that's not good, you want complete combustion. You want none of that methane to get into the air.

And the technology is there, and we can develop newer technology, and we can learn to use it better. And that's the job of a facilities engineer. And I see those regulations coming and I see enlightened oil companies that want to maintain their license to operate, actually implementing these without the regulations.

And I can tell you for one example, the company that I work part-time for, Oxy, has been very proactive in doing this in their new facilities. And they're one of the most active companies in the Permian basin, which is good. I'd like to see that with everyone, and there are many other companies… Pioneer is fantastic. It's a small company. They've just made a decision as a company that they're going to do it right.

Unfortunately the majority of our industry isn't quite there yet, but it will be, and it will be there because of regulations. And we're going to argue against the regulations, but eventually we're going to like them. So that's my summary, if you will.

Marty Stetzer: Ken, that was great. Thank you so much for your insights, especially your encouragement to the role of the facilities engineers. They will definitely be valuable to the SPE GCS audience and our own community of 10,000 EKT interactive listeners. Listen, as we wrap up, do you have any recent articles, papers, or texts that you would recommend for our communities to get more background information on this important role?

Ken Arnold: I do, but I'm going to answer that a little bit differently. First of all, I think all facilities engineers need to get familiar with some basic texts that explain the technology involved in our processes and equipment.

A good source for that is the SPE's *Petroleum Engineering Handbook*, Volume Three, which is called Facilities and Construction Engineering. I know that because I was the editor of that volume, so I know it's perfect.

Another is the *GPSA Engineering Data Book*. And again, I think every facilities engineer should be familiar with what's in that data book. There's lots of good information about the topics we just discussed, and how to go about designing them, and how to go about figuring out whether they're working properly.

And then, another shameless plug is a five-volume series by Elsevier called *Surface Production Operations*. It's based initially on a two-volume series, and I was co-author of the initial two volumes, partially an author of some of the five volumes. And I'd like to recommend those as well.

After that, the more hands-on field experience, and talking to the operations and maintenance staff you can get, will always make you a better and more innovative problem solver. I think visits to fabrication and manufacturing facilities are beneficial, as are many lunch and learns and short seminars that are free and put on by vendors who are glad to show you their technology.

I would also use some of the free sites, some of the vendors in the instrumentation, and especially the artificial intelligence and the digital twin background, have sites you can sign up for and sign up for the webinars that they give periodically on various aspects of the latest technologies in these areas. And so I would recommend that as well.

Marty Stetzer: Thanks again Ken. If our listeners want to learn more about the SPE Gulf Coast Section, again, go to www.spegcs.org. You can access recorded webinars and our on-demand library, or support our scholarship program by contributions to our scholarship endowment fund.

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