[SQUEAKING]

[RUSTLING]

[CLICKING]

PROFESSOR: And our next speaker is Mark Metzner from Endurant Energy. And he's going to talk about codes and standards for geothermal heat pumps and networks.

MARK METZNER: Thank you. I got mine. I do have now. Good morning, and I want to thank HEAT and MIT for putting this meeting on. I think it's absolutely vital that this audience understands what is happening now and where things are potentially going.

I'm going to talk to you about the scintillating topic of codes and standards. I'm sure you're on edge, but they're good to have. You have to have standards. And just as a note, a standard and a code actually, but a standard in particular, lays out minimum standards, OK.

So don't think this is the gold standard as far as what you could do in a system. Now, that's up to a designer, engineer et cetera. These are the minimums that you have to adhere to be compliant to this standard, which is the C448 standard, which is applicable in the United States and Canada. It actually worked, excellent.

This became a binational standard between the United States and Canada in 2016. At that juncture, it was a bit of a milestone to get the two countries actually to agree to things. So the background on that, quickly, was in 2014, is when the process started. And we gathered experts in North and South of the border, approximately, at that time, 45, to formulate the 2016 standard.

Since that time, the standard has to go through a revision cycle. Unfortunately, COVID hit and put a pause on that. So this should have been done in 2021 as a new standard. It'll now be 2025. We had to reaffirm this standard to allow us to continue work on the new standard. That new standard encompassed over 70 subject matter experts, north and south of the border, as well as from Europe and Asia.

There's a difference between a code and a standard, and I think it's important that people understand that. They get mixed up. They think they're all the same thing, and they're not.

A standard is a voluntary set of guidelines or prerequisites that you adhere to. You can do it or not do it. You can say, my system, my geothermal system will be C448 compliant, which means you follow the standard. You don't have to do that. In Canada. I'll get to in a moment, you do. In the United States, you don't. There's a difference between the countries, as we all well know.

However, a standard can become a code if the code body adopts it. So as an example, here in the US, you have code bodies like ICC, IAPMO. If they adopt this standard, then it becomes code. Code basically becomes law. So that's the genesis of how it works. And again, there's confusion out there. But I want it to be clear. That's how this works between a code and a standard.

Quickly, in Canada, it's the C448 standard and its various iterations before, which was C445, C447 date back to 1992. And that's in the National Building Code of Canada. So in Canada, we have one code for the whole country. And then that can be modified, province by province, with limitations. You can only modify it so far, and that can be dropped down to the city or municipal level as well.

So it's a bit of a different approach between Canada and United States. If one of the code bodies, like I say an IAPMO or an ICC adopts this code, then where they have jurisdiction, it becomes quote unquote "the law of the land." And if you're putting a geothermal system in and either one of those bodies adopt, this is what you're going to quote unquote, "have to do."

Quickly, we're not going to go through all this because I got 10 minutes, and how much have I burned through already? Too much, OK.

[LAUGHTER]

What we did is, as a technical committee, we gathered all of the subject matter experts that we could that were recommended to us, et cetera, looked at the 2016 standard, and said, all right, where are the gaps? Where are the holes?

And there were. And the reason why that happened is getting two countries together to agree on something is not easy, as you can probably imagine. So there was compromise, accommodation made in various areas, and we lived with that as an industry for that five-year period. And then we identified oh, wait a second, this has got to change.

So there was substantial changes done to the C448 standard. It will be published in May of this year. So there's been some hiccups along the road, like I mentioned with COVID, et cetera. So it's a bit overdue. It's the best way to say it.

Again, we worked with the IGSHPA Standards Committee, which by the way, I'm now the chair of, so I don't think it's a conflict of interest, but I don't know, to look at their current standard, which was published in 2017. And technical committees went through the IGSHPA standard of 2017, as well as the Bi-National Standard of 2016, and say, we have to reconcile these two.

What's going to happen is once the 2025 edition of C440 is published, the IGSHPA standard gets sunset, and there will only be one standard within the United States. Right now, there's two, so it's a bit awkward.

A number of issues that we went through that had to be relooked at and expanded upon, and more detail given, was what Garen was just talking about, was the formation thermal conductivity testing, thank you, as well as piping materials to have absolute clarity on what you're putting in the ground and more importantly, what you're not.

Heat transfer fluids was a hot topic because-- when I'm talking about heat transfer fluids, that's the fluid you're circulating through the system. And it could be just water. It depends on the design parameters. A lot of designers will put an antifreeze agent into the system, not so much to. combat freezing from ambient, it's down four feet or whatever, and you had a really cold winter and you're freezing the pipe. The real impetus is to be able to run your heat pumps below freezing.

It's a bit of a combination, but that's usually why people are doing that. That's a whole design issue, from a designer, how cold do you want to run your system? As Connor alluded to earlier, it depends. But usually your parameters low are 30 degrees Fahrenheit, high about 90. Now, that's not written in stone, but they're pretty good goalposts.

The other one we looked at very, very closely was hydrostatic testing. And that's basically using a fluid water only to pressurize and test your system. If the system is leaking because of a bad install, you could be chasing it kind of quote unquote "forever." Where's the leak? So you want to be doing a proper pressure test prior to backfilling because imagine you have a bore field below a 40-story building. You're not getting back in there, so do it right the first time. You have one chance.

I'm not going to go through this in too much detail. The quick overview is there is a general section, which basically encompasses a number of elements. One is the definitions that are in the industry, so there's clarity.

In a lot of cases, you'll see the same item referenced in two different ways depending on a region. So we want to clarify what those all are. So it's a fairly exhaustive definition section that one should be looking at because if you hear one term in Texas, and it could be something different in New York.

So we tried, and did, I think, successfully to capture all the definitions and then use one throughout the standard, so there's no ambiguity. That general section also included any particular topic, so i.e., piping or heat exchange fluid as examples that touched on more of two source system configurations. They went into the general section, so there was no confusion.

Then there was a residential section focusing, obviously, on single-family homes, a commercial section, there was a new section, and that's the district systems. Now, a quick segue, we're hearing gens, U10s, 10s, community loops, shared loops. There's a whole bevy of terms out there.

We looked at it from a technical committee side and went, they're all district systems. There are variations to it. They are district systems. And by definition, you are servicing two or more buildings with that system.

So we went into a lot of detail on a new section for district energy system, which includes what you're all looking at is ambient loop. It is one of the types of district system. It's not the only one. There's a number of them.

Then after that, we went into the various configurations of source systems. What I mean by that is the most prevalent one out there is a vertically drilled borehole. So that's the vertical section. And you'll find that in probably the majority of commercial installs, in urban settings in particular. You'll see horizontal systems, which was the next one, where you have space. You have to have a larger area, land-mass wise, at the surface to be able to put in a horizontal system.

From there, we went into the various different types of source systems that aren't that common, but are out there depending on your geographic location and your geology. So surface water systems are basically looking at a lake, a river, the ocean. So that's a source system.

We went through all of them that are currently out there. Groundwater systems are open systems. You probably heard the term "pump and dump." Maybe you have, maybe you haven't. That's where you have a water well, basically. You're extracting water, running it through a heat exchanger, and then re-injecting that to the aquifer or to surface, depending on what the jurisdiction allows.

Standing column well is a bit of a niche because you have to have competent bedrock to be able to put them in. It's very specialized. Here in the Northeast, they're prevalent. Not so much in the rest of the continent, reality.

The new one that we put in that was coming up is for foundations or energy piles. They're getting some traction. We said, we got to put this in there, address it, and have a standard around it.

There's informative annexes at the back of the standard. These are not mandatory. These are information. That's why they're called informative annex. So they give you direction on things. And the new one was for wastewater energy transfer.

I think Nick was talking about it, I think Connor maybe a little bit. The SHARC system is one. Huber out of Germany has them. There are pipe systems. And you're harvesting thermal energy from your wastewater stream. So again, we thought it was very important to put that in.

I am going to skip over this because zero minutes. Oh, well, that means I'm done. Is that what you're telling me? OK, hang on. Let's get to it. Can I have two more minutes? I'll talk real fast.

PROFESSOR: Yeah.

MARK METZNER: OK, thank you. Back one-- piping, one of the big issues there is, what are you putting into the ground? It's vitally important that we're not putting garden hose down a borehole.

So in a standard, you tend to be performance oriented. Meet this performance metric, and you are compliant. There are issues where it has to be prescriptive. There's no way out of that one.

We have to be very careful in what we're putting in to a borehole. Bearing in mind we are putting in infrastructure that's going to last 50, 100 years, 150. We don't even know. So what you're putting in the ground has got to last. Sorry, I'm talking fast.

Oh, that last one, PVC CPVC, no longer will be compliant with the standard. A lot of testing, a lot of research was done on PVC, in particular. And heat exchange fluids within PVC are basically corrosive is the best way to say it. They break down, and you have real problems.

Again, infrastructure, we're not doing that. I'll skip over that. Heat exchange fluids, a lot of work went into this. What's available? What can you do? There's tables in there that give you properties of heat transfer fluids, again, for a designer to choose what is the applicable heat transfer fluid and may just be water. That's quite possible.

Pressure testing. Like I said, I'm not going to belabor this one because I'm out a time. The integrity of the ground loop system is paramount. You have to be able to say this is not leaking before you backfill. Otherwise, you have huge problems.

That's what an energy pile looks like. It's a bit of a new approach to a source system. They're gaining some traction. They are applicable, in some cases, not all cases.

The whole district energy systems, many people have been talking about the various source inputs that you could have to a district system. So we went fairly exhaustive on that and deviated a bit from the format that is currently within the rest of the standard. And that's under number four, project planning.

As a designer, you're doing a district energy system. These are some vital elements you have to look at, which are applicable generally to geothermal systems, but really take a good look for a district system. There's lots of moving parts, and you have to be cognizant of what is out there.

Piping materials, again, I said very prescriptive on the piping materials. This one here is for the distribution materials inside or above grade, I should say, for district systems. So it's a little bit of a deviation from what's in the ground because there's more flexibility given to your different source systems and temperatures.

I think it was alluded to earlier, depending on how the system is being designed, you may have insulated or pre-insulated piping, hot pipe, cold pipe. You've got to be careful there that you're not having thermal interference between the two. Insulation in confined areas is your best go.

Energy transfer stations, I believe Brian Urlaub touched upon that. That's one way of isolating your system, your ground-loop system from the building. And, doo, doo, doo, doo, doo, that's the wastewater. Again, these are informative annexes to say, here's what you could do.

You can do a pipe, as you can see on the left there. That's another way of harvesting energy from the wastewater stream. This is some of the investigation we did. There's not a lot of information from a standards point of view, in North America. So we referenced a German specification to get some guidance. They've done a lot of work. We're not going to reinvent the wheel.

This is the timeline. Like I say, the last bullet is what we're looking at, release in May 2025. That's just a quick overview of sunsetting the standards from IGSHPA. Any standard is a bit of a living document. There's a revision cycle every five years.

However, should there be some monumental change within the industry, there is the ability to do an update or an errata. Looking at things in the future, the A2L refrigerants will be a big issue. District energy systems will continue to be on everyone's mind, and that's about it, so sorry, Stacy.

[APPLAUSE]