Rachel Shepherd: Hello, everyone. My name is Rachel Shepherd, and I'm with the U.S. Department of Energy's Better Buildings Initiative. I'd like to welcome you all to the January edition of the Better Buildings Webinar Series. In this series, we profile the best practices of Better Buildings Challenge and Alliance Partners, and other organizations who are working to improve energy efficiency in their buildings. Next slide, please. Today, we will be exploring how to prioritize laboratories to meet an organization's energy efficiency goal.

First, we will discuss why energy efficiency in laboratories is important, and more specifically, what a smart laboratory is. Next, we will give a brief overview of the Better Buildings Smart Lab Accelerator, which is an effort we've been working on at the Department of Energy for the past two years. Next, we will hear from an industry expert on ventilation management, which is a key element of a smart lab and critical to achieving energy efficiency in laboratories. We will specifically discuss the benefits of ventilation management from a safety standpoint.

Lastly, we will hear from a Better Buildings partner that is leading the way in implementing a smart labs program. So let's introduce our presenters today. So our first speaker is Otto Van Geet with the National Renewable Energy Lab, or NREL. Otto is a Principal Engineer in the Integrated Application Center at NREL. Mr. Van Geet has been involved in the design, construction and operations of energy efficient research facilities such as laboratories, data centers, offices, and general use facilities, as well as energy use campus and community design.

Mr. Van Geet has authored many technical reports and conference papers and has been recognized with many awards for professional associations, including the 2007 Presidential Award for Leadership in Federal Energy Management, and the 2011 Green Innovation Presidential Award for the NREL Research Support Facility. Fun facts about Otto: he lives with his family in an off-grid passive solar house with a two-kilowatt PV hybrid power system and solar water heating that he designed and built over 20 years ago.

Next, we will hear from Tom Checksfield from 3flow, formally known as Exposure Control Technologies. Mr. Checksfield is currently the Senior Vice President of 3flow and has over 30 years of experience in the HVAC energy management and laboratory control field. Mr. Checksfield sits on several committees for the development of best practices and codes for lab designs and sustainability and is active in several associations. Before joining 3flow, Mr. Checksfield worked as a General Manager for Tech Air

Systems, which is a critical environmental controls manufacturer, as well as Senior Account Manager with Siemens Building Technologies, focusing on critical environmental control systems.

Our last speaker is Monica Witt with Los Alamos National Laboratories. Ms. Witt is the Sustainability Program Manager for the Los Alamos National Laboratories. Under her management, the Laboratory has significantly reduced energy and water usage across the 40-square-mile campus by establishing a building automation system team, recommissioning 30 facilities, upgrading aging facility systems, and working with organizations across DoE. Recently, Monica has initiated the Smart Labs Program at Los Alamos National Labs to operate laboratory spaces at the highest level of safety and energy performances.

Monica received her master's of environmental studies at Antioch University in Seattle. She also chairs the Sustainability and Environmental Subgroup within the Energy Facility Contractors Group, which is comprised of management and operating contractors across DoE. Thank you all for being here today. So before we start with our presenters, I wanna remind everyone that we will hold questions until the end of the hour. Please send your questions to the chat box on your webinar screen throughout the session today, and we'll try and get to as many of them as we can.

And as a reminder, this session will be archived and posted on the web for your reference. So now, I will turn it over to Otto, who will give us an introduction of energy efficiency in laboratories.

Otto Van Geet: Thank you, Rachel. Good afternoon, everyone. This is Otto Van Geet from NREL, and as Rachel mentioned, I'm an engineer here at NREL. I've been involved in energy efficient buildings, and especially laboratory buildings, for my whole career, so 30-plus years. We at NREL provide technical guidance to the program that we'll be talking about today, Smart Labs. Next slide, please. So why focus on labs? Laboratory buildings use a lot of energy – three, four, five times more than the typical office building – and case study examples that I'll talk about here indicate cost savings opportunities of 20, 40, maybe even 50 or 60 percent.

For example, the diagram on the right is from University of California Irvine, and if you notice, on that diagram there's a blue line, which is business as usual, and then there's a green line of actual, and you notice a really big turn in the green curve, where they've been able to achieve 50 percent energy reduction for their campus. What it turns out is that laboratory campuses, research campuses, the energy use is often dominated by lab buildings.

Typically, like in the case of UCI, 65 percent of their campus energy use was from labs.

So they were able to focus on their lab buildings and create this program called Smart Labs, where in their very good lab buildings they were able to reduce the energy use by an additional 60 percent. That's super-impressive, and they're sort of the poster child for Smart Labs. Better Buildings and the lab industry had noticed this, and because of the great results at UCI have launched the Better Buildings Smart Lab Accelerator that I'll talk about in the next slide, please. So what is a smart lab? I'm gonna read this definition to you, but.

Smart Labs enable safe – and that's the primary thing, we never compromise safety – and efficient world class science to occur in laboratories by: reducing ventilation to the lowest safe level, which could be different during occupied and unoccupied times; high effectiveness, meaning good air movement; ventilation design – that's the HVAC system; minimizing fan energy; and using smart building controls to optimize everything. Rach, Monica and Tom will talk about this in much more detail.

And then there's a diagram on the right with the key elements of smart labs, and I'm not gonna read all of those to you, but for reference you have these later, and again, Tom and Monica will talk about that some more. So next slide, please. So again, DOE under the Better Buildings Program launched the Smart Lab Accelerator. The map on the right shows the location of the 15 partners, plus there's a couple affiliated partners that I'll talk about in a moment.

But the goal of the Better Buildings Smart Lab Accelerator is to have the partners come up with a plan for a 20 percent energy reduction over their portfolio of lab buildings over a 10-year period. So we're asking them to come up with a plan to do that. A sub-goal is at least a 5 percent energy reduction in one of the lab buildings by the end of the Accelerator. That's typically been accomplished by things like retro commissioning. The Accelerator did get launched in March of 2017; it'll continue till February 2020.

Even though we're late in the program, we would encourage you to participate if you're interested. And then the end results will be a showcase of partner success, a Smart Lab Toolkit, which will include a website, and then we're all developing training as an additional resource. Next slide, please.

Rachel Shepherd: All right, thank you, Otto. Next, we'll hear from Tom Checksfield on ventilation management. Tom?

Thomas Checksfield: Okay, great. Thanks, everybody, for attending today; looking forward to the questions and the discussions that will ensue. So I'm gonna speak a little bit about the ventilation management plan and the training that's a part of what Otto just described as the Smart Lab Program. Next slide, please. Obviously, there are all differen6t kinds of labs: chemical, biological, radiological, just all kinds, teaching labs, vivariums. At the bottom of this slide, you see in red it says, "risk plus functional requirements equals demand for ventilation."

I'm not gonna get into a very deep discussion, if you will, about demand for ventilation, but I am going to address it a bit in a slide that's coming up. But just to give a little bit of background to that, risk gets defined there by doing a risk analysis or a risk adjustment, if you will, in the laboratory itself. So both the exposure control device, let's say defined by dealing with fume hoods – that's one of the biggest if not the biggest energy user in the lab itself – and the space that's not defined by fume hoods or fume hood driven. Just a lab that has no fume hoods, but let's say it's a big open lab that has all these interchanges going on.

So what we do is we go in and we evaluate and analyze what that risk is for what they're doing and what the processes are in the labs themselves. 3flow is a company that wears two hats; we are basically a energy and engineering firm, and we are also a health and safety firm. So to use an example, at a university, for instance, generally there are two organizations: there's health and safety, or the industrial hygienist, and then there's the facility group, which there's all kinds of groups within the facility group. They both have different agendas, but they have to work together to get things done.

The functional requirements are basically the building itself, what the HVAC system has to do to be able to get the processes and the research under control and have the correct ventilation for that research, and also the creature comfort of the people in the building. So based on what the risk is and what the functional requirements are, that equals what we call the demand for ventilation.

And the demand for ventilation, once you get the building fine-tuned or optimized, if you will, that demand for ventilation, if it's working properly, would be a building that's tracking usage, if you will, day and night and weekends, and however many people are utilizing that building, and tracking it so the HVAC system is just giving what is required for that particular point in time. Next slide, please. So labs. One of the reasons that labs are being looked at now in greater detail and scrutinized at campuses around the country is that laboratories use a lot of energy.

You can see under the construction there, the average size of a lab around the U.S. is 100,000 square feet, and the cost of the construction can really range from even less than $250.00 a square foot to over $1,000.00 a square foot. So labs can be very expensive to build, and the HVAC in that lab can be 15 to 30 percent of the cost of building it. Now, operationally, all right, here there's the utility cost; again, around the country an average might be $7.00 a square foot. Annual cost of the building is $700,000.00 a year.

And again, some buildings which are bigger, more dynamic, costs are gonna be greater than that. And on the HVAC, use can be 45 all the way up to 85 percent, and this pie chart you see on this slide has been utilized by I2SL and Labs 21 for the last 20 years or so, and it's a very good example or visual, if you will, of what goes on in labs. And you can see at the top, you can see lights, and lights might be more than 4 percent. Plug load's at 9, and the plug load, depending on what you have going on in that laboratory or in the building, it could be a little less, could be a little greater.

But for the HVAC, defined by ventilation, cooling, and heating, that's the big nut. So if you wanna get the biggest bang for your buck for a program going on on your campus, to be both safe and efficient and sustainable going forward, laboratory ventilation is the way to go. And what we've found from doing many tests on fume hoods – our company started as a fume hood testing company some 25 years ago, and we still test a lot of hoods. We have a division that tests hoods around the country; we're probably the largest hood testing organization, at least in North America.

And what we had found from all this data with the 40,000-plus hoods that we've tested is about 50 percent of the HVAC energy is wasted by excess airflow, inefficient systems and improper modulation of flow. And that doesn't do with a building that's just brand new, that just comes out into service, and also a building that's been operational for a while, for years. But without paying attention to some kind of a process or plan to maintain that building, these are the kinds of energy that's wasted in a lab building. Next slide, please.

So organizations can improve safety, reduce risk and provide workplaces that better facilitate success. The picture at the top happens to be a lab at UCI. I'm gonna talk a little bit about how the Smart Lab Program really started with the EPA, and I'll get to that shortly. But UCI's been working with, and is still working with, the building and fine-tuning the Smart Lab Program over the last 11 years, and they're doing a terrific job of it. So some of the main attributes of it is to attract and retain top talent.

Research organizations around the country, if they're not keeping their people happy, their researchers, they'll lose them. We see this all the time. They wanna be able to get the top people, they wanna be able to keep them, and it's not just keeping them comfortable, but it's making sure their research is gonna be okay, and that their research is not gonna be affected by let's say a substandard HVAC system. Obviously, ensuring safety; safety should be number one. Bottom line, safety requirements have to be met before you start playing around with optimizing and putting in energy conservation measures and things of that nature.

Minimizing waste – I like that statement. UCLA, we work with them and we're still working with them, and they have a lot of push-back at UCLA with researchers at the facility group there that we finally came in to say, "Hey, we're gonna come in and save some money in your lab." They got tremendous pushback and negativity. They thought every time a facility person came in, they were just gonna do something negative to their lab environment. So they chose to, instead of calling it energy efficiency or energy savings, they called it minimized waste.

Our company particularly liked that, so we're utilizing that same statement. Improve sustainability, maximize resilience, accommodate change, mitigate risk. Accommodate change, that's a big one, because labs are very dynamic; and that's this lab management program that we're gonna be talking about on the Smart Lab Program. One of the big things it does is it gets stakeholders together to be able to communicate and have a vehicle to communicate to be able to accommodate change, 'cause labs are always changing.

And of course, enhance return on investment. When this program is in place and managed correctly, it resonates with the highest levels of management at any organization, because the numbers are outstanding. I think Otto mentioned that some of the savings at UCI, for instance, with the 11 or 12 lab buildings that they have running under the Smart Lab Program, they have savings in excess of 50 percent. So that's focused right now is on sustaining that sustainability, or sustaining that savings, if you will, moving forward.

And if you can maintain those 50 percent savings, those are big numbers, and those big numbers, again, resonate very well with upper management. Next slide. So Smart Lab, the optimization process is fairly simple; it's not rocket science. You plan and assess, and you optimize your system, and then you put a plan in for performance management for that building, whatever those lab buildings. Next slide. If you go on the different sites available, the government sites, you'll see this Smart Lab phased out plan here, and again, it's fairly simple.

Phase 1A would be the plan and assess, so you'd get your information together, what buildings you'd wanna do, and then you do what we would call a deeper dive into that building. The left portion of the slide at the bottom of the timeline you see the Lab Ventilation Risk Assessment, an LDRA. Those are done in the lab building; they could be done for new design and it's definitely done for renovations and upgrades of existing buildings. But again, that's taking a look at processes and things that are going on in the lab from a health and safety perspective. To be able to come up with an air change rate that is one that can work in that space, and the way we do that is we develop control bands.

Simply stated, the control bands run from zero to five; zero is nothing really going on in there; that space is being used as maybe a meeting room. And then five, by contrast, is lots of stuff going on. It could be an ominous lab, a lot of things happening, high ventilation rates required, so on and so forth, and each one of those control bands is associated with an air change rate. Now, it's not cast in stone. What it is, again, is for stakeholders to be able to communicate requirements and changing requirements for laboratories.

So after the risk assessment is done, then there's, you know, you would call it an ASHRAE audit, if you will, but you would take a look at how the building is actually operating its existing HVAC system. We call that the demand for ventilation, and we take the risk assessment, what we found from the risk assessment, and then we look at the building and we challenge the building and we challenge the lab system itself. And we look at it as a system, holistically; the system defined by exhaust, supply, and all the components that are a part of that system.

So when I say challenge it, what we do is we'll go in, w4e'll open all the fume hoods, for instance, and see what the HVAC system is doing on that system of fuel, both supply and exhaust, and then we'll close all the hoods and we'll see what it does, and we're basically defining what the range of operation is for the building itself. So we take the risk assessment and we put it together with the existing range of operation of the building, and then we see where that building kinda fits or what it's doing.

And maybe there's a lot of excess air, and lots of times there is, because buildings or labs have been designed that way; they've been over-designed for a number of reasons. Or maybe the building has been added on to a lot, and it changed a lot, and the HVAC system is doing everything it can to actually keep up with its health and safety requirements. But the fact is we get to a point, customer gets to a point where they can now see what they have, and then develop their plan moving forward from the information that they get.

Phase 2 is the optimization phase; there's all kinds of things that can be done, depending on budgets. You can build new equipment, you can operate equipment, you can upgrade fume hoods, you can put in V80 controls; there's all kinds of things that can be done. But once you have an understanding of where your building is at from a health and safety perspective, an operational perspective, then you can start to implement and optimize. And then the Phase 3 Management plan.

Won't say it's the most important, but it's certainly a very important part of doing the assessment and then the optimization – is to be able to manage the change that's going to occur in that lab. And we'll address that a little bit on further slides. Next slide, please. So what this slide does, it's really there's a lot on here, but I'm gonna just talk through it fairly quickly. So on the left where it shows the circle in the building, and it's under that 3 to 6-month calm, that's a building that you've already picked or prioritized as a building that you wanna start with.

And for all of you that might be just starting down this path, or maybe you're already into this path of upgrading and optimizing lab buildings, I'd like to make a recommendation, I guess. Start with a building that you can manage and get a win with. There are a lot of places that we start to work with developing a lab management plan on the campus, and they want to tackle a large, difficult building to begin work. And sometimes the politics, or sometimes the management, that has to be addressed, and I understand that.

But if you've got the ability to pick a building that you can really manage and have a short-term win, that's really the way to go, because the lessons learned in the stakeholders' working together, that's a really good foundation to move forward to being able to replicate going to different buildings on the campus as you move off. So anyway, finding the building and doing that deep drive that I just talked about, doing the risk assessment, and then also doing the audit of the building or having an understanding of what the HVAC system is currently capable of.

Now you have that information, and then you can move along with the optimization and what you pick and what you wanna do, and then you get into the management and the maintenance program, so. And then you just go back, and you start from square one again, and you go through it with a different building: plan, assess, optimize and manage. You know, it's really simple stuff, and sometimes it's very difficult to do and it takes all stakeholders working together. Next slide, please. So the success requires a combination of efforts.

Otto had a slide, and you might see some of that similar stuff with Monica when she goes to her slides, but we can't really drive it home enough. The success of an organization to be able to implement – I should say develop, implement and then manage – a plan really depends on how all the stakeholders work together. And you can see from this, management, environmental health and safety, finance, facility, the researchers, facility engineer – there's other groups in there that aren't here, that aren't shown.

But anybody that has any stake in that building operation should be a part of the group of the stakeholders that are involved with developing this plan. So the design and the mechanical attributes, if you will, there are many, but some of the big ones are the high-performance fume hoods, electric fume hoods. Variable air volume systems – maybe they're already there but they just need to be optimized, or maybe you're going from constant volume to VAV, or whatever the case may be – optimizing the controls.

High-efficiency mechanical systems – maybe the mechanical systems that are existing need to be upgraded. Building information and control systems – I believe that Monica is going to address some of the things going on at NREL, but there's a lot going on in the industry right now with building information and control systems, or analytics, if you will; great stuff. And there has been good information that's come from BMS systems, or building management systems, if you will, automation systems. But the information is only as good as how it's being collected, and more importantly, how it's being used and communicated.

Management and leadership is what makes it happen. Occupant information and floor plans, ventilation safety, system diagrams;

an airflow management program, an AMP, as we call it. It's kind of the same thing as an LVMP, but it basically is an airflow management program for that specific building or buildings. Then I'll talk a little bit about your lab ventilation management plan manager / coordinator. Next slide, please. So I mentioned before that the Smart Lab Program kinda started years ago with the EPA.

We're headquartered in Raleigh, North Carolina – actually Cary, which is right outside of Raleigh, and right near the Research Triangle Park. So almost 20 years ago now – maybe 18-1/2 years ago – we got involved with the EPA because they had this particular series of buildings was their flagship. Biggest energy, supposedly the greenest lab building they had in their portfolio for all of the EPA sites across the U.S. And as they got this thing operational with all these buildings – I think there's six buildings, they all have labs – it became their worst user of energy; the highest inefficient user of energy in their portfolio.

So we got called in and we started talking with them, and we started a program to evaluate the buildings. And the Smart Lab development, if you will, kinda started with not only a clean slate, but even the people that we were working with at the EPA, we started with really nothing, and we really didn't know what we were doing. But we learned a lot of lessons, and we're still learning lessons, and this whole Smart Lab Program, the process truly started here, trying to understand what was going on in all these labs.

So six buildings they occupied in 2003, a little over a million square feet – that's gross square feet. And the approximate cost of energy back then was about almost $6.8 million a year. So management at EPA said they wanted to establish a goal and try to save 30 percent or greater in the building; but more importantly, they wanted to understand why this brand-new high-end building was not working correctly. Next slide, please. So here's just a diagram, if you will, of the airflow systems as they were optimized to meet the demand and improve ventilation at the EPA NRTP.

You can see on the left that pre-optimization, kinda running wild, and then after we found out what was going on and started to do the upgrades, then TAB at commissioning, that came in, and then following final commissioning, you can see the reductions – oops – you can see the reductions that had taken place throughout that time period. Without getting in depth about this, it was a relatively new building, and what it turned out to be was that they had very inexpensive controls in the labs; very inexpensive, slow-reacting VAV boxes.

So what was required was to be able to get the actuators to work quicker, and have these boxes be a little bit more dynamic, and it was a very pedantic thing doing it through the whole building. It took a lot of time, but that was the biggest thing, just the adjustment of the controls in that building; that was the win for that. But during a period of time, maybe the seventh or eighth year working with the EPA, at the same time, University of California system put out an edict that their campuses were gonna need to attain certain levels of energy efficiency by the year 2020, or 2025.

And Wendell Brase and his group at the time at UCI, Wendell stated to his group and his team that, "Hey, we at UCI, we're gonna be the most energy efficient campus in this state university system in California," and that's where it started. They came down to the EPA, took a look at what was going on at the EPA, and they took a lot of stuff, the lessons learned at EPA, and they brought it over to UCI. So the process of starting and developing and building on the Smart Lab has really been about an 18-year process; and again, with UCI really being involved during the last 12 years. Next slide, please.

So over the years of working through all the Smart Lab processes, not just at UCI and not just for EPA, but then the Smart Lab processes being utilized and worked with many campuses throughout the country – a couple of major things that come into play. One is the fume hood upgrades; that's the ability to take an existing fume hood and retrofit it and make it a high-efficiency hood. The EPA wanted to know why they couldn't utilize their existing hoods and make them more efficient, because they couldn't afford to put 1,800 or over 2,000 new hoods in that were high-efficiency hoods.

So they get us a grant, and they let us do a study, and we determine what the really good characteristics of the high-performance hood were, we came up with our first generation of a retrofit kit. And this retrofit kit goes into existing hoods, and it basically allows the hoods to reduce its exhaust by 35 to 40 percent. And with having sliding shields on the front, you can now have whatever face velocity you want to have, from 100 feet down to 60, and still have the hood reduce its exhaust by 35 to 40 percent. In the State of California, for instance, the OSHA requirement is for 100 feet per minute face velocity.

So this is becoming a big deal at UCI and in the campus system, and through the State of California, to have the ability to maintain 100 feet per minute face velocity. The other thing this does for the fume hood retrofit kit is not just save money – I mean, that's a big deal, saving money with the fume hoods. But the other thing it does is it creates and then opens your freeze-up capacity. In a lot of the older buildings around the country and lab buildings, capacity becomes a real issue; so for every two hoods you retrofit, you can put either a new high-performance hood in, or a new standard hood.

VAV valves themselves are becoming better, if you will; there's been some enhancements in the industry. The valves are now coming with flow sensing ability in them that actually works well, so that when you start talking about metrics and measurements and analytics, if you're not measuring it, if you don't know what you got, then you don't know what you have; so the ability to be able to measure and validate is very important. So the valves have gotten a lot better over the years, and they're continuing to improve. Demand control ventilation is like an air system, if you will.

If you're not familiar with an air VOC system, it's basically a system that goes into a lab, and it's monitoring or it's taking samples of different CO2s and different things in the lab itself, and it's bringing it back to a central location. And then air change rates in the lab are being minimized, maybe time of day or whatever they might be, and then if there's an event that's been sensed with this VOC system, it brings the lab up to its highest level of supply, of bringing the air into the space. The one on the right which says "High VEFF Diffusers",

I'm not gonna get into that, but this is very exciting. We've been doing a lot of studies with UCI, because we've been working there with their Smart Lab system for over a decade, and one of the things they asked us was, "Hey, is six air changes in one lab the same as six air changes in another?" And we said, "Oh well, let's do a study." What that boiled down to is we found that air changes, if you start putting more air into a room, the air changes going up and up may not be the best thing for that space.

So we define VEFF or Ventilation Effectiveness as how well air sweeps from supply to exhaust in the space itself, and the better it sweeps through the space, a lower air change rate with a good VEC rating, if you will, could be better, more efficient and safer than a higher air change rate. We have papers and we have shown and are talking about air changes that are three and four, compared to six and eight. Okay. So anyway, we think this is gonna be a big deal, like a really big deal; we think the ventilation effectiveness will now become almost certainly – it'll certainly work with air change rates moving forward.

But we think that ventilation effectiveness will become even more important than designing around air change rates themselves. Next slide, please.

Rachel Shepherd: Hey, Tom, this is just a reminder; you have about five minutes left.

Thomas Checksfield: Okay, thank you. So this is the EPA after ten or so years of working with it. We called it the Demand Based Optimization that began the beginning of the Smart Lab. It's pretty major, a strategic execution, coordinated efforts, budgets; we worked with a lot of ppl. Energy reduction was 48 percent. The estimated cost reduction, if you will, is $3.2 million per year, so it was certainly a win for the EPA. Next slide, please. Efficiency can be improved, and energy can be reduced, but can it be maintained?

And this is what a lot of lab buildings run into when they're optimized or there's a performance contract that's done, or whatever it might be. But if there isn't a plan in place to be able to keep the building optimized, we have found through our work in the field that buildings that get optimized, lab buildings, if they run three to five years, sometimes less, they can go right back to where they were before they were optimized. So a plan to be able to keep that sustainability going forward is imperative. Next slide, please. So this pyramid.

Again, if you could go into a lab ventilation management plan, at the bottom, you're doing your risk assessment, your demand for ventilation, finding out what your building is capable of, and developing your flow specifications. And then above that, the high-performance hoods and airflow control systems – that's your optimization process, if you will. And above that, the building information, the dashboards and the analytics, whatever it is you already have or you're going to put in there; but having a plan to be able to use that information appropriately and be able to get it to all the stakeholders.

And then of course, the management plan itself for operations and a plan for the building and for against. Next slide, please. So I ask all you attendees out there, you probably have some kind of a program going on, but the questions that I ask are do you have master building documents? Are there operating specifications? What are the key metrics? Do you have a maintenance management plan? Do you have a management for change? Do you have a plan for that? Are they complete, are they clear? Next slide.

So this lab management plan, this Smart Lab plan, the things that it really delivers, there's an operating manual and training to achieve and maintain the performance of that building. System and line diagrams, equipment inventories, a risk matrix, specs, control sequences, procedures and guidelines, training for stakeholders. Training is key. We have found in surveys that the technicians that are out in the field working in labs right now are being outpaced like crazy with technology. So it's imperative that we get these technicians – not just the techs, but different people, stakeholders – again, trained so that they understand and keep up the pace with the changes in technology. Next slide, please.

This is something that every lab building could get right now from the design engineering field just by asking, and saying, "Look, as a part of our management plan, this is what we require." Now, maybe you have something like this in your organization right now; if you do, hats off, and if you don't, the reason why this is good is you have different people at different levels coming to the building to try to ascertain what's going on. Could be Operations, could be Maintenance, but if you had something like this that was either a graphic it'd be a master of the scheme just in the building.

So if someone came in to check out a problem or figure out a problem, things were color-coded, so you know where the system was. Where the air handler and exhaust, and where it was doing, and just a simple line diagram on the right, so that you knew where things were when you looked at it. People that are responsible for buildings and their operation would love to have this, because it just makes their life that much easier. Next slide, please. The development of the flow specs are very important, and as a process of managing change, flow specifications need to change as risk assessments are done periodically throughout the year or throughout the months.

This is a slide which just shows a spreadsheet, if you will, with a lot of different labs and fume hoods, and the color coding and the control band, and it needs to get updated and then on to the BMS, and then everybody else can kind of be looking at the same thing. Next slide. With some of the changes, nuances of buildings now on campuses can look at a different way, and maybe a way of utilizing the resources better when it comes to maintenance. We have done this with the EPA. Teams of people actually will go in and do mechanical and equipment maintenance first of the air handlers and exhaust, and then do what we call system operating tests.

And that's the system – supply, exhaust, and everything that's with it – just the system. And then a lab environment test; a lab environment test would be the fume hoods and exposure control devices, and the things that are in the labs, along with a routine hood test, and then the ongoing monitoring. And with a _____ way of doing this at the lab building, one of the things that does is if a call comes in and the tech goes to the field with it, and if none of this exists, then they have to troubleshoot everything.

But if there's a plan to have this kind of a process in place, then maybe they'll know that well, it's not a mechanical system, it's not the exhaust, it's not the air handling unit, it's not a lot of things, and they can just kind of focus down to one area, which will save them a lot of time. Next slide, please. There's all kinds of graphics and things that can be developed from the building automation systems. My message to you is when you start to do this upgrading, the Smart Lab Program, you have the information that you and your stakeholders wanna use.

Now, with dashboard development and everything, you can extract and get the information that is vital to how you want to run the building, or how the stakeholders are gonna run the building. This is just an example. It can be a graphic and trends on the bottom; for instance, you've got the trends in the bottom right-hand corner. You can see the trends of the space itself, Monday, Tuesday, Wednesday, Thursday, Friday, and you can have the analytics, again, that your specific team wants to see. Next slide, please. Next slide.

So a management program's comprised of multiple elements; I'm not gonna read all these, but obviously, they're all important: documentation, coordination, risk assessment, maintenance, stakeholder training. It's a team effort. Next slide, please. Successful implementation requires leadership and a coordinated team effort. This happens to be the group _____ _____. Stakeholders, facilities, environmental health and safety, occupant representatives, like the researchers, contractors and vendors, hood specialist – just getting everybody on board and everybody together. And then at the bottom it says "Program Manager and Coordinator" – next slide, please.

We're getting here a little bit from Monica about what's going on at LANL, and one of the things that they've done is have to put in a coordinator or a manager to be able to connect the dots, if you will, of all the things that we've been discussing here, or I've been discussing. Smart Labs includes training for all the stakeholders; I mentioned it before, training is a biggie. Training has got to be in place, because again, technology is outpacing our technicians. Next slide.

So the lab building management coordinator – you can see the management at the top – is kind of bringing the two groups together. You've got EH&S on the left, Facilities and Operations on the right. You've got Space Planning, R&D, Record Keeping. A coordinator or a manager, again, is just really helping all of these things get done and being able to connect the dots to move forward. It can be done by an existing person at an existing site, if you've got one or two buildings.

But with the money that can be saved with having a proper plan in place, there usually has to be a person dedicated to this moving forward as you get into multiple buildings with multiple usage. Next slide. So anyway, the LVMP improves performance, mitigates risk and maximizes sustainability. Just a before and after – this happens to be on the percentage of hood failures – you can see how before there was many. With a plan in place we are able to keep it going, and that's really the name of the game. I believe that's it. Next slide, please.

So to really keep it simple, we're about the right flow in the right place at the right time. Again, that's something that's easily said, not so easily done, and with that, that's the end of my presentation.

Rachel Shepherd: Yeah, thanks, Tom. This is all really great information. Just a quick reminder to send any questions you may have through the webinar chat box on your screen, and we'll be collecting those for our Q&A period. You can also contact us directly for questions if we don't have time to answer it during the Q&A section. Before our last speaker, we would like to hear from you, so can you please take a minute to fill out the poll that's gonna be popping up on your screen?

We're interested in what's your organization's biggest barrier in achieving greater energy efficiency in laboratories; so we'll just take a minute or so, and if you could fill out that poll. All right, so thank you for filling out that poll, and our last presenter today is Monica, speaking on Los Alamos National Labs Smart Lab Program. Monica?

Monica Witt: Great, thank you. So I work at Los Alamos National Laboratory, and the laboratory is located in Los Alamos, New Mexico, and it is one of seventeen DOE laboratories, specifically one of three NNSA laboratories. And this lab was established in 1943 simply to design and build an atomic bomb in the war. We were successful with that, but today our mission is very different. We do maintain the safety, security and reliability of the nation's nuclear deterrent, but we do it in a very different way.

We also work on energy and infrastructure security, countermeasures to nuclear and biological terrorist threats, and tons of science. There's tons of science at LANL; we have applied physics, high-performance computing, material science, quantum information, bioinformatics, chemistry, earth science, you name it, we got it. And we have the infrastructure to match that, so we have to support all that vast work, so our site is huge. We have about 40 square miles, and we're at about 7,500 feet in elevation, so just last week, we got over 30 inches of snow, which is unusual, but we all had to come back to work and dig our way into our office.

We have about 920 buildings here on site, and about 8.2 million gross square feet of facility space, so more than half of these facilities are more than 40 years old. So you may think, "I can't do Smart Labs, because I just have old buildings." Well, I'm here to challenge that. So we also maintain over 80 miles of roadways throughout the site, and we also manage and maintain our own entire utility system. So I work for the M&O, which is the Management and Operations contractor here at Los Alamos.

And that is Triad, and it's made up of Battelle, Texas A&M University, and the University of California, and the University of California has been a managing partner here since the very beginning. Next slide. So today, with all that science, obviously I have to talk to you about our laboratory space, so a space with fume hoods and science work going on. I will focus today's presentation on how we've begun to implement a Smart Lab Program at LANL and use the resources that you've heard about already today, like 3flow and the Better Buildings Program, to move our initiative forward. Next slide.

Again, we look at Smart Labs as laboratory spaces that are operated at the highest level of safety and energy performance. Next slide. So you know, over the last ten years here at Los Alamos, we've done a lot of energy efficiency work in office-type facilities, but the epiphany came when we attended an International Institute for Sustainable Laboratories conference about four years ago, and I heard about the University of Irvine's Smart Lab Program, and I thought, "Duh." We have old, inefficient buildings with tons of fume hoods, over 700 fume hoods, so that's my next focus.

We knew we had to get out of the office space and into the challenged buildings, and so this pie graph represents our building portfolio by age, and the red piece of the pie is the oldest. About 8 percent of our operating facilities are from our first operating decade, so I thought, "Well, we'll see if Smart Labs will work at

LANL. Our buildings are so old, but I guess we're gonna try it," so that's kinda where we started. Next slide. So first things first. I asked the UC Irvine management team, and they kind of initially started Smart Labs.

And I thought, "They should come out to Los Alamos and meet with our management team, and explain how they started the program, why it was important, how they funded it." And the LANL management team really needed to hear that, and that was pretty key for us beginning our program, so we are very thankful for that visit. Next slide. And this is some of the results that they shared with the management team here. They had about 50 to 60 percent energy savings, but more importantly, I had a lot of the ES&H folks in the room, and we talked about the safety in those laboratory spaces.

And that was pretty key, and having the UC Irvine Environmental Health and Safety Manager in attendance was very important. Next slide. So the first thing we did was we established a Smart Lab core team, and the key for LANL is the safety aspect of Smart Lab, so it's really important that we establish our initial core team, and that we brought in the right ES&H or industrial hygiene members to the table. And on the right is the Laboratory Ventilation Management Plan Coordinator role, and you'll see there on the left-hand side that one of those bubbles is the Laboratory Ventilation Management Program Coordinator, and then on the right is more of her responsibilities.

And so that core team that we developed there had people ranging from the commissioning program to project management to industrial hygiene, and we meet every other week, and that's very important. Even though we might not talk about building automation systems for the whole meeting, Jeff, who is there in the bubble, needs to hear everything that we're doing in the facilities, so he has an idea of what's going on and what he has coming up next. So I'm gonna talk a little bit more about that coordinator role in a minute. Next slide.

Some of the management attention that was important as we first started the program after UC Irvine left and we made the core team, we realized there are a lot of risks for implementing Smart Labs. Some of the things we realized that first year is that everybody will hate you, because people hate change. People really come around, but it takes people about three to six months to really understand what Smart Labs is and get on board, especially if they're change-averse. So people hate change, people think we can't afford change.

And also, we're not trained well enough to manage this change; so those are the three things that we struggled with the most. And then I have to kinda come back and counter those arguments with the risks of not implementing Smart Labs, which was very clear to everyone on the team; that new talent expects safe and efficient lab space. They can't do their jobs in sub-par space. The equipment is run to failure, and quickly, it's really a safety issue, and the lighting isn't sufficient in the scientific areas. They were redoing some of the experiments because of temperature fluctuation, and our hoods were down all the time.

They were broken, there was no preventative maintenance. We had flow issues, they didn't pass certification, our staff wasn't trained to fix it. So those were the risks of not doing it, and obviously, in everyone's mind, those outweigh the risks of implementing the program. Next slide. We did join the DOE Better Buildings Smart Lab Accelerator Program, and this is key because we got management champions right away, okay? So the benchmark tools were available for us through this program, and that was very key. We did have management champion right away. Next slide.

The next step after doing the core team and getting management champions was doing a building selection. We selected buildings based on the highest energy users and the most fume hoods, so we got a list of about ten buildings to start with. And you can see on the pie chart that the fume hoods were heavily located within three organizations, and that's where we focused our efforts. We also selected a smaller pilot building to work concurrently, for a quicker win. Next slide. Then we set to following the road map that was built by 3flow and the Accelerator Program.

We did down-select to four facilities, and we did conduct rapid energy laboratory assessments with 3flow, and also, we conducted hood demand ventilation assessment in those facilities. So at this point, we also sent in our recommissioning agent to put together a comprehensive recommissioning plan. That was really critical for us, because we had a lot of deferred maintenance that we had to get to. So right now, we are in Phase 2 of Smart Labs in about four facilities, so some of them are funded and some of them we're working on the project funding for. Next slide.

So at this point, I think that we're going to be running out of time, and I'd like to go ahead and skip to probably slide 23, which is metrics to measure success; and all of you will be getting a copy of this presentation, and the slides that I skipped over are pretty self-explanatory about the things we've been doing in each of the buildings that we identified. And if you have any questions, my contact information is at the end of the presentation. So these metrics that we use to measure success are identified by the Smart Lab Accelerator Program, and we call every month and we talk about them. That's been very helpful. Next slide.

Obviously, we're working on future funding for Smart Labs Program, and I think it's really important to recognize that this program for Los Alamos, and I suspect for quite a few of you, will take major investments. Next slide. Again, this is the team that we set up to work on the Smart Labs Program, and if you have any questions about the slides that I have or the ones you didn't quite get to hear about, please feel free to contact me. Thank you.

Rachel Shepherd: Thank you, Monica, for sharing that great story of Los Alamos, and we're excited to hear more success that you guys have in the future. Unfortunately, since we're running out of time, I definitely wanna encourage folks to contact Monica for more information. So right now, I'd like to point out some specific resources listed relative to the content that was presented today. In particular, you've heard throughout all three presentations, University of California Irvine, who's a very active Better Buildings partner, and they will actually be hosting a free workshop on their campus on their Smart Labs Program that they have done.

So if you're able to attend, the workshop is January 29 and 30, and you can register through the Better Buildings Calendar and the link there. So next slide, please. All right, so we're gonna go ahead with the time that we have remaining to open up for questions, and we have received several questions. So the first question goes to Tom, and it asked for the EPA building example, were there are existing VAV boxes used with optimization that were replaced with fast-acting controls?

Thomas Checksfield: Sure.

[Crosstalk]

Rachel Shepherd: Thought you might be _____ _____. Okay.

Thomas Checksfield: No, I'm good; trying to understand the question. Hopefully I'll answer it correctly, and if not, I'll read it and get responses back. I know you'll adjust that at the end. But anyway, the boxes at the EPA, they didn't want to put all kinds of new controllers or control knobs, if you will, so we utilized the existing VAV box, but we put in a better sensor, flow sensor, and a faster-acting actuator. Not on every single valve, but strategically throughout the building. I hope that answers your question; if not, ask again and I'll try to do a good job.

Rachel Shepherd: Yeah, thanks, Tom; actually, we have another question for you. So from an outsider perspective it seems that there are a number of codes and guidelines for laboratories related to required air changes that are at times conflicting. How do you navigate these conflicts in line with your risk assessment and the lab functional requirements?

Thomas Checksfield: Great question. Between myself and Tom Smith, we work a bunch of different groups and organizations – ASHRAE, for instance, CETA. ASHRAE right now has a risk assessment for ventilation that's a little bit different, and what we're trying to do is we're trying to get everybody on the same page. It's pretty close, so we're not there yet, but we're able to address any existing ventilation risk assessment that's out there right now; can pretty much homogenize it so that one applies to the other, so to speak. Again, it's a reference, it's a vehicle.

These things aren't cast in stone, but it's a vehicle for stakeholders to start talking about risk assessments and related control bands. Go ahead.

Rachel Shepherd: All right, thank you – yeah, thank you, Tom. So unfortunately that's all the time we have for questions today. Again, I encourage you to send your questions to us directly, but before we go, I'd like to remind everyone of some upcoming webinars as part of this series. Next slide, please. The next webinar we hope that you attend is on Tuesday, February 6, from 3:00 to 4:00 PM, entitled Lessons from the Field: Real World Applications that Inform R&D. This webinar will focus on real world applications of energy-using equipment and processes that can inform the direction of energy-related research.

In this webinar, actual end users from among Better Plant partners and representatives from the R&D community will discuss how they have informed research into new energy-related technologies, materials and best practices. Next slide, please. Just a quick reminder that the 2019 Better Buildings Summit will be on July 10 and 11 in Arlington, Virginia, and registration will be opening soon, so I hope to see you there. And with that, I'd like to thank all of our speakers for talking to us today. Feel free to contact us again directly with any questions.

If you would like to learn more about Better Building Initiatives, please check out our website, and feel free to contact my colleague

Kendall directly at the email shown here. I encourage you to follow the Better Buildings Initiative on Twitter for all of the latest information. And then lastly, you'll receive an email notice when the archive of this session is available online. Thank you very much for attending today and have a great day.

Otto Van Geet: Thank you.

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