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Richard Fowler: Welcome everyone. I am Richard Fowler with the Pacific Northwest National Laboratory. I'd like to welcome you to the US DOE National Energy Codes Conference seminar series.

In the light of the NECC being postponed, this weekly series has been developed to share insights and spur discussion on a collection of timely and emerging energy code topics. Today's seminar will cover performance-based codes compliance. Looking ahead, this seminar will cover other timely topics such as virtual remote inspections, the 2021 IECC, advance technologies and more. We hope you will join us on Thursdays at 1:00 PM and keep the conversation going.

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Before we hear about our speakers, we want to hear a little bit about you by asking you to answer a pair of quick polling questions. Please respond by selecting from listed options with your mouse or touchscreen. I will launch our first question, which asks what most closely aligns with your profession? I'll give you a few seconds to select from the five choices. All right, I'll go ahead and close that and let's see what we got.

Okay, a lot of architects and engineers it looks like and a good representation of other folks, thank you very much.

Second question: In what reason are you located? Okay and it looks like we're all represented across the US. Excellent. Thank you very much.

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Now without further ado, I will turn things over to our moderator, Bing Liu, of NEAA to give us an introduction. Bing, take it away.

Bing Liu: Thank you, Richard. Let me see if I can present my slides.

Welcome everyone. This is, I think, the number four DOE National Energy Codes Conference Seminar Series. The topic is about commercial building the performance-based codes compliance.

So performance based codes compliance have existed in the codes for years but have not been a popular ____ choices for both

commercial and the residential buildings across the country. In the residential building sectors since energy rating index insured ERI was introduced into IECC in 2015 the year high performance passed for ____ builders another flexible options for complying with the homes.

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And the number of the homes receives ____ ratings have grown.

However, this is not a case in commercial sector where the performance base the compliance still presents as a minority of the project even though ASHRAE standard 90.1 has issued a new performance path called performance _____ commonly referred to as Appendix G in 2016.

To address this issue and to remove the barriers to achieve deeper energy savings through the whole building in the design and the performance, we start a project and the reported progress at the DOE's national codes conference last year. This webinar will present the state of our involvement of the tools and the resources since May last year.

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We'll also highlight how [*unintelligible*] programs and other ____ program use Appendix G for their whole building performing based program design.

Let me introduce our panelists. Mike Rosenberg is a chief scientist at the Pacific Northwest National Laboratory. He's a program manager for PNNL's building energy codes program leading the team that provides technical analysis and the support for development and the implementation of energy codes and standard. Mike's has over 25 years of experience in building energy codes training to code officials and design professionals. Mike is ASHRAE fellow, a voting member of ASHRAE 90.1 community responding for the development of Appendix G.

We have another Michael, Mr. Michael Tillou is a senior researcher scientist at PNNL supporting commercial codes development.

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Mike has worked for over 20 years as energy analyst supporting the design and operation of high-performance buildings. And that is complex building systems and the codes development. Michael is a registered professional engineer.

Our third panelist is Maria Karpman. Maria is a principle of Karpman Consulting. She also has over 20 years of experience in building science, energy modeling, and energy code. Maria is a member of ASHRAE standard 90.1 committee and also worked with Mike Rosenberg in terms of the development of Appendix G. She also _____ in the technical content and the tool development for programs such as Energy Star and _____.

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Maria leads research studies to reinform energy code development, streamlines code compliance and the enforcement, and conduct trainings on the energy codes and the modeling.

Lastly, myself, Bing Liu, I'm you're the moderator for the seminar and also a presenter. I'm a senior manager at Northwest Energy Efficiency Alliance managing the codes standards and the _____ new construction program. My teams work involves the development and the implementation of the building energy codes, federal appliance _____ standard and the _____ new contracting program.

I have worked in the field for 25 years particularly in the codes standard development and energy efficiency technology development and the application. I'm a ASHRAE fellow, a registered professional engineer, and a former member of ASHRAE standard 90.1.

Okay, let's start with our presentation from our panelists.

[0:07:00]

Michael Tillou:

Welcome everyone. My name is Michael Tillou and I'm one of the senior researchers at PNNL supporting the building codes program. As part of today's webinar, I'm going to give you a short background on the new ASHRAE 90.1 compliance tool

The project got its start in response to an increasing number of support requests from state and municipal jurisdictions facing an increase in the number of performance-based energy code submissions they were receiving. Unsure of how to properly

review these complicated project submissions they turned to PNNL and DOE for help and guidance. In 2019 this project was started in order to address the need for greater support of performance-based energy code compliance.

The goals for the project included collecting information on the challenges and best practices of using performance-based code compliance.

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Developing a roadmap for improving quality control of performance-based code submissions.

Identifying and developing a new quality control tool. And identifying how to maintain that tool for the long term.

To collect the necessary information on the challenges and best practices of using performance-based code compliance we convened a stakeholder group with over 70 members. The group covered a broad spectrum that included both commercial and residential building interests. The group included both state and municipal code compliance jurisdictions, beyond code programs, software vendors, practitioners, members or relevant ASHRAE standards, and interested third party organizations with a vested interest in improving simulation code compliance outcomes.

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When the stakeholder group convened the Northwest Energy Efficiency Alliance sponsored a comprehensive survey of the stakeholder group to help solicit specific feedback. Karpman Consulting conducted the survey, compiled the results, and reported the results back to the stakeholders.

The survey targeted the jurisdictional and beyond code members of the stakeholder group, which represents roughly half of the members. Without going into too many details about the survey results I will highlight several of the key questions that informed the decision to develop a new compliance tool

The survey included several questions about the number and type of projects using performance-based compliance. Overall, as a percentage of projects most jurisdictions see a small number of performance-based submissions. However, the ones they do see are often large, energy intensive buildings with complex systems.

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The results also revealed that some jurisdictions are moving towards requiring all projects to use performance-based submissions so a robust quality control process was especially important.

The survey asked respondents to comment on the different types of submissions they accept. In this case ASHRAE 90.1 Appendix G and ASHRAE 90.1 Section 11 are by far the most common submissions.

Another important set of questions asked respondents about the challenges they face with performance-based compliance submissions. In this case modeler error and ambiguous simulation rules were reported as two important challenges.

Finally, respondents were asked to comment on short term and long-term priorities for improving the quality control of performance-based compliance.

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In the short term, overwhelmingly the respondents asked for a standardized reporting template and tools to improve submittal review. Based on the survey results and feedback from the entire stakeholder group it was decided to develop a new sort of tool for documenting performance-based compliance that would also help with submittal reviews.

The initial version of the tool would focus on the compliance requirements of ASHRAE 90.1 Section 11 and Appendix G. The new performance-based compliance tool was developed with funding from the US Department of Energy. It supports ASHRAE 90.1 2016 and ASHRAE 90.1 2019 requirements. The tool is posted to the Department of Energy Building Energy Codes Program website and is currently available for people to download and use.

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The tool itself was created using Microsoft Excel in large part to facilitate the integration with the wide range of custom tools most energy practitioners already have developed for code compliance submissions. The Excel platform also supports further

customization that may be required by different state and municipal jurisdictions looking to adopt this compliance. Currently, the tool can automatically import simulation results from any of the most common building energy tools making it easier to use. But the results from any simulation tool can be manually entered making it extremely flexible to fit the specific needs of a practitioner.

The reporting requirements for performance-based compliance in Appendix G in Section 11 are very thorough in order to ensure jurisdictions receive all the necessary information to conduct a complete review of each submission.

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The new compliance is built around these requirements and will help ensure that all of the requirements in either Appendix G or Section 11 or properly addressed.

The new compliance form also addresses reporting requirements that are not easily extracted from the standard reporting that most building energy modeling tools provide. For example, the new tool facilitates the documentation of prescriptive and mandatory criteria in ASHRAE 90.1 that may not be part of developing a whole building energy model. It is important for practitioners to document compliance with these requirements and the new tool streamlines this process.

The tool also helps practitioners document many of the backup calculations that are needed to translate information from design drawings and specifications into energy model inputs.

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An example of this type of backup calculation is the determination of lighting power. The detailed requirements of a specific lighting design from construction drawings and specifications are often distilled down to a single lighting power density value for use as an energy model input. The compliance form provides a convenient way for energy practitioners and designers to document the calculation of lighting power based on the type and quantity of light fixtures into the necessary energy model inputs using either lighting power or lighting power density on a zone by zone basis.

For most energy practitioners the current process of documenting energy code compliance for a performance path is a linear process that occurs once an energy model is complete. Finalizing the

documentation is time consuming and often there are only a few days between the completion of a design and when it needs to be submitted.

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This leaves little time to pull together all the necessary information. The new compliance tool is design to streamline this effort. The tools the practitioners use to development energy model inputs is also the tool used for documentation compliance. When used correctly, an energy practitioner can develop the required documentation as an integrated part of the energy model in process. This integrated approach eliminates the time and effort associated with having to create additional documentation at the end of a project.

Now that the first version of the compliance tool is available publicly a number of jurisdictions and ___ code programs are getting ready to adopt it. Jurisdictions such as the state of Washington, city of Seattle, and New York City are looking at adopting it for their code compliance programs.

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USGBC and GBCI are figuring out how to make this an option for LEED NC projects. The EPA multifamily program and the Northwest Energy Efficiency Alliance are also preparing to adopt the new form for their beyond code programs.

As I previously talked about the tool was created to allow each of these programs to customize the contents of the tool to ex match their needs.

And with that, I will hand things over to Maria Karpman who's going to walk you through some of the key features of the new compliance tool.

Maria Karpman:

Hello everyone, thanks for joining us today. My presentation has two segments.

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I will start by demonstrating to you the functionality of the compliance from that Mike talked about and then I will talk about the planned new features of the compliance form and other tools that we have in the development.

So I will start with the compliance form and here is one of the compliance form text that illustrates the two ____ courses. So the modeler uses design documents to determine systems and components in the proposed design and enter description of the system and components into the compliance form. So the compliance form is illustrated by this box in the center. Each rectangle within the compliance form box in response to the input tab.

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Do the compliance form as Mike mentioned to you, helps energy modeler to determine simulation inputs for the proposed design based on entered details or what's specified on drawings. It also helps modeling determine ____ of the baseline that should be entered in the simulation tool. And then it helps determine compliance based on the simulation results.

This process and this information flow is illustrated using the arrows and most of the information transferred is manual but one exception is simulation results can be imported into compliance form by pasting –

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standard simulation reports produced by common modeling tools into the specified area of the compliance form. And I'm going to describe it to you shortly.

So I'm going to go over several sample tabs to give you an idea of the interface of the compliance form and the main features. So the general information tab is where high level ____ details are entered. You know, for example, here modeler will specify the compliance path the project follows so the compliance form supports 90.1 Section 11 and Appendix G. And the current version of the form supports 2016 and 2019 additions of the standard.

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So here modeler would also enter simulation tool that was used. Climate zone and then provide any of the other details that would be helpful for the code official who's reviewing the signature.

So next I want to talk about the dashboard. So dashboard tab is really the main home base and navigation center of the compliance form. So it lists all the tabs, all the input tabs that included and

modeler can click on the tab to jump to it. So this is, for example, the interior lighting modeling inputs tab.

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And then there's a link at the top that one can click to return back to the dashboard.

So one of the notorious issues with performance-based compliance is disconnect between the model and design documents. So for example, the model may reflect lighting power density of say .5 watt per square foot in the proposed design but has design documents based on the specified lighting have much higher lighting power density.

So the compliance form helps _____ and eliminate this disconnect. There is a place here for design professional to sign off on the content of each tab and design professional doesn't have to be expert in energy modeling.

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Design professional is just signing on the description of the proposed design including in the compliance form.

And then, there is also a place where modeler signs off to _____ content of each tab is reflected in the modeling input. For example, if interior lighting tab states that proposed design lighting power density should be .5 and baseline should be .7 then that's what was entered into the simulation too. So again, both modeler and design team _____ signs off on each tab.

The dashboard also shows compliance outcome at a glance. So it _____ the compliance path viewed by the project, in this case it's Appendix G.

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It states whether the project meets codes based on the simulation results and also confirms that both design professional and modeler sign off on each tab, each applicable tab.

So I'm going to show you one sample input tab and I think I'm going to show you _____ tab. So all input tabs here and system interface so at the top of each tab there is table of contents. And it lists all the tables in order on the tab and you can jump to this table

by clicking on its name. So each table includes instructions that describe information that has to be provided.

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There are many help boxes throughout the compliance form and the help boxes are the buttons with the little question mark, if you click on it, you will see the help text related to this field. And help text may include references to requirements of 90.1, may include examples. They may include tips on effective use of the compliance form in respect to this input.

Compliance form also has consistent color coding throughout all tabs. So that gray to respond to column or row headings. White color to respond to cells that are auto populated. So in this case, the U value for the baseline design for various exterior surfaces is established based on the surface type whether it's a wall or roof conditioning _____. Or whether its residential, non-residential, or semi-heated space and climate zone of the project specified in general information tab.

And then, similar prescriptive requirements applicable to each exterior surface are auto populated. So prescriptive requirements is not something that's _____ simulation tool but they must be reported based on 90.1 reporting requirements so compliance from helps modeler meet this requirement.

So some of the user inputs and user inputs are shown in different color of peach. So come of the user inputs just type _____.

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Some other inputs use boxes that allow selecting from pre-defined choices that are applicable to that input. So again, this interface is shared by all input tabs.

So I mentioned to you that compliance form allows importing simulation results from popular modeling tools. So in this example project was modeled in eQuest so selecting eQuest on the general information tab displays results from eQuest tab. And there will be similar tabs for other modeling tools supported by the compliance form. So at the top of each such tab there will be instructions. So these instructions typically develop the input form to vendor and then user can _____ standard simulation reports generated by the _____ --

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into the prescribed areas of software specific tab and that populates compliance calculations tab. So this tab is standard irrespective for what simulation tool was used. So again, at the top you see table of contents and here in the table tool there is baseline and proposed design simulation results or they are _____ results from eQuests tab. You can see that some other populated cells can be overwritten by user, by modeler and if other populated cell is overwritten it's highlighted in a different color here.

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And tells both the modeler and reviewer that this information was not just imported from the simulation tool.

And last, but not least is submittal checklist. Submittal checklist is content sensitive. It is updated based on all the information that must be submitted by particular project. For example, if project uses actual utility rates for electricity and gas the checklist will ask modeler to include the _____ to substantiate these inputs. That there is also list of simulation reports applicable to the two being used that must be submitted and included in the submittal page.

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So that completes compliance form demo. I encourage you to download the compliance forms that are posted at _____ website. We have both the clean version of the compliance form posted and the sample filled out with inputs for sample projects. And perhaps the form filled out with sample inputs is the most useful for you if you just get a taste of what the form is about.

I want to mention two trainings that will be developed for the compliance form. The first one is a two-hour training.

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It was delivered about two weeks ago but the recorded version is available from energycodes.gov training website. This training focuses on 90.1 reporting and the _____ requirements applicable to performance-based projects. It demonstrates how to fill out compliance form, include productivity _____, discusses efficient work flow and common mistakes.

The second training will be held on December 8. It's also a two-hour training but this training will focus on using compliance form

to perform submittal reviews. It will discuss review steps and the ____ for prioritizing review effort. It will also be recorded and the recording will be available from the same website.

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The next segment of my presentation will discuss upcoming updates to the compliance form, which include new quality control tab, customized versions of the compliance to support jurisdictions and rating authorities who adopted 90.1 Section 11 and Appendix G with some modifications. The ability to generate the compliance reports and data exchange with external tools.

I will also talk about the new tools that are being developed, which include submittal review manual and technical support documents aimed to facilitate wider adoption of 90.1 Appendix G.

I want to refer again to the stakeholder survey that Mike mentioned in his presentation. Along with the standardized compliance form, stakeholders really focused on tools that would help to facilitate submittal review.

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Including submittal review manual and submittal review checklist. And I want to point out that such tools not just help submittal reviewers but also help modelers. You know, for example, on modeler wrote in the stakeholder survey that when they develop energy model on the project that participates in multiple incentive programs such as Energy Star and LEED, even though the project may follow the same simulation requirements for both programs it has to go through two separate reviews. And each rating authority EPA and LEED often come back with different review comments. And of course, that impacts cost and effectiveness of modeling projects.

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In general, review steps include verifying that proposed design reflects design documents. For example, if lighting ____ density for the proposed design is reported in the compliance form as .5 watt per square foot, reviewer needs to verify that lighting plans and schedules in fact, support this number. Reviewer also needs to confirm that the baseline design is correctly established following 90.1. You know, for example, baseline exterior wall U value, lighting poly density, HAVC system type is correctly established.

Reviewer must also confirm that the baseline proposed designs are modeled as described in the compliance form.

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And that compliance is established correctly based on the simulation results.

And then the last three steps may be automated in the simulation tools, but in order for reviewer to be able to trust relation tools the simulation tools have to go through some vetting process or certification process. And unfortunately, such certification process does not exist at the national level. Individual adopters such as state of California state of Florida developed certification processes for their states and there is a national effort on the way. And this is ASHRAE standard 229 that strives to develop such vetting process either for individual projects or in future for simulation tools to certify them as compliant.

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But for now, reviewers have to perform these review steps manually.

So here's an example to illustrate complexities of review of ____ base submittals. There is a rule in Section 11 Appendix G that calls for the floor area to be the same between baseline proposed design model and equal to the area, the actual area of the project. So what simulation reports should reviewer use to verify that? Projects can be modeled in different simulation tools and each tool has custom reports and reviewer needs to know which report to use for the given simulation tool to find this information.

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In addition. Modeled floor area often doesn't match design documents and there may be some legitimate reasons for that such as workarounds that modeler may use to model multi-level areas. Also, there's difference in definitions in floor area between initial building code versus 90.1. Or perhaps there's a mistake in the model and perhaps it was developed on preliminary design and not updated to reflect the final design.

So how can the reviewer decide whether the mismatch in model versus actual specified floor area is acceptable and submittal can be approved?

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Submittal review manual addresses questions like that. It specifically focuses on aspects of the review that you need for performance-based projects. It includes several hundred of review checks. For each check it provides software neutral description. You know, for example, it will say that floor area must be the same between the baseline proposed design and match design documents.

And then, it includes software specific sections that include annotated simulation input, output reports that were developed by vendors of supported tools that help reviewer get the necessary information from software reports. The manual currently support Carrier HAP, Design Builder, Energy Plus, eQuest, Trane TRACE 3D Plus and 700, Open Studio.

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And we're hoping to also get this information from IES-VE.

So the manual also describes review prioritization strategies to help focus review effort on the areas that are most impactful for the given project. And it also describes the key elements of the enforcement infrastructure that are necessary for effective and efficient submittal reviews such as recommended ____ modeler and reviewer qualification requirements and adoption of a detailed compliance form.

And this slide illustrates annotated simulation reports. And this is for Trace 700 so as you can see, it shows the report for a sample project.

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And it highlights areas that can be used to support various checks in the review manual and here there are references to specific checks that use information included in this report.

The regional plan was to implement review checklist, which would be companion to the review manual. But when we sent draft documents to the stakeholders, many stakeholders suggested to incorporate review checklist into the compliance form. And we followed this recommendation so the next version of the compliance form will include quality control tab. This tab will include all the checks described in the review manual.

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And it will allow identifying the checks that should be performed on the given project based on prioritization strategy defined in the manual. Many of the checks are performed automatically. For example, the check that verifies alignment between reported lighting power versus model lighting power can be automated by comparing the reported lighting wattage for the proposed design, let's say, to the peak lighting demand coming out of the simulation tool. So both datapoints will go into the compliance form and can be compared.

So ____ tab will also allow reviewer to record comments if any checks fail.

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And there is also space for the modeler to reply to those comments.

The next new feature of the compliance form that I want to talk about is support of the custom versions. And Mike mentioned that in his presentation so many jurisdiction rating authorities that adopt 90.1 Section 11 Appendix G make some limited changes to modeling requirements. And the DOE intends to fund of this to the compliance form to reflect these changes. So there will be this box on the general information tab of the compliance form that will allow modeler to select custom version.

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For example, Seattle commercial energy code or LEED and ____ program and that will update certain ____ within the compliance form to meet requirements of these programs.

You know, very common customization example relates to compliance calculations. In the default version of the compliance form the building performance factors are based on ASHRAE 90.1 Section 4 table. And these building performance factors are used to determine project compliance with energy code or margin of improvement beyond code.

I have many jurisdictions above code programs that adopt Appendix G modify this compliance calculation logic and building performance factors.

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For example, New York City energy conservation code that is currently in use have the performance factors that translate into higher stringency of ____ past. In addition, New York City allows establishing compliance based on source energy as an alternative to energy cost. So their prescribed site to source energy conversion factors and BPFs, Building Performance Factors for projects that use source energy-based compliance ____ to energy cost. So these factors would be used in the compliance form if projects select New York City from the drop down list that I showed you on the previous slide.

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Another compliance form feature that we hope to implement is expenditure reporting. Based on the stakeholder's survey one of the most persistent issues that is yet to show improvement is mismatch between information included in the model and the actual design documents. And adequate reporting really can address this area. So the reports that are being planned include compliance reports summarizing parameters of the baseline proposed design that can be printed on the drawings to facilitate plan reviews. And also reports that will just focus on the ____ and compliance in the proposed design to help facilitate site inspections.

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Another important new feature is data exchange with external tools. Data exchange will include exporting information from the compliance form into third party tools such as central databases maintained by program administrators, listing projects that were approved, or custom calculators such as those developed by many incentive programs to determine project incentives. Or do some additional ____ processing such as to determine energy savings of the proposed design relative to current code.

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So in addition, there are plans to incorporate data import from third party tools into the compliance forms. You know for example, there may be expanded data exchange between simulation software and the compliance form and perhaps also data exchange with inhouse tools used by moderators such as tools to calculate lighting power density.

And we have a poll question coming up where we hope to get your input on what data exchange functionality you think would be helpful.

The additional data exchange that I mentioned will likely involve using prescribed data format ___ for the schemer.

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And this example shows schemer envisioned by COMNET so you can see they used x amount format and the information included in the file included general building description such as building type, floor area, energy consumption by end use, contact information, information on utility costs.

Additional tools that are planning to develop include technical support documents to facilitate adoption of 90.1 Appendix G. So these documents will address some of the known challenges that programs run into.

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For example, some incentive programs require must report savings of the proposed design relative to current addition of energy code. And this is no longer the natural byproduct of Appendix G modeling because now Appendix G baseline is stable and based ___ 90.1 2004.

Another challenge with Appendix G can be fuel switching where a different energy source is used for heating in the baseline compared to the proposed design. And then another challenge is perceived panel for projects with electric space heating even if it's an efficient system such as ___ but it's compared to fossil fuel heating in the baseline.

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So there are some known solutions for many of these challenges but currently each adopter has to solve these puzzles on their own so the role is to develop central repository of solutions that adopters can easily use.

All right, thanks everyone, that's all I had for you today. And with that, I'm going to pass it on to Bing who will talk about using 90.1 Appendix G in ___ code problems.

Bing Liu: Thank you, Maria, for demonstrating the compliance form.

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My name is Bing Liu from Northwest Energy Efficiency Alliance, in this section I will walk through a few examples to demonstrate how to use Appendix G design above code programs.

Here are some common issues and how to address them when using Appendix G as the whole building performance metric to design the utility incentive program, Energy Star multifamily new construction program, and the above codes compliance. I will wrap up my session with the main takeaway and the resources.

As mentioned previously Appendix G provide a path to set up energy performance target for both code compliance and above codes programs. The stick on the left hand side of the slides showing the performance costs index as defined in Appendix G.

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So the index 1.0 means your building energy performance as stringent as 90.1 2004 standards requirement. And the 90.1 2004 also refers to as Appendix G baseline.

And when we move down to index zero it means your proposed design is at zero energy performance level.

Let's look at 90.1 2010. In the index it's showing 0.7 it means for the entire standards of 90.1 2010 it's about 30 percent more stringent than the 2004 edition.

When using Appendix G for above codes program design we have run into a few common issues I'd like to share. Since Appendix G baseline is 90.1 2004 how can we calculate the following items?

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The first one the common issue we ran into is the state codes is not 90.1 2004. It might be 90.1 2016 or IECC different codes. So also, their current performance is calculation based on energy cost but my program may be try to address the set energy, source energy, or carbon emissions. How do I do the calculations different from the energy cost budget?

Another issue we run into is to do the cost in terms of the cost effectiveness of the individual measures since Appendix G is ____ address the entire building performance.

Another one is on certain utilities may be only incentive to electric or natural gas driven measures.

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So how do you calculate the fuel level savings of the proposed design relative to the current effective codes?

Let's look at ____ example. In the next few slides, I will walk through a methodology, how to adjust the baseline codes from 90.1 2004 to your current codes and I'll use Oregon codes as an example.

Oregon has adopt 90.1 2016 as its commercial codes since October 2019. So for utilities to design above codes incentive program they need to adjust their baseline from Appendix G baseline to the current codes, which is 90.1 2016.

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The first we can use the PNNLs prototype building models to calculate the ratios at the end use level between those two codes version.

So what I'm showing here using as a medium office building as an example. So the first line down here is showing ____ of the major end use level, the site energy consumptions for to meet 90.1 2016 standard requirements. Not including the lightings, service hot waters, heating energy yields, cooling energy yields, fans, pumps, transformers, elevators, process load, etcetera.

And at the second line we're showing down here for the same prototype building just meet the 90.1 2004 baseline requirement what's the site energy yields for each of end use level?

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Then you calculate the ratio between these two standards also referred to as building performance factor. So you use the 2016 annual level, divide by your starting point or baseline of 2004 and you get the ratio for these two standards. For each of end use level you can see we have a difference of the ratio among end use. And

keep that in mind because the end use level ratio can be applied to the next step.

So the first step we use PNNL prototype buildings to calculate ratios, adjust between 90.1 2004 and your current codes.

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Then you use your real building project to model Appendix G baseline energy use follow the rule set. This is a hypothetical number we're showing, you know, just go through the Appendix G, define the baseline for your real project what's the site energy yields, the end use level may looks like

The next step is to calculate the current codes energy use for your real project. Step one we already have our ratio between 2004 baseline and your current code. And the step two you modeled your real project using Appendix G define baseline use set and calculated their energy consumptions at end use level. And step three is if your design only to meet your current code requirement, in this case is 90.1 2016 standard and what their energy end use ___ looks like.

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Which is yielded in a ratio from step one times baseline 2004 baseline end use level from step two. So the total number here is 31.32 kBtu per square foot presenting the total energy use if your design building just to meet the current codes requirement.

The next step is to calculate your proposed design energy use for the real project. Follow the rule set defined in Appendix G you can model your proposed design energy use. What we demonstrate here is for your proposed design it's showing a total energy use about 23.6 kBtu per square foot.

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Finally, calculate the savings of your real project compared to the current codes. That's the step number five. You have the baseline calculator from steps three and also your proposed design calculated from step four. The difference of energy end use level showing here at step five is the savings from your proposed design compared to the design just meet your current codes requirement. And also, you can calculate the percentage of savings you can see the savings at the different end use level have a range of different

but on all your proposed designs showing 24.6 percent better than the current codes requirement.

The next example showing how Energy Star multifamily new construction program using Appendix G to design its program.

[0:59:00]

Energy Star multifamily programs set up the performance target of the 15 percent better than energy codes and the rate the buildings is permanent. As shown in the DOE state codes adoption map here this present a challenge for the program design due to the wide variation in code stringency across the country. As showing in the map some states with effective codes equivalent to 90.1 2007 level and some all the way to 90.1 2016 level.

Appendix G ____ in the same modeling requirement for project in any state with the difference in stringency accommodated for in the compliance calculations.

[1:00:00]

The program simulation guidance provides performance rating based on the building performance factor for different edition of 90.1.

The building performance factors we show in this table, again, this is the ratio of whole building energy performance at the different 90.1 editions all compared to 2004 baseline. For example, let's use a one 4C. Take a look, that's their climate zone *[unintelligible]* Oregon area. So if your state level codes is 90.1 2004 the building performance ratio factor is 0.97, which is three percent, maybe a little bit better than 2004 in that particular climate zone.

[1:01:00]

But if your state energy codes, current codes is 2016 level, which is the true case in Oregon, then your multifamily building performance factor is 0.81. So this kind of the building program factor as a ratio is really, they key to helping adjust your state current codes requirement and ____ the multifamily performance ratings. You can find the detailed methodology examples from the link here, which is Energy Star multifamily new construction programs simulation guidelines.

This example showing how Appendix G can be used for the ___ codes and the utility application. The ___ Washington State energy codes adopted Appendix G as the performance-based codes compliance ___.

[1:02:00]

The city of Seattle has its own commercial energy codes targeting 10 percent more stringent than state codes. ___ instead of using the energy codes as a metric Washington State adopted carbon emissions as a metric in Appendix G.

Since they were able to calculate the building performance factor at an energy end use level to change the metric from energy cost to other metrics such as carbon is relatively straightforward. Especially the Washington codes has defined the conversion factors from ___ energy by field type to carbon emission.

This table shows the performance index for 90.1 2016 standards Washington State and Seattle codes.

[1:03:00]

Keeping in mind the smaller of the index means more stringent of the codes and the better efficiency of your building. So what we can see among the different building types we have a different index, that means you have a different achievement target for your building. And for example, for multifamily to meet 90.1 2016 requirements the index is 0.81. And the Washington codes requires index 0.58 and Seattle is 0.53 so it's a more stringent in Seattle and the Washington codes compared to 90.1 2016.

And if you want to design a utility program above Washington codes or Seattle code requirement, for example using multifamily, you can design your index 10 percent or 15 percent better than Seattle codes your index number may be .05 or 0.48.

[1:04:00]

A few takeaways from this session. First Appendix G provide a pathway to set up energy performance target for both code compliance and above code programs.

Secondly, we have established methodology to help customize the performance target and based on the local codes and the technologies that the programs wants to promote.

Lastly, align the reporting requirement with other national and local programs that use Appendix G help to reduce the overhead for participants and streamline submission reviews.

I would like to share some resources for your reference. First, about methodology.

[1:05:00]

PNNL has published a report in terms of developing the performance cost index target for 90.1 Appendix G using the performance rating method. You can find the link here to download that report.

And there's also a methodology report coming soon from PNNL it's about how to calculate the savings compared to the current your ___ codes and using the different metrics to support the policy goals and other utility programs as well.

And as Maria mentioned, PNNL has developed their compliance tools as Appendix G compliance form. It's a free download for everybody to use. You can use the same form for codes compliance also about codes reporting requirement. And we will continue to provide Appendix G training.

[1:06:00]

You can find more training information from energycodes.gov. And also, Maria launched Appendix G pilot project in partnership with Energy 350 and we're looking into a few projects, real world project and what was their energy modeler and designers using the Appendix G compliance form to walk through how to use these forms to document their Appendix G compliance requirement. And also conduct some interviews with inspectors and the code officials from their perspectives when they gather their Appendix G compliance form how that help them to review their project, which is *[unintelligible]* performance past.

[1:07:00]

We'd like to share the result maybe the beginning of the next year with the pilot project.

Lastly, this slide is showing the national local above codes program which already adopt Appendix G as their methodology for help with their performance path. The first one is Energy Star

multifamily construction. We have an example how they design their program using Appendix G.

The next one is NYSERDA multifamily new construction. If you want to learn more about this program you can contact Maria Karpman since she is very instrumental in terms of helped to design these programs.

The next one is New Jersey pay for performance new construction program that provides the use end ____ to above codes performance but using Appendix G as same modeling.

[1:08:00]

And lastly, Energy Trust of Oregon new construction program also considering using Appendix G as a whole building metric for its annual construction program.

This will conclude my presentation and we're going to move on to a few more polling questions and open up for questions and answers session.

Tess:

Hi everyone. So I'm going to start the polling questions, the panelists would like to collect some of your feedback on the performance-based compliance form so they'll be three polling questions.

[1:09:00]

Go ahead and put your inputs in there and we'll give it another minute for this question. Okay, great, we'll close this first polling question and then we'll launch the second one. I'll share the results on this first question.

Okay, question number two. Great, thank you for your answers there. I'll close this one. Sharing the results and it's a pretty good spread.

[1:10:00]

And then, final question. Thank you. Okay, ready for the question and answer section.

Bing Liu:

Thank you, Tess. We have about 15 minutes before 15 minutes and there are a few Q&A sessions. Keep sending us the questions so we will try to address as many as possible.

[1:11:00]

I assume since we have recorded webinar give us advantage to address your question directly. There are some common themes on the questions I see. First is some of the clarifications. So today's seminar is really talking to focus on performance-based compliance. So in the ____ model codes, ____ based compliance is still available and the COMcheck will still continue to support ____ based compliance.

There's a question about when 90.1 2019 and the 2021 IECC the latest national model codes can be supported in COMcheck. Mike Rosenberg from PNNL addressed. So 90.1 2019 standards will be available in COMcheck this year.

[1:12:00]

Sooner is better. Some of the states are waiting for COMcheck for us to help adopt the 90.1 2019. No pressures.

Since we're still pending for the publication for 2021 IECC I was told this month or next month it's going to be published their electronic version. The timeline to incorporate the 2021 IECC into COMcheck will be developed and finalized later by DOE.

[1:13:00]

The question is about this is performance-based compliance form how this form or Appendix G help to encourage the deep ____ and innovation in buildings. And if here will be a way to post process and incorporate the special ____ condition. Mike Rosenberg, I know you have briefly addressed that question but I'd like to give the floor to you to share your thoughts not that one.

Mike Rosenberg:

Yeah, so I guess two things. First of all, a jurisdiction or rating authority could do whatever they want with the data and implement their own requirements or calculations. But we're also planning to customize the tool to support jurisdiction and rating authority specific needs. For example, the state of Washington is basing their performance calculations on carbon emissions.

[1:14:00]

So we'll be customizing the tool to create targets based on end results based on carbon emissions. It can also be done for source energy. Targets can be made more stringent if that's the desire of

the rating authority or the jurisdiction. So the options are there to customize it and make it support high efficiency building goals or any other policy goals that states or jurisdictions have.

And I guess the last thing to mention is if you are a state or jurisdiction or a rating authority and you're interested in having that customization down reach out to me or Maria and we'll discuss that and try to get the ball rolling on that.

Bing Liu: Thank you Mike. There's a question about a compliance tool itself from Mark Franco. Does this tool rely on the user to developed schedules and the process loads?

[1:15:00]

Or the schedule and the process load has been standardized? Maria, do you want to address that question?

Maria Karpman: Sure. So the tool follows ___ 90.1 Section 11 Appendix G and requirements of this section allows modeler to capture schedules, ____, and process loads that best represent the building they're modeling. So with ___ the flexibility we're also including in the compliance form the default values. So for example, schedules and some process loads are populated. In the accepted defaults for schedules, for example, we use schedules from 90.1 user manuals so those defaults are there for the modeler to use and then calculate in their model.

[1:16:00]

But modeler can also modify these defaults to match, to reflect the building that they're modeling.

Bing Liu: Thank you, Maria. There's one more question here, panelists, feel free to weigh in but I might just call out Mike Rosenberg because I think this is original intent of this project. The question is the time and the resources of the local building department are already limited. Totally agree. And what impact do you think will the performance compliance have on this building department. Their staff has limited resources and a lot of times limited experts because you cannot expect everyone to be modelers.

Mike, do you want to share your thoughts and other panelists, feel free to weigh in as well.

[1:17:00]

Mike Rosenberg: Yeah. So I think it's important to understand that the impetus for this form in the first place came about because a lot of jurisdiction, building officials were getting more performance-based compliance project submitted and they really didn't know what to do with them. So that was one of the main reasons why we took this task on in the first place.

So what we're attempting to do is these forms are attempting to bridge the modeling process to the building officials. So it puts things in a format that gives them something to look at that they can understand. So for example, it translates the modeling inputs into design specifications so that they have something to inspect in design documents and inspection.

It clarifies reports, modeling output reports that a building official, we can't expect a building official to be a modeling expert on one tool alone never mind the six or seven that they probably get submittals in. So as Maria pointed out, the output reports in the simulation tools capture the pertinent information right into the form so the building official can see that the calculations are done correctly.

[1:18:00]

So the idea is that it's meant to provide a lot of aid to the building official to make their job easier. They can use it to the extent that they want. They can go through it and check it in detail or they could not check it in detail and just require it as a submittal. It's really up to them and how much time and resources they have to spend on it.

And I think Maria also mentioned about quality assurance checks being built into the tool in the future and I think that will be a big help as well. So it will automate that process instead of having the building official have to do some of those checks themselves they'll be done automatically. So I think in general it's meant to take some of the burden off of the building official.

Bing Liu: Yeah. And I want to add to that, if I may, so a lot of jurisdictions already adopted allowable performance-based compliance.

[1:19:00]

And currently, there is no standard reporting format that they can prescribe to _____. So what happens is either each project kind of invents the format that they would use to submit the documents and jurisdiction already have a very tight budget have to figure out the way through different formats. Or another ___ is that jurisdiction have to develop compliance forms inhouse. For example, New York City developed their own compliance form so this compliance form really means to alleviate the burden on jurisdiction with ensuring compliance by giving them this tool that they can use in their programs.

So again, I think it will help significantly jurisdictions to achieve meaningful enforcement of performance-based compliance.

[1:20:00]

Okay, I think we covered most of the commonly asked questions. Let's take one more in terms of the data exchange some ideas to consider. This question is are there any plans to link the outputs as a score, you know, simulation software to simply find that they're already in process in 10 years such as New York City any one requirement? Maria, I think you're more familiar on New York City requirement can you share your thought on this one?

Maria Karpman:

Yeah, sure. We're at early stages at figuring out what kind of data exchange would be helpful and this is a great idea to consider exit score.

[1:21:00]

And I mentioned that in my slides that we are looking in developing data exchanges were ___ was certified to ____ so exit score would be one of the certified _____ who would take advantage of this functionality. We're really looking forward to hearing your ideas, what tools you think could benefit from inputting information from the compliance form because we certainly want to make sure that we're facilitating _____ process with code and with other programs by using data exchange between the two to avoid having the user enter the same information multiple times.

[1:22:00]

Bing Liu:

I want to tag along with that thought because we're going to be facing the same challenges and opportunities. You know Washington State passed the last year passed a law requiring

existing buildings with over 50,00 square foot to meet energy performance target starting from next year, 2021 as a voluntary process and from year 2026 will be mandatory requirement with enforcement power of fine if your building not meeting the energy performance target. So if you design the building today to meet the codes requirement but in five years your building going to be outdated to the existing building performance standards how to maintain a set of the ____ and capture the building characteristic and all the modeler requirement and have that data exchange among the tools.

[1:23:00]

Particularly for Washington they already identified as a score ____ outdated for existing building performance standards. How to have a data exchange from today's code compliance using ____ paths to tomorrows audit requirement. It is real and it's in the horizon coming up. I would like to encourage DOE and other bright brains to pull this research into the agenda and ____ it out at the market we really need it is true.

At that I think we're at the perfect timing for today's session. And I want to clock in for the future series of the sessions. Again, thank you everyone for turning in for the DOE's National Energy Codes Seminar Series. Just as a reminder and a showing here on my screen energy codes program has a great lineup of topics to cover during future seminars.

[1:24:00]

We hope you will join again next Thursday and in the following Thursday all the way before Christmas and keep our conversation going. Thank you everyone, appreciate it.

[End of Audio]