Rosemary Bartlett: Welcome, everyone. I'm Rosemary Bartlett with the Pacific Northwest National Laboratory, and I'd like to welcome you to today's event, Performance-based Compliance for Submittal Reviewers. Okay, let's start with finding out a little more about all of you through a couple of polling questions. So, let's start by finding out where you all are located. So, the poll will hopefully pop up here. I'll give you a couple seconds here to answer. Okay, I'm going to close the poll, and I'll share the results. Well, fairly decently spread out, I would say. So, thank you very much for that. Let's move to the next polling question, which is asking which of these most closely aligns with your profession. All right, I'm going to close the poll and share the results. Great, it looks like we have a lot of architects and engineers and code officials as well, so that's great. Again, thanks, everybody, for joining. I'm going to close that poll. Our speaker today is Christina LaPerle from Karpman Consulting, and Christina has actually pre-recorded the presentation today. So, I'm going to start the playback of that. And here we go.

Christina LaPerle: Thank you, Rose. Hello, and welcome to Performance-based Compliance for Submittal Reviewers. This training is targeted for submittal reviewers. However, I just want to point out that we do have a training available that's targeted to modelers, energy modelers and design teams, and that is posted on the DOE website, and it's called Performance-based Compliance Documentation for ASHRAE 90.1, Section 11, and Appendix G. And that is also a two-hour training. So, we recommend that you check that out if you're interested in learning more about the actual compliance documentation itself.

This slide shows the learning objectives for today's training. Generally speaking, the goal of the training is for attendees to have a general understanding of the review process for performance-based compliance, and to understand the documentation that will be provided for performance-based submittals, how to review that documentation, and prioritize review checks in order to perform efficient quality reviews. The training touches on the submittal requirements of 90.1, but, in general, it's assumed that attendees have a general understanding of these requirements. And our target audience today is submittal reviewers. However, this training could benefit modelers and design teams, as it will provide an understanding of how reviews are conducted, and so will help with the QC process when reviewing your own submissions. The focus today is on Appendix G. However, similar principles apply to Section 11.

This is the agenda for today's training, so we'll start with an introduction to performance-based compliance. Then we'll go over some general submittal review concepts. Then we'll move into a demonstration of the review process and go over some actual review checks with a case study. And then we'll have a question and answer session at the end for about 20 minutes. The training format is such that there are Power Point segments, and then also a segment where we dive into the actual compliance form. The Power Point presentation will cover the introduction, the general submittal review concepts, and the review check demonstrations. When we go over the – when we demonstrate the review process through the case study and the various steps, we'll do that within the compliance form itself.

When conducting a review, you first have to understand what type of information to expect, and what is required for a given submittal. Documentation requirements for the prescriptive path are covered in COMcheck, and many of you are probably already familiar with this type of documentation. However, for the performance-based paths in 90.1, which are Section 11 and Appendix G, previously there was no equivalent to COMcheck. However, now with funding from the DOE, a compliance form was developed in order to document performance-based compliance, per the requirements of 90.1. Similar to COMcheck, in addition to supporting the reporting requirements of 90.1, the compliance form also includes functionality to assist reviewers in verifying that the project is in compliance. For example, and you'll see this today, there is a quality control check tab in the compliance form that automatically flags inconsistencies and potential areas of non-compliance in the compliance form.

I just want to provide a high-level overview of the compliance form. It supports ASRAE 90.1, 2016 and 2019, for Section 11 and Appendix G. It's posted at the DOE Building Energy Codes Program website. And just a brief summary of features, it's in the Microsoft Excel format, and, like I said before, it provides a format for submitters to meet the reporting requirements of 90.1. It has built-in calculators and code look-ups to help modelers establish modeling inputs. And it allows importing simulation results from the popular building energy modeling tools, directly into the compliance form. It also automates the compliance calculations, which for Appendix G can be quite complex. It also includes a quality control checks tab, which is designed to help facilitate the submittal review process, and is a companion to the review manual, which I will talk about now. But today's training is focused on this quality control checks tab.

All right, so this is just a high-level overview of the companion document to the compliance form, which is called a Submittal Review Manual. The Submittal Review Manual supports ASRAE 90.1, 2016 and 2019, for Section 11 and Appendix G. It is a PDF document, and will be posted at DOE Building Energy Codes Program website, and it includes strategies for prioritizing the submittal review. So, essentially, strategies for deciding which review checks to conduct. It includes a list of review checks, which are implemented in the compliance form on the quality control checks tab. So, the quality control checks tab includes all of the review checks in the review manual.

For each check in the review manual, the relevant sections of 90.1 and their requirements are described. There are review tips, including the specific steps for actually conducting the review and where to find the information in the compliance form to verify compliance with the review check, and then a discussion of common mistakes. It also includes simulation reports that are annotated for the common building energy modeling tools, and on these reports are tips for conducting the actual review checks. The focus of today's training will be on these high-level concepts associated with the review manual.

There are different user groups that the review manual is intended for. Authorities having jurisdiction and rating authorities, the review manual helps them to establish the framework for the submittal review process, and helps them publish policies for conducting reviews. Of course, the Submittal Review Manual is intended for submittal reviewers, and it essentially provides instructions for performing reviews. And for energy modelers, the review manual can help facilitate an internal quality control process, and this will help minimize review iterations, and just create a more efficient performance-based submittal process.

So, now we're going to go into some general submittal review concepts. So, let's start with the general concept of performance-based compliance. In performance-based compliance projects, there are two models. We have our proposed design model and our baseline – or in the case of Section 11, our budget design model. The baseline or budget design model, the modeling inputs are based on the requirements of 90.1. So, for an example, for Section 11 projects, the baseline model, the inputs for efficiencies and other building components are set at the prescriptive and mandatory requirements in sections five through 10. The proposed design model is basically the building as designed, and to

determine compliance, the energy cost associated with the proposed and baseline models is compared. There are some things that are consistent across the two models, so it's required to use the same simulation tool, weather file, and it's required that the utility rates be consistent across the two models.

Okay, now we're going to go into the review process. Step one of the review process is to check the submittal for completeness. And what you can see here in blue are the relevant compliance form tabs, and in green, shown below each step, are the relevant sections of the review manual. I'm not going to dive too deep into these different aspects because we're going to go into them deeper on future slides. So, as I said, step one, you check the submittal for completeness. Step two, you need to develop a general understanding of the project in terms of number of floors, square footage, the different building areas, whether there are any yet-to-be-designed systems. Step three, establish the review scope, so which checks should be included in the review, and what are the impactful systems and components. This is actually automated in the compliance form, and a preliminary recommended set of checks is provided for the reviewer.

Step four is where you actually perform the review, and this will be performed using the quality control checks tab in the compliance form. While you have open the actual review manual so you can consult it for details regarding each check, and so you can look at the annotated simulation reports in the review manual. Step five is to communicate the review outcome, and this is done on the quality control checks tab. There are fields for proving both submitter and reviewer comments. So, the reviewer provides a comment, and then the submitter has a chance to provide a response. And this is both done on the quality control checks tab.

Okay, now we're going to go through the steps of the review process in more detail. The first step is to check the submittal for completeness, and this would be done by looking at the dashboard tab where the modeler and design team signs off on the individual tabs in the compliance form. We'll get into more detail regarding this tab later. The next would be to look at the submittal checklist, which is a tab in the compliance form that includes all of the documentation requirements of 90.1, and the modeler and design team need to select that yes or no that the items were submitted, and then they would provide the location of those items. So, you check both of those tabs to make sure that all of the documentation has been marked as being submitted.

Another thing that we just want to point out is that per section 4.2.2.2 in 90.1, you're not limited to the requirements of 90.1 in terms of information that you're able to request. As a reviewer, you can request any back-up calculations, worksheets, vendor literature necessary to feel confident that the project is in compliance. And, lastly, I just want to point out that there is an item number 10 boxed in red on the submittal checklist below, and this is where the design team or modeler marked not available for the NFRC certifications or labels for fenestration. This is a very common issue. So, we suggest that you consult the review manual. It has a list of appropriate documentation for this particular items, and as a way to know exactly what to look for when you're reviewing the documentation submitted for a particular submittal.

Okay, step two is to develop a general understanding of the project. So, this is primarily done on the compliance form on the general information tab. This is where you can see the square footages of the building, the different building area types, the number of floors, the number of floors associated with each building area type, and it's where you can see if there are any yet-to-be-designed components or systems in the project, because these have special rules, so you'll need to know about them when conducting your review.

Step three, establish review scope. So, the first action for step three is to determine the impactful end uses in the project. So, first, you need to think about the metrics used to determine compliance for your project. In 90.1, its cost; some jurisdictions use other metrics. In our example here, we're using energy cost. So, this methodology is described in the review manual, but it involves three things. So, you need to figure out which end uses are the – contribute the most towards the difference in energy cost between the baseline and budget and proposed models. So, the top three in that category would be considered impactful. Then, look at the top three end uses that contribute towards the total energy cost in the proposed design. And then you would do the same thing for the baseline budget design. Tables two through four on the energy performance summary tab in the compliance form do this for you.

So, as you can see here, energy cost is boxed in red, and it shows the top five end uses for each of the categories I described: savings, contribution to the proposed, and contribution to the baseline budget. End uses that should not be considered impactful are those where trade-offs are not allowed. For an example, for Section 11, trade-offs are not allowed for exterior lighting. So, even if exterior lighting contributed significantly to the budget

design, if it was one of the top three, it would not be considered impactful because it's not eligible for a trade-off.

Step three continued. Once the impactful systems or the impactful end uses are identified, then it needs to be determined which performance characteristics and operating conditions associated with those end uses drive energy consumption in the project. So, for an example, if lighting is an impactful end use, we would look at Table one, actually in the review manual, which provides this information for us, and see that the wattage of the fixtures and the quantity drive energy consumption.

In terms of operating conditions, the lighting run time hours drive energy consumption. And, actually, the compliance form will select checks as yes or no based upon the automatically determined impactful end uses. So, the compliance form will preset review checks using the methodology in the review manual that I'm describing here based on the identified impactful performance characteristics and operating conditions. And these will be the preliminary recommended review checks.

Okay, so step four is to actually perform the review. So, first I want to start with the review check nomenclature that is both in the compliance form and in the review manual. The review checks are organized into the categories shown on the slide by building system, and each category has an abbreviation associated with it. And then the review checks are in the format where it goes the abbreviation associated with the category and then a number, and then dash either B or P, depending on whether the check is associated with the proposed design or the baseline budget. So, as an example, check BE08-P is check number eight related to the building envelope for the proposed design.

Step four continued will go over the types of checks. There are seven types of checks in the review manual, and they either apply to the proposed design, baseline design, or both, and they're either always performed, always performed based on sampling, or only for impactful systems and based on sampling. So, you can observe that in the two columns on the right as I go through the different types of checks. The first type is to check that the project is meeting the general requirements of 90.1. So, an example would be checking that unmet load hours do not exceed allowed limits. The second is checking that specified systems reported in the compliance form reflect actual design documents. So, do the lighting counts and fixture wattages input in the compliance form match the design documents?

The third type is that specified systems meet mandatory requirements in 90.1. So, an example of this is do the lighting controls specified in the proposed design meet the mandatory requirements of section nine? The fourth type is that the budget and baseline systems reported in the compliance form meet the requirements of 901. And these, a lot of these inputs are determined automatically in the compliance form. So, for the majority of the time, this will be checking if any overrides were made, and these will be flagged automatically on the QC tab. Check number five is whether simulation inputs reflect systems and components reported in the compliance form. So, an example of this would be checking whether modeled lighting power densities match the lighting power densities in the compliance form.

Check type number six, are inputs consistent with systems and components reported in the compliance form? So, an example of this type of check would be if the baseline systems, if there are no electric heating baseline systems, HVAC systems, you would check to make sure that there's no electric space heating modeled in the bassline. And the last is whether the modeled end uses are consistent with benchmarks, and we'll go into these benchmarks in more detail when we do the compliance form demo.

The next aspect of conducting the review checks that I want to talk about are coming up with the sampling strategies. So, this is included in the review manual, and there are recommendations for how to determine your sample. And the compliance form has helper tables on the quality control checks tab to help with this process. So, just as an example, for checks that verify specified fixture wattages, so, for when you want to verify that the wattages reported in the compliance form are consistent with design documents, you want to focus on the fixtures that contribute the most to the wattage in the project. If there's a fixture that, you know, is 10 watts and there's only one of them in a project with hundreds of fixtures, it's not an efficient use of time to check that fixture.

So, these helper tables rank – they provide rankings of wattages based on fixtures, thermal blocks and space types. So, with our fixture example, in the last column of this screen shot of the table from the compliance form, we can see that fixture E amounts for a very large proportion of the wattage, the lighting wattage in the project. So, as a reviewer, you can use these tables in the compliance form to come up with your sample and choose the

impactful space types to spot check, the impactful thermal blocks, and fixture types to compare with design documents.

Step four continued. Okay, so we just want to point out that within the compliance form, on the quality control checks tab, certain checks are set to yes by default based on the prioritization logic that's described in the review manual. So, essentially, the compliance form determines the impactful end uses, and then the review checks that deal with the components and operating characteristics associated with those end uses and sets include to review, which you can see here in this column to yet. Then, for certain checks, the pass/fail review outcome is automatically set to pass or fail based on the information available in the compliance form, so it can perform calculations automatically to determine the outcome.

For checks that are automatically determined as fail, there is a default review comment that populates automatically for that particular check. And, actually, the rev zero iteration of the review is simply between the design team and modeler and the compliance form and these automated checks. So, they will need to address the checks or provide a response in rev zero.

So, the review check organization in the review manual is such that there is a check ID and title. Then, as I said previously, there is a description of the relevant sections of 90.1 for 2016, 2019, and for both Section 11 and Appendix G. Then there are review tips for each review check, which point to the relevant information in the compliance form or design documents where you find the information to conduct your check. There are recommendations to reviewers for cases where reviewers and rating authorities and authorities having jurisdictions where it might be okay for projects to deviate from general rules. There are discussions of common mistakes, and then there are lists of applicable simulation reports for common simulation tools.

And then there's a simulation report section of the review manual that consists of annotated simulation reports for the tools listed on this tab, and helpful tips with how to review these simulation reports to conduct the review checks. Lastly, we just want to touch on step five, which is the communication of the review outcome to the submitted. So, on the quality control checks tab, for each check, there are fields for providing comments to the submitter, and then for the submitter to provide responses. So, the response may be the check – the issue was corrected, or there might be a

justification for the issue provided. And this goes back and forth across iterations.

Okay, now we are going to dive into the actual compliance form, and we're going to touch or go over the tabs that we've been discussing so far throughout the Power Point presentation. On this slide, each of these rectangles are tabs in the compliance form. So, the ones boxed in red are the tabs that we're going to focus on mostly when we dive into the compliance form. We might touch on others, but the main focus will be the tabs boxed in red. During the compliance form demo, we're going to go over steps one through three of conducting the review in detail, and then we're going to touch on steps four and five.

This is the compliance form, and this is the first tab that you will see when you open the compliance form. It's the instructions tab. We're going to focus on the tabs that are relevant to the review steps. Starting with step one, which is to check the submittal for completeness. So, we begin that check by taking a look at the dashboard tab, and the dashboard tab has a number of features. One is that it allows easy navigation of the compliance form. So, on the left here, you can see all the tabs in the compliance form. And they're hyperlinks, so you can click on them and go straight to those tabs. Once you're there, you can click return to dashboard and come back.

As you can see, each tab has a complete and a name and a date for the design professional and modeler associated with it, and essentially, the submission – for the submission, the design professional signs off on each tab that's relevant, verifying that the inputs on the tab align with design documents. Modeler signs off on each tab to verify that the modeling inputs shown on each relevant tab align with what's actually modeled. So, at a glance, at the top here, you can see the compliance path associated with the project. So, our case study here, since we're in step one, which is to verify the completeness, we're looking at the dashboard tab. But, this is also gives us some basic information, which is the fact that it's an above code submittal and it's for Appendix G, 2016.

Under this, we can see whether or not the design professional and modeler has signed off on each of the relevant tabs. This will show green and say yes if that is the case. So, it's up to the rating authority or authority having jurisdiction whether or not the policy is to send back submittals for correction is they come in and not all of the tabs have been marked as complete. For an example, if a tab is in progress, it'll show no here, the design professional sign-off,

and it could facilitate a more efficient review process to send it back and have them ensure that everything is complete prior to diving into the detailed review. Another aspect of checking for submittal completeness is to review the submittal checklist tab. This is the submittal checklist tab, and we actually discussed this already in the Power Point. But, this is a checklist to ensure that the submittal meets the requirements of – the documentation requirements of 90.1.

So, as the design team and modeler verify that the package includes each of these items, which align with requirements of 90.1, they would mark it as yes, submitted, and then they would provide here in this column location of the particular item in submittal package. There is space across review iterations for the review and for the design team and modeler to respond to provide comments. So, if something is missing or inadequate, the reviewer can provide comments, and the design team can address the comments and respond. So, as we discussed previously, in our submittal, they did not provide an FRC certification or labels for fenestration. So, it may be the policy to send the submittal back so they provide it, but it's up to the particular jurisdiction or rating authority.

So, the next step in our review process for our case study is to develop an understanding of the project. So, to do that, we're going to go the general information tab and we're going to look at the basic project information. So, in this case – and we already saw on the dashboard tab, this is an Appendix G, 2016 submittal, and it's an above code program submittal with 100 percent construction staged, and then there's some other general information in this section. On this tab, it shows us the building areas associated with the submittal. So, we can see that there are multi-family and retail building areas, and we can see the associated square footage and number of floors. Because there's multi-family, we can also see the number of dwelling units and the square footage associated with them, and the number of bedrooms.

And then, down in this section, we can see whether or not there are yet-to-be-designed system and components in the submittal. This is important because there are special rules in 90.1 for yet-to-be-designed building systems and components, so we need to know this going into the review. In this case, there are none. So, we have a multi-family building that is 14 stories above-grade with the floors one through three consisting of retail that are all fully designed. So, our next step in our review process is to establish the review scope. So, to do that, we're going to head to the energy

performance summary tab first. And this tab compares the energy performance of the proposed design to the baseline, and then also to various benchmarks. That's the main – those are the main items on this tab.

So, in the first table, we have a table that compares the baseline and proposed consumption across different metrics, between the baseline and proposed for different end uses; and these are on a per square foot basis. Then, and you've seen these in the Power Point, tables two through four rank the various end uses by their contribution towards either the proposed design, the baseline or budget design, and the savings across the proposed end baseline design. So, in our case study, if we want to figure out what are our impactful end uses, we would look at these tables.

The metric for our case study to determine compliance is energy cost, so we're going to focus on the energy cost columns here. And we can see that in terms of the proposed design, miscellaneous equipment, space heating, and space cooling contribution the most in terms of energy cost to the proposed design. In terms of the baseline, it's interior lighting, miscellaneous equipment, and space cooling. And then in terms of savings, the most savings are derived from interior lighting, space cooling, and fans. So, from this, we can see that our impactful end uses are miscellaneous equipment, space heating and cooling, fans, and interior lighting.

Okay. So, the next table five is where the user sets the benchmarks. So, what are we going to compare the baseline of proposed models to? There are defaults, which are set at – for the proposed design, they're set at the next addition of 90.1 for above code submittals. So, in this example, it's a 2016 baseline, so the proposed benchmark is the PNNL models associated with 90.1 2019. Okay, and then the baseline, because our baseline for an Appendix G model is approximately 90.1 2004, it automatically sets our benchmark as the PNNL prototype models for 2004 for the associated building types. And these can be overridden if the user would like, but these are the defaults.

So then, our tables six and seven below basically compare our actual results for the proposed and baseline to the benchmarks. So, we're looking at Table six now, and we can see in terms of site energy, this column shows the proposed EUIs, and then this column shows our benchmark EUIs. And then we can see the percent difference. And this is a great way for modelers to QC their models to see how far the model deviates from the benchmark. Over here on the right are the acceptable differences

before there's a QC flag, and there will be defaults here. But the reviewer is able to override these based on the policies of the authority having jurisdiction or the rating authority.

And these will flag on the QC tab if the percent difference for the various end uses exceeds the allowable limit. Okay, below this table there are charts, so these tables are in chart form. You can toggle between pie charts and bar charts just to look at the data in another format, if you prefer. Then below this, we also have Table seven, which is the same information but for the baseline versus benchmark data. And I just want to point out that this blue here indicates the impactful end uses. So, as we said for cost, interior lighting, space heating, space cooling, fans, and miscellaneous equipment. So, it calls it out right here for us, directly in the table.

So, once we've identified our impactful end uses, we move on to the quality control checks tab. Now, as you can see, the compliance form automatically identifies the impactful end uses. Okay, so on the quality control checks tab, before diving into the actual review checks, just want to give you a brief overview of the different features on this tab. So, at the top here, we have the submittal review dashboard, then we have some instructions for submittal reviewers and modelers. And then we have some instructions for generating a Word document report. Then we have a legend section to provide the meanings of the various headings. Then we have the individual review checks. So, I just wanted to give you a high-level overview of what's on this tab before diving into the details.

So, let's go back to the tab, and actually dive into some of what these things are. Okay, so this first table here is where the modeler or design team and reviewer enter the dates at which they are either returning the compliance form or submitting the compliance form and submittal package. So, this particular compliance form is at the stage where the modeler is starting to review the quality control check flags. And then, once they've addressed them or provided comments, they'll submit this to the reviewer. And at that point, they're going to enter the date. So, you can see here, it's at rev zero. And rev zero is between the compliance form and the submitter, okay? So, we can see which revision we're at by looking here.

And when the modeler enters the date at which they're submitting the compliance form, it automatically changes to the next revision. And this is the case as you go down and add dates. The submitter and the reviewer will also provide their name, just so we have a

history of who conducted the reviews and submitted the documentation. Okay, then we have our navigation table. So, these are all of the different sections on the tab, the different categories with the review checks. These correspond to the categories in the review manual. So, in this column, we have the total number of checks, which is basically the total number of checks in the review manual and on this tab for the particular category. Then the quantity of those checks actually included in the review. And because the compliance form automatically determines the impactful end uses and the components and operating parameters associated with those end uses and then the associated checks, it automatically sets checks to yes.

And so, you can see here that the quantity of checks included is automatically less than the number of total checks. And this is a starting point for the reviewer. These are the recommended checks. Now, the reviewer should still read through and be aware of all the checks as you go down the list, just because these checks are based on the assumption that the design team and modeler entered all of the relevant information in the compliance form. So, for an example, if there are no chillers entered in the compliance form, all of the checks related to chillers might be marked as N/A, when in fact, perhaps, there are chillers in the design documents that just were not entered. So, it's important to be aware of that as the reviewer as you're going through the checks.

Okay, so then in this column, it shows the checks with outstanding comments. So, these are checks basically that are marked as failed. Then, in this column here, we have the number of checks where the submitter actually provided a response. So, if this is zero, that means that there was a fail, and no response was provided. And, again, it could be the policy of the rating authority to just send it back if the checks aren't addressed. The color coding here is it's red if the submitter has not responded to all of the outstanding checks in that category. If they have, then it will turn yellow. Green means there are no checks in that category. Then down here, we have the review outcome, which _____ respond to comments, which will be yellow. And then once it's approved, it'll turn green, and it will say approved.

Okay, so the next row here are the general notes, and I just want to show you a feature of the compliance form. So, this is for any general notes that the modeler/design team or reviewer want to provide to each other. Sometimes it can be difficult in Excel to provide communication in these free-form cells, so there's a feature where, if you double click on any free-form cell, a dialogue

box will pop up where you can type whatever you want. It will populate that cell with that information. And then when you click on the cell again, the dialog box will pop up with that information, and you can just add to it, and on and on, and it will retain what's been type.

Per the instructions, and I'll get into more detail with regard to the instructions as we are in the actual review check section, so I won't go into that here. But I do want to show you that there is a button for generating a Word document summary report, and I would like to show you an example of that particular report. And the function of that report is to provide another form to look at the comments and responses. So, here's an example. When you press that button, it'll generate a report with all of the review checks in the project, and it will show the comments and then responses.

So, we're at rev zero, so this report – and no one's entered any comments or responses. So, these are blank. If comments and responses were entered, you would see text here. Like, for an example, we have an auto-generated comment down here at SG07, so it populates there. But if you were at, like, let's say rev four, you would see the complete history from rev zero to rev four of the comments and responses. And even over here on the left, because these are stylized headings, you can use the navigation pane to easily jump to different checks. So, it's just another way of reading through the history of the comment and responses for the different checks.

Okay. So now, let's jump down to the actual checks. Oh, one more thing before we get there. There is an option to filter the check. So, as you know from the Power Point, we have baseline budget checks and proposed checks. So, you have the option of looking at all checks, only baseline checks, or only proposed checks. Some reviewers like to do all of the proposed design checks and then do all of the baseline design checks. It depends on personal preference. So, this will filter the checks so that can more easy accomplished.

All right, so now let's look at the actual check sections. So, like I said, the checks are organized by category, so we're in the simulation general category right now. Each category has a table that looks just like this, and then there are summary tables above the actual review checks that just provide some useful information for actually conducting the checks. Also above the tables are hyperlinks to relevant tabs so you can easily navigate to the locations in the compliance form to verify the review checks.

Okay, so, as you move to different iterations, so, as I said, the first iteration is between the compliance form and the submitter. So, as we can see here, as an example, SG07 is an automatic check, and we will actually go over this check shortly, but it's an automatic check, and it flagged as fail. And then an automatic default on it populated. So, it's up to the modeler now to address this comment and provide a response. So, that response might be addressed, or, actually, if it is addressed, then this check will turn to pass, and they won't need to even provide a comment. But, let's say there's a reason for the unmet load hours that's justifiable. _____ provide a response in this box here, okay?

So then, when you move to the next review iteration, you need more fields for entering comments and responses. So, you just click this button here, and what it does is it unhides the next set of review comments and responses. And then, if you don't want to see them, so let's say you're at rev four and you don't want to see all the previous, you can just press the button and it will hide them. There's also a feature that allows you to freeze the pane, because as you can imagine, as you get out to rev four, rev three, you'll want to be able to see the check that they apply. So, you can just click on the freeze pane spot and scroll across. And then if you click it again, it'll unfreeze the panes.

Okay, so let's look at the actual review checks themselves. If a check is overridden, so right now these are all auto-populated, will show in bold or just brown color. So, let's say the modeler or the reviewer said I want to change this to pass. Well, it turns to orange, so that's just a way of easily seeing what has been overridden. Let's say you override something and you're like, oh no, I didn't mean to. All you have to do is copy and paste the row below – you have to copy the row below and then paste it in the cell that you overrode, and it will reinstate the information for you.

Another feature that I'd like to show are the reference information provided for each check. If you click on this, a box will pop up and give you some relevant information about that check. So, in this case, it tells us the 90.1 references associated with unmet load hours check. Now, software reports for this check are N/A, so it says N/A, but let me click on a check where they are relevant. The one below is checking on that load hours in the compliance form, this actual simulation output reports. So, now we see that it's showing us the relevant output simulation output reports. So, it's just an easy way to access that information as you're going through the review checks.

However, you will want to have review manual open while you're going through the checks so that you can access all of the details associated with conducting the check. So, I have the review manual open here, and I just want to show you this process, okay? So, if I'm interested in finding out more information about conducting check SG07, I would have my review manual open, and I would just do a Ctrl+F, and I would type in SG07, and then I would navigate to the check. And so, once I'm at the check, I can see all the relevant sections of 90.1, and a description of those sections, and then I can see the review tips with enforcement recommendations, like when it would be acceptable to approve this unmet load hours check when the unmet load hours exceed acceptable limits. I'd be able to see common mistakes.

And then, I would also be able to see, for checks that apply to simulation reports, I'd be able to see the simulation reports associated with common simulation tools. So, once I see my reports, I can also navigate to the annotated reports section in the review manual. So, I would go to eQUEST in this case, and I've been looking at check SG08; that's the one we were on. It has to do with verifying that unmet load hours in the compliance form are consistent with the actual simulation output. So, I can see SG07 here – SG08 here, and it gives me some tips, how to conduct the check. So, this is an example of those annotated output reports.

Okay, so that concludes our demonstration of the actual compliance form. And, as you can see, there are automatic checks selected as being included in the review. I just want to summarize that these are based on the compliance form automatically determining the impactful end uses, and identifying a preliminary recommended list of checks to conduct. So, you would go through each category as the reviewer and conduct the checks. Some are automated, like the two you see here; some are not, of course. Checks like comparing design documents and the compliance form cannot be automated. But, yes, that is the compliance form. So, we're going to go back to the Power Point now and do some actual example review checks for our case study.

Now that you've had a taste of the compliance form, we're going to do some actual review check demonstrations. Okay, this is just going to be an overview of the case study. We already touched on some of these details when we were in the compliance form, but to set the stage for the sample review checks, I just want to provide a reminder that the building is mixed use, multi-family with retail, fully designed, climate zone 4A. And, just to let you know that the

dwelling units have four pipe fan coil units. The corridors and retail areas are served by constant volume gas fired with DX cooling package units, and lighting is LED. Just some high-level details to provide a context for the review check demonstrations we're about to do.

Okay, we are going to start with the simulation general category. We are not going to be able to touch on every category today, but we will do a handful of the major categories. We are going to look at two types of checks in this category. They are – one is checking that the number of unmet load hours is compliant with the rules of 90.1 in terms of the allowed limits. So, that's one of the general type checks that we talked about previously. So, that's of type number one. Then we're going to check whether the lighting site EUI in the proposed design is consistent with the benchmark. So, that is of type check number seven, checking against benchmarks.

Okay, let's get into the details of check SG07. As I said, it's a check that the number of unmet load hours reported in the compliance form, that they do not exceed the prescribed limits in 90.1. And, again, this is one of those general type checks. So, as we go through the review checks, just note that anything that refers to the review manual will be shown in green, and anything that refers to the compliance form will be shown in this blue color. The review check demonstration will take the form of us first discussing the review tips section from the review manual, and then diving into the actual details of conducting the check for our case study.

So, in this example, we have our review tips from the review manual, and number one tells us where to look in the compliance form to verify whether or not the project passes this check. So, Table one on the compliance calculations tab, which is shown here. Then, there's a little bit of background provided as to the rationale for conducting this check. If thermostat set points are the same in the baseline and proposed models, but there are higher unmet load hours in the proposed, well, that result, actually, in less energy consumption. So, basically the project will be getting credit for under-heating or cooling spaces in the proposed design, which is not an allowed trade-off.

So then, in the compliance form, on the quality control checks tab, this check is actually automated. So, you're seeing a screenshot of it here, and it automated to fail based on Table 1 on the compliance calculations tab. And you also see that here, and you see that in the proposed design. There were 642 unmet load hours, which exceeds

the 300 allowed limit. And a default comment has auto-populated, so as a reviewer, we don't have to write a comment; it's there. And when you do craft a comment, if there isn't a default, you want to make sure that there's a call to action. You don't want to just state an issue without providing what the submitter needs to do to correct the issue.

So, in this case, we asked them to correct the fact that the unmet load hours exceed allowed limits. You can also say please correct or provide an explanation, because often there are explanations for issues that we encounter in reviews, so you want to give the submitter the opportunity to explain. For an example, even in this scenario, and this is from the review manual, there may be circumstances that, as a reviewer or a rating authority, we consider accepting unmet load hours that exceed the allowed limit.

For an example, if it only exceeds the allowed limit by a small margin, let's say the unmet load hours are 315, in that case, we might consider accepting that. Another is if the floor area with unmet load hours is low. So, if the unmet load hours occur in a small 100 square foot storage room that's rarely occupied, we might be willing to accept that because it applies to such a small proportion of the building. And then another is how far below the indoor temperature drops, or how far above does it rise out of the acceptable range? So, if it's only a degree or two, we may want to consider accepting it because it's relatively low impact.

The next check we're going to go over is whether the modeled interior lighting energy use in the proposed design is consistent with the selected benchmark, and that the difference is less than the threshold. As you saw in the previous demonstration, the thresholds can be overridden by the reviewer. So, the rating authority or reviewer can set these thresholds. So, these are the instructions from the review manual, which instruct us to look at those tables on the energy performance tab to check that we are happy with those thresholds. And then we question the results, if the difference between the modeled interior lighting EUI and the benchmark is outside of the limits that were set.

So, some common mistakes when the proposed design is not consistent with the benchmark are that the lighting wattage is just being modeled as too high or too low. Maybe the fixture wattages were not entered correctly, or the lighting counts from the design documents were not correctly translated into the compliance form, or the lighting power densities were not applied correctly to the thermal blocks in the model. Lighting runtime – this is very

common – lighting runtime hours are too high or too low. Sometimes modelers will forget to adjust schedulers, or they won't realize when they make a mistake entering a schedule. And then just some errors with modeling occupancy sensors and making it such that adjustments that are made result in energy consumption that's too high or too low. And these common mistakes are included in the review manual.

So, this is another screenshot from the compliance form, and this is another automated check, like the previous one. And our acceptable difference in Table 6, was set at 50 percent, and this is comparing the proposed design interior lighting EUI to a benchmark, and, in this case, this is an above code program case study, and so our benchmark is the next version of 90.1 from our baseline. So, our baseline in this case is ASHRAE 90.1 2016, so our benchmark for the proposed design is ASHRAE 2019. And we are 54.1 percent less than the benchmark, and this isn't – this does not mean that the submittal is incorrect. But what it does do is it tell us as reviewers that we really need to make sure that the design documents align with what's been entered in the compliance form, and that the modeled LPDs align with the compliance form.

Okay, moving on to the building envelope category. For building envelope, we're going to do a check where we compare the proposed design compliance form inputs to the actual design documents. Now, just to note that sometimes the outcome of one check can lead to another check becoming inapplicable. For example, if we find that proposed design inputs in the compliance form were established incorrectly, well, we wouldn't then check whether the modeled values are consistent with the compliance form because they're incorrect. We would do that check once revisions were made. So, the other type of check, which is check type number five we're going to do is check that the modeled U values and areas of the above-grade walls in the baseline design are as reported in the compliance form. So, checking model output reports with the compliance form.

And, lastly, I just want to point out that the compliance form automatically selected two checks shown here as N/A, and that's because the compliance form knows that there are no below-grade floors; so, it set the checks related to below-grade walls to N/A. Our first check is whether or not the thermal properties of the above-grade walls in the proposed design are established correctly. So, let's check out our review tips for this. We will locate the selected constructions for review based on the plans and specs in Table one on the proposed envelope assemblies tab. So, first we

need to find where constructions are described in the design documents. The focus of the review will be on the constructions with the highest wall area in the project, and there's a helper table in the building envelope section, and you'll see this in a second, of the quality control checks tab, to help identify the constructions that comprise the largest area.

So then, we're going to verify that the constructions in the design documents match the compliance form. We're going to verify that the modeled UCF factors are established correctly, and we also want to make sure that any uninsulated assemblies are captured correctly in the compliance form. Some common mistakes, and this is very, very common, the overall assembly for a particular construction, the U value is established without accounting for thermal bridging, which is required per Section 5.5.3. And the way to account for this is to use Appendix A. Or, that's the typical and probably the easiest way, using Appendix A of 90.1, which has lookup tables to determine the assembly U-factor accounting for thermal bridging.

So, here's our example. This is that table I just spoke about in the building envelope section of the compliance form. Now you can see here this column heading says proposed design, and there are surface types on the left. So, we only have one above-grade wall construction in our project, but if there were 10, let's say, this would rank them by the ones that have the largest total area. So you would see the top three here. So, if you were doing a project with multiple constructions, you would see the top three in terms of area, and then you could do your check on those, because they're the most impactful in the project, because they comprise the most area.

Okay, so there's our check screenshot from the actual compliance form. So, we're going to conduct our check. So, we see here that we see under the plans/specs column that we need to look at design drawing A-601, so we pull that drawing, which is shown in the bottom right corner. And then we also have a zoomed up section of that drawing that shows the exterior wall assembly that's been captured above in Table one on the proposed envelope assemblies tab in the compliance form. So, here are the key items that we're checking. Is the construction type captured correctly? Well, based on this screen shot, it's a six inch metal stud wall, 16 inches on center. So, steel frame, that's correct, 16 inches on center with six inch depth, that's correct.

Then we look at our cavity and continuous insulation, so I see that there's R 8.5 continuous insulation, the two inch mineral fiber board. And then I can see that there is also R 19 insulation. So, if you look at six inch metal stud with six inch fiberglass bat insulation R 19. So, confirmed; so, they entered that correctly. Then when we look at the auto-populated value from Appendix A, so the information entered performs a lookup in the appropriate table in Appendix A to give us the assembly U value, accounting for thermal bridging. And so, we get U 0.057.

However, in column – the column highlighted that's circled in red, or, sorry, boxed in read, it says 0.036. Well, this is far less than the assembly U value calculated or determined from Appendix A. So, it appears they have not accounted for thermal bridging in their modeled U value. Okay, so that's an issue, and we would make a comment asking them to correct this issue and account for thermal bridging when determining what U value to model. And so, since this, we found that this is incorrect, we would not then do the later check for the proposed design to see if the modeled value matches the value here, because this value is incorrect.

Okay, our next check is BE06-B, and this involves checking whether modeled U-factors in areas of the above-grade walls in the baseline design are as reported in the compliance form. So, as you can see, we have our review tips from the review manual, and it instructs us to compare the simulation reports from the building energy modeling tool to verify that the modeled U-factors and areas of the exterior walls reflect the values reported in Table one on the envelope areas tab. Now, these values are auto-populated, and so we can easily compare them to the model output reports. And we want to focus on the constructions that account for the largest above-grade wall area. We want to use sampling.

And so, we will refer to our table once again, our helper table in the building envelope section on the quality control checks tab to figure out which baseline constructions account for the largest above-grade wall area, and then we will check those. In our project, we have a limited number of constructions. So, we will be checking – I believe it's just one, but we'll see on the next slide. Then, number three, you can see the relevant building energy modeling tool output report for this check. In our example, it's eQUEST, so our relevant report is circled right here, the LVD report.

Okay, so this is our check of the modeled U-factors. This is Table one on the envelope areas tab. And these are our auto-populated –

nothing was overridden; you can't override these – baseline values for our above-grade walls. And here is the – down here is the simulation output report showing us a selection of walls that were modeled in the baseline. And as I showed you in the demonstration of the compliance form, the pop-up told us also which report to look at. So, when we compare the U-values in the output report to what is reported in the compliance form, we see conformity. They are approximately equal. So, we see values of 0.124, which is consistent with the non-residential baseline above-grade walls, and we see values of 0.063, which is consistent with the residential U-values in the compliance form.

Now, you'll notice there is a small deviation between the residential U-values, and that's okay. Small deviations up to three percent may be allowed for this because of differences in accounting for exterior air films. The values, the prescriptive U-factors in Section 5 are determined using fixed R values for the exterior air films. However, simulation tools may calculate these dynamically based on weather conditions leading to very slight differences in U-values. So, this one is all good.

All right, the other part of this check is to check areas. So, this is just a little snippet of this check. Same report, LVD, and we look at Table one again. And we look at the – what we're going to focus on here are the north, the areas of the north walls. So, we can check this with the LVD report by summing the total – summing to arrive at the total north wall area. And then we check our LVD report for the north wall, and we check the wall area, which matches what's in the compliance form. So, this check is all good, and the submitter passes.

Our next category is interior lighting. For interior lighting, we're going to do a check where we examine whether the proposed lighting power in the compliance form reflects design documents. So, a check of the compliance form versus the design. Then we're going to do one of the checks where we inspect the submittal to determine if mandatory requirements in 90.1 are met, which is a pre-requisite for compliance with the standard for Section 11 and Appendix G. So, we're going to check that for lighting controls. Then we're going to do one of the checks, check of type number six, where we look to see if the modeling output reflects the inputs in the compliance form. So, we're going to check to see if the interior lighting runtime hours at the baseline are realistic.

Okay, the first lighting check that we're going to go over is the LI02-P, and it's looking whether the proposed lighting power

reported in the compliance form reflects the design documents for spaces where lighting is fully specified. So, our review tips tell us to refer to the helper table in the interior lighting section on the quality control tab to help us identify lighting fixtures with the highest total wattage, and also to identify space types that we want to look at that account for the greatest total lighting wattage.

So, we don't want to spend our time checking whether or not a small storage room that only comprises .001 percent of the total wattage in the project. We want to focus on those high-impact, high-wattage space types. So then, we will locate the selected fixture, the make and model numbers on the lighting schedules to verify that the maximum rated wattage reported in the compliance form in Table one on the interior lighting counts tab is in alignment. Then we'll want to locate our several high-wattage space on the interior lighting counts tab, and we'll want to refer to the lighting plans and confirm that the fixture types and the counts for the spaces that we're investigating match the compliance form.

So, briefly, some common mistakes are that individuals enter in the compliance form, they don't enter the manufacturer maximum fixture wattage. Instead, they might enter the wattage of just the specified lamp. So, for an example, if a fixture is rated at 60 watts but the design specifies eight watt LED fixtures. The requirements of 90.1 are such that the 60 watts needs to be modeled. The second is not correctly capturing track lighting per the requirements of 90.1, and then not correctly accounting for partially-specified or temporary lighting. For an example, not accounting for the fact that in dwelling units, often the design assumes that the resident will use plug in lamps and fixtures to supplement the hard-wired lighting specified in the actual design.

Okay, so we have our helper table on the quality control checks tab. And we're going to start first with fixture types, and this is the ranking by wattage of the different fixtures in the project. And we see that C2 is a highly impactful fixture. It has the highest wattage in the project. So, in our example now, we're going to do C2. So next, we go to Table one on the interior lighting counts tab to find out where in the construction documents do we look to confirm the fixture wattage. And it gives us E-105. So, we open up the design documents and find that drawing, and then we look for our fixtures that we're verifying. So, we can see that C2, and while we're at it, I'm checking the C2 emergency fixture as well.

So, we've got our fixture and the reported wattage here, and then we have our lighting fixture schedule, which I zoomed into here

from the design drawings, and we can see that the fixture wattage reported in the compliance form 16 matches the design drawings. What we also need to check are cut sheets to make sure that the maximum rated wattage is reported in the design drawings and in the compliance form. So, this is a little excerpt from the manufacturer cut sheet, and it's confirmed that 16 watts is the input power. So, this is all good. Wattage in the compliance form matches maximum fixture wattage, and it's consistent. So, we're happy they passed this check.

Okay, so now we want to check that the actual lighting counts match the design drawings. So, again, the space types are ranked by wattage, and we're – in our example, corridors are three, so they're pretty high on the list. So, we're going to do corridors as an example. And we go to the interior lighting counts tab and we find where the drawing, where we can see our lighting counts. We pull up that drawing – there it is – and then we count our fixtures and compare them to the compliance form. So, this is the row for the corridor. And we can see we have 10 C2 fixtures and six C2 emergency fixtures. And we've counted them from our design drawing, and they match. We have 10 C2s and six C2 emergencies. So, they pass and we're happy with this check. Now, you would, of course, do a few other checks in your sample, but in our example here, they passed this item on our sample.

Our next check is that the specified lighting controls meet mandatory requirements in 90.1, section nine. So, our review tip is to check our Table one on the interior lighting counts tab. All the mandatory lighting control requirements for each space are listed there, and it actually flags when a space is not in compliance. So, this check is actually performed automatically in the compliance form. So here is an example, and this was automatically flagged because, as you can see, this is where, in Table one, that lighting controls are characterized, so they're entered from the proposed design documents into the compliance form, and this space here with red outline shows us that, okay, this space is not meeting mandatory requirements.

The red goes away when the user enters the controls that are – that satisfy the mandatory requirements of 90.1. So, we can immediately identify which spaces are not in compliance, and ask the design team to correct this issue. So, this is a check that the mandatory control requirements in the compliance form are correct. There's also a check to check that these controls are consistent with the design documents. We're not doing that example today, but that'll be another check as well.

Now we'll do IL10-B, and this is a check that the modeling output aligns with the lighting entered in the compliance form, does it make sense? So, modeled interior runtime hours of the baseline design are realistic. So, this check is automatically performed in the compliance form, and, essentially, the compliance form calculates effective full-load hours, which is basically equal to the sum of the hourly schedule fractions in the model for a year. So, it takes simulated annual lighting energy in kilowatt hours and divides by the total lighting wattage from Table one on the lighting model inputs tab, okay? And the review manual has typical lighting effective full load hours for common building area types that don't account for controls, and in Appendix A.

So, this check compares those typical effective full load hours to the calculated effective full load hours, and as long as the baseline does not exceed those typical effective full load hours by more than 30 percent, it passes; otherwise, it's flagged. And there could be an explanation for the flag – irregular schedules that differ from the typical building of the type. So, an explanation can be provided, but if the explanation is inadequate, this would need to be corrected.

The table you see here is a helper table on the quality control checks tab in the interior lighting section. And what's boxed in red are the effective full load hours calculated for the baseline model. And then, the effective full load hours per Appendix A of the review manual. And, as you can see, the values are quite close. They are definitely within 20 percent. So, this check automatically passed in the compliance form, so there's no further action as a reviewer or as a modeler.

Okay, our last category for today is air-side HVAC system. So, we're going to delve into two checks. The first we're going to check whether the baseline system types reported in the compliance form are established correctly. And then we're going to do a check of the type where you examine whether or not the design reflects what's reported in the compliance form. So, the first check we're going to do, AHVAC03-B, that the baseline system types reported in the compliance forms are established correctly. Now, this is a very, very common issue that we see in reviews, so we wanted to do this for our demonstration. So, in our review manual, it tells us that baseline HVAC types are reported in Table 1A on the baseline HVAC Appendix G tab.

So, we want to do spot checks, sampling to confirm that the baseline systems are established correctly. And we have some other tables in the compliance form on the general information tab, the interior lighting model inputs tab, that can help us with determining what those modeled baseline systems, should be, according to the rules of Appendix G. So, some common mistakes are that the incorrect baseline heating fuel source is modeled. So, based on the climate zone, Appendix G requires specific heating energy sources than the baseline. For an example, for system nine in climate zone, let's say, 6A, you're required to model gas-fired heating whereas in climate zone two, you're required to model electric.

And we often see, when conducting reviews, that modelers will model the same fuels sources in the baseline and proposed for system nine and 10. So, that's a common issue. Another is if there's a dedicated outdoor air system, like in our case study, in the proposed design, the modeler will also model that in the baseline, but the baseline system types need to be determined per section G3.1.1. So, just because you have a DOS in the proposed doesn't mean one should be modeled in the baseline. And, lastly, not modeling systems five through eight as one system per floor, as per Appendix G. So, what often happens is that modelers will just model the baseline systems with the same number that are in the proposed. So, because, I mean, it saves time in terms of reconfiguring the model. But, that's not per the rules of Appendix G. One system needs to be modeled per floor for those system types.

Our first step when determining which baseline system types are correct is to go to Table one on the general information tab to look at the building area types, the square footage of each, and the number of floors. So, once we gather than information, we go to table G3.1.1-3 to determine which of the baseline systems we would expect based upon the square footage, floors, and building area. So, first we've got multi-family, and so that's residential. And so, we look at our table and we see for residential, we expect system 1-PTAC. Then we look at retail, which is another building area type. It is greater than – the area is greater than 20,000, so it should be treated as another building area type when determining the baseline systems. So, we look at the table and we look at the retail row, but we see that it says retail and two floors or fewer. Well, our retail is three floors, so that doesn't apply. So, we go to the next row, which is other non-residential and three floors or fewer and less than 25,000 square feet. Bingo, that matches our

retail building area, so we would also expect system three to have been modeled.

There is item E in this section of Appendix G where the rules of determining the baseline HVAC system type are provided, and E says that thermal zones designed with heating-only systems in the proposed design serving storage rooms, stairwells, vestibules, etc., should be modeled as system type nine or 10 in the baseline. So then, we take a look at Table one on the interior lighting model inputs tab to see if there are any of those types of spaces where we would expect them to be heating only, and to therefore be modeled as system nine, based on our climate zone, which, if you look at this column here, our case study is climate zone 4A, so, you know, we fall into this column here. So, for these spaces, we would expect for these heated-only spaces, we would expect system nine.

And we have some. We have stairwells, storage rooms; so we would expect there to be system one, system three, and system nine on the baseline HVAC tab. So, our next step would be to go to the baseline HVAC Appendix G tab, and to look at table one to see what systems were modeled. And it appears that they've modeled the correct systems. We see system 1-PTAC, system three, and system nine, just as expected, and the zoning appears correct. They're all system pre block as per the rules of Appendix G. And we see that the system nine applies to the stairs, so then we could double check whether that's correct by looking to see if they are, in fact, heated-only spaces. So, we can go to the proposed HVAC tab Table one, and we can check out the system serving the stairs to verify that they're heating only. And we see there's no cooling equipment for these system, so it's a check. The systems have been established correctly.

Okay, the next check we're going to go over is AHVAC07-P, and it's to check whether the reported airside HVAC system, cooling, heating, and efficiencies reflect the design documents. So, our review tip tells us where to look for where this information is reported in the compliance form. So, that's Table 1A of the proposed HVAC tab, and we want to crosscheck this with design documents for a sample of systems. And so, the review manual tells us that there is a table on the quality control checks tab that summarizes the HVAC systems in the project and ranks them by various metrics. So, that table is shown on this tab right here, and it ranks the HVAC systems and the project by heating capacity, cooling capacity, design airflow CFM, and the outside air associated with each. So, this gives us a basis for choosing the

most impactful systems when we're conducting our review checks using a sampling procedure.

Okay, so we are going to conduct our checks on RT one to six, and we go to the proposed HVAC tab, Table 1A, to find out where we look, because it tells us in that table which design documents to look at. So, we pull those design docs, and then we check whether the reported efficiencies match the design docs. And in this case, they all do. So, the heating efficiency matches both the units and the actual efficiency with the design documents. Then we check the cooling efficiencies here, and those units and numbers, values, match the values in Table 1A. So, we have an 11.1 EER in the design docs. We've got a 12.8 IEER, and these match the reported efficiencies. So, we are happy for this particular unit with this check.

Okay, that was our last review check demonstration, so this concludes the Power Point and compliance form demonstration of the training. So now, we enter the Question and Answer session portion of the training. So, thank you for your attention, and I look forward to hearing all your questions. Thank you.

Rosemary Bartlett: Okay, great. Thanks so much, Christina. That was a jam-packed presentation; lots of great information in there. Before we move to the questions, I'd like to invite Nick O'Neil to join us to give us a quick overview of some work that he's doing for the Northwest Energy Efficiency Alliance. Nick?

Nick O'Neill: Yeah, thanks. Thanks, Rosemary. Right, so now that you've seen how this compliance tool can be used to help with submittal reviews, we're looking to hear more about what you need when you review performance models, either through Appendix G or other performance-based models. So, we're working with Northwest Energy Efficiency Alliance, or NEEA, to interview a few code officials that do work in the Northwest. And the goal of this is to understand better how these kind of compliance forms and tools can best suit your needs as you're reviewing models. So, we are looking for your experience, and just want to ask you a couple questions about this. The interview should only take only 20 to maybe 30 minutes, and in return, we're happy to send you a $100 Amazon gift card as thanks. So, if you're interested, again, if you work in the Northwest doing plan reviews as a code official or an examiner, and you have experience with performance models, it'd be great to hear from you. And you can contact me at the email address below or at the phone number of our office. So, thanks. I'll turn it back over to you.

Rosemary Bartlett: Okay, thanks much, Nick. As we get ready to start the Question and Answer portion, I'm going to turn it over to Maria Karpman.

Maria Karpman: Great, so, thanks, everyone, for attending this training. We're really excited about these tools. They are both posted on _____ website, and we're looking forward to your comments. And some of you are code officials, some of you are modelers. You may have different priorities, and we're really interested to hear feedback from all these different perspectives. And the forms, you know, both the review manual and the compliance form are still being developed, and we're planning to post updates to them. So, your feedback will be very useful. And if you have any questions, I see one question so far. Does the spreadsheet identify what needs to be changed during construction? _____ used to offer some reports with this information.

So, we do plan to incorporate some additional reporting features into the compliance form. So far, there's no such report, and the focus, again, development so far was on aspects of submittal review that are unique to performance-based compliance that involve reviewing energy simulation, because that was one area that was identified by code officials as well as Department of Energy as, you know, falling a little bit behind in terms of the tools that are available. So, going through the questions that you asked. Is there a check for building infiltration rates? Yes, there is a check like that included in the compliance form, and the review manual discusses common mistakes that we see with this check. And, in fact, compliance form automatically calculates the infiltration rate that should be modeled based on the requirements of 90.1. So, again, the quick answer is that yes, there is a check like that.

For Section 11, Appendix G, could we include _____ in the proposed case and the baseline case would be zero for _____. Yes, Appendix G – both Appendix G and Section 11 allow some created for renewable energy intervals as slightly different between the two product goals. But there is built in, you know, knowledge within the compliance form that helps establish the allowed contribution of renewable energy depending on the compliance path, and the project rules whether it's Section 11 or Appendix G. And, if it's Appendix G, there are different rules, depending _____ documents _____ code compliance _____ and above code project. So, yes, that is supported by both the compliance form and the review manual.

Christina LaPerle: Maria, do you want me to read some questions to you?

Maria Karpman: Yeah, _____ coming up. Yeah, so if you can *[crosstalk]*

Christina LaPerle: Sure. Unfortunately, it doesn't keep them in the order that they come in, so I'm just going to pick one. It says for mechanical schedules, often we see the COP or EER as not listed, but just the model number. Will the reviewer need the EER – will the reviewer need the EER to be listed, I guess in order to conduct the check?

Maria Karpman: Yes, and so _____ mandatory requirements in 90.1 regarding equipment efficiencies. So, irrespective of compliance paths _____ whether it's prescriptive or performance path, code official needs to have efficiency available and reported in order to confirm that it meets minimum efficiency requirements and also that it is modeled based on what is specified. And so, again, the quick answer is yes, that would need to be reported and I believe it's actually required that it's included design documents. And I know Mike Rosenberg has been _____ on the call as well, so, Mike, maybe you want to chime in on that, because I believe, again, that this is 90.1 requirement efficiencies are reported.

Christina LaPerle: I don't hear Mike, so maybe I'll ask another question and he can chime mine once he gets his audio up, if he wants to. So, there were a couple questions about how long it takes to fill out the spreadsheet, and it appears the question from one individual applies to the modeler, and then there's another question about whether we have any times in terms of input from the submitter, and then how long it takes to complete the review.

Maria Karpman: So, you know, filling out compliance documentation does take some time. So, I want to stress that the compliance form doesn't ask for anything that is not a reporting requirement of 90.1. So, it basically implements and tries to simplify and streamline the documentation process for projects. But, again, this level of detail that you saw in the compliance form, that is all based on what has to be reported following 90.1. And we tried to develop compliance forms so that it helps establishing simulation inputs. And in my experience, modelers often have a supplement tool or spreadsheet that they use to transfer information from drawings into simulation tool.

You know, for example, there is certain requirements in terms of the units in which heating and cooling efficiency has to be entered in the simulation tool, and these units do not align with what you would see on the manufacturer documents. So, there are calculators to help with that included in the compliance form.

Another good example is lighting. So, lighting entered in the models, typically in terms of lighting power density. But, of course, what's specified on construction document is lighting fixture schedule and their lighting plans with fixture counts. So, they have to be a tool to help model or design team translate this lighting design into lighting power density that could be then be entered into simulation tool.

So, the compliance form, it's not just documentation overhead for meeting the requirements of 90.1. It also helps organize the inputs for entering information into simulation tool. So, in terms of extent of data exchange between compliance form and simulation tool, at this point, it's _____ with importing simulation results from supported tools into the compliance forms. And most of the popular tools are supported and will work directly with the software vendors, the vendors of those tools to help come up with the most streamlined way to import information from there into the compliance form.

And then another part of this question was from the reviewer perspective, so reviews _____ entire project to develop the compliance form and submit review manual was prompted by requests from code officials who were really overwhelmed with projects that followed performance path. And they really sometimes would just get, you know, thousands of pages of simulation reports, and they wouldn't know where to start with reviewing submittals and performance path was often viewed as a loophole that was exploited by projects to avoid really complying with codes. So, this review manual, when used in conjunction with the compliance form, will hopefully address this gap.

Christina LaPerle: Okay. So, we have a question, several 90.1 compliance simulation tools were listed as compatible. When a modeler uploads the model outputs, does the review tool identify the name/documents that are unique to each tool?

Maria Karpman: Yes, yes. In the submittal _____ list that Christina demonstrated, it's context sensitive. So, once the simulation tool used on the project is identified, _____ reports that apply to this selected tool, and then these are the reports that are used and referenced in the review manual. So, they use that – all the reports that are necessary to complete the review, for when the procedure described in the review manual would be submitted. And, again, we really had great cooperation with the software vendors who helped us with developing this annotated report, and they basically guided this decision making in terms of what kind of reports from their tools

need to be included in order to support meaningful review. And, yeah, so that's the answer to that.

Mike Rosenberg: Can you guys hear me now?

Christina LaPerle: Yep.

Mike Rosenberg: Okay, sorry about that. So, Maria was asking about whether 90.1 required that you include the EER or COP of your equipment in your design documents. It doesn't specifically say that, but it does tell – gives a generic requirement that all the information that is needed to demonstrate compliance with the requirements in standard 90.1 are shown on the design documents. So, you know, the answer to that really is yes, they should be showing the equipment efficiency in the design documents.

Marie Karpman: Yeah, thanks, Mike. That's a good point, and there is also, I remember now, there is also another I think requirement in Section four of 90.1 that says that really, code official has authority to request any additional documentation necessary to certify compliance. So, if you are a code official and if the information on the equipment efficiency is not submitted to you, I wouldn't assume that it's your responsibility to check manufacturer catalogs and confirm that equipment meets the efficiency requirements. It's design team responsibility, one of the responsibility, to provide this information to code official.

Christina LaPerle: Okay, thanks. It seems like maybe we have time for one more question. This question is I believe Appendix G wants fan energy taken out of package HVAC systems. How should the adjusted COP or EER be shown?

Maria Karpman: So, for – there is a place in the compliance form where this calculation is performed automatically for the baseline systems, and then there is a detailed tip, again, I think within the compliance form to allow, you know, to describe how this should be calculated for the proposed design. So, again, the answer to this question is that yes, fan power has to be extracted, and some automation for that incorporated into the compliance form for the baseline, and detailed tips on how to do it for the proposed design.

Christina LaPerle: Thanks, and there were quite a few questions about capabilities of the compliance form. So, I just want to recommend, again, that people check out the training on the compliance form. That's also posted on the energy codes website.

Rosemary Bartlett: Great, thank, Christina, and thanks, Maria, for answering all those questions and a great presentation. And thanks to all of you for tuning in. Thanks again to all for joining.

Maria Karpman: Thanks, everyone.

Christina LaPerle: Thank you.

[End of Audio]