LAND USE BOARD
TOWNSHIP OF BEDMINSTER
COUNTY OF SOMERSET

In the Matter of)
The Application of:)
CASE LUB# 12-015 (BOA))
KDC SOLAR SA55 LLC) Transcript of
Solar Project -) proceedings
Country Club Road)
Block 71.02, Lot 1)
Block 62, Lot 10)
Block 69, Lot 4)

Thursday, December 11, 2014
Bedminster, New Jersey
Commencing at 7 p.m.

LAND USE BOARD

LANCE BOXER, Chairman
GEORGE RODELIUS
NICK STRAKHOV
DORN STEWART
KENNETH OLSEN

ALSO PRESENT

TRINA LINDSEY, Recording Secretary
FRANK BANISCH, Township Planner
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STOP SOMERSET HILLS POWER PLANT

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Attorney for the OBJECTORS
STEVE and SABINA FORBES

I N D E X

THE CHAIRMAN: It's been a while since we've had KDC before us. We will go straight to KDC, Land Use Board 12-015, so it's been since I guess October.

MR. HALL: Good evening. We were here in October. I'd like to call George Rever. Bill -- I'm sorry -- Rever. You're going to get sworn.

W I L L I A M R E V E R, sworn.

DIRECT EXAMINATION BY MR. HALL:

MR. COLLINS: Please state your name and please spell your last name.

THE WITNESS: Yes, my name is William Rever, and I reside at 119 Kingbrook Road in Linthicum, Maryland, 21090.

THE CHAIRMAN: Mr. Rever, could you do me a favor and speak into the microphone.

THE WITNESS: Sorry, yes, sure.

MR. COLLINS: And spell your last name.

THE WITNESS: Yeah, R-e-v-e-r.

Q. And, Mr. Rever, can you tell the Board your background and qualifications.

A. Yeah, sure. So my educational background is a BA in physics from John's Hopkins University, MSC and MBA degrees from University of

Pennsylvania in Philadelphia.

Q. Can you tell them what the MSC means?

A. Oh, master of science in energy engineering.

Q. Okay?

A. And I began my career in photovoltaics in 1982 with industry pioneer company called Solarex. That company become part of BP in 1999, and I worked for that company until the end of 2011, and since then I've been an independent consultant working in the field of photovoltaics.

Q. And have you testified before planning and zoning boards such as this one on issues involving photovoltaics?

A. Yes, I have, yes.

THE CHAIRMAN: And what states have you been testifying?

THE WITNESS: In New Jersey.

THE CHAIRMAN: Okay.

Q. And have you been accepted as an expert in that field?

A. Yes, sir.

Q. And could you -- you said photovoltaics. Can you just describe for the Board what that entails and what types of things you've testified

about and are experienced with.

A. Of course. So photovoltaics is the direct conversion of electricity or -- sorry -- of light into electricity, and I've testified a number of different aspects around that technology, including the impact of the --

THE CHAIRMAN: Just speak into the mic.

A. I've testified at a number of different hearings regarding the technology, the systems, the attributes that are encountered during use, how systems perform, certification, system lifetimes, basically all the key issues that are surrounding PV technology.

Q. And that includes the composition and -- of solar panels?

A. Yes, correct.

Q. And the equipment used in connection with solar energy projects?

A. Yes, correct.

Q. Inverters?

A. Yes.

Q. And the other components?

A. Yeah, combiner boxes, transformers, switch gear, et cetera, all the different aspects of a complete photovoltaic system.

MR. HALL: I would offer him as an expert in photovoltaic equipment.

THE CHAIRMAN: Thank you. Mr. Collins.

MR. COLLINS: Mr. Chairman, I would recommend you open it to the attorneys for questions as to voir dire, meaning any questions just about the qualifications of this expert.

THE CHAIRMAN: I appreciate that. Mr. Sasso, Miss Donato, nice to have you again this evening. Do you have any questions for this witness?

MR. SASSO: Thank you. Just a few. And I guess in terms of him providing testimony, it'll be interesting to know at this point in the proceedings whether or not he's going to be testifying about the panels that are actually going to be installed in Bedminster, or is he being offered as an expert to talk about all different panels, because as you know, on behalf of the objectors, we've been seeking for over a year to find out what panels are going in in Bedminster so we can do our due diligence to determine the toxicity of those panels. So is he going to base it -- I know Mr. Hall's wiggling in his chair, but I guess the question is will he be testifying tonight

as an expert as to the panels that are going to be installed in this township in this project or just overall in the industry.

MR. HALL: That question has nothing to do with voir dire. I mean, we're testifying. If they don't like what they hear, they can ask questions.

MR. SASSO: Mr. Chairman, I beg to differ.

MR. COLLINS: I think Mr. Hall is correct, Mr. Chairman. You should focus, Mr. Sasso, at this stage on not on speeches but just on any questions you have about this witness's qualifications to appear as an expert before this Board.

MR. SASSO: Well, my question, Mr. Collins, which goes to the direct meet of the matter, the crux of the matter, is --

MR. COLLINS: I'm directing you now, Mr. Sasso. You know how this works.

MR. SASSO: Well, I do, but I think --

MR. COLLINS: And you shall focus your attention solely on the question for this witness, not a statement to me, not a statement to the Board. Ask your question of the witness.

MR. SASSO: Sure.

MR. COLLINS: Make it relevant to his qualifications for this time. That does not mean that later you will not be able to ask questions about the substance of his opinion.

MR. SASSO: I understand that perfectly well, Mr. Collins. My question is --

MR. COLLINS: Go ahead and ask your question, Mr. Sasso.

MR. SASSO: I'm trying to. Mr. Rever.

THE WITNESS: Yes.

MR. SASSO: Are you going to -- do you have knowledge as an expert with regard to the panels, the solar panels that are going to be used on this particular project?

THE WITNESS: The client has advised me that there are -- is a general class of PV modules that's being considered for use in this project, which is crystal and silicon based PV modules, with which I'm very, very familiar and can talk to the issues around the manufacture and deployment of those modules, but I believe that the client has not selected a specific model of panel for use in this project at this time.

MR. SASSO: Okay. So is it within your

realm of expertise to talk about panels in that general area when you don't know the exact panel that they're going to use? Do you understand what I'm saying? In other words, within that general area of, quote, panels could there be a panel that they pick after you leave here tonight that you're not familiar with?

THE WITNESS: I would say that it certainly is possible, but it's very unlikely because PV modules of the type that are being under consideration for this project are very highly standardized in terms of their design, and the client has enumerated a number of models, essentially what I would call a short list of -- and they all fall under the same fundamental category. They all meet the same basic certifications. They pass the same sorts of tests. They're made in very, very similar ways. So I think that, you know, you could -- some people will call them a commodity. So I think that's in some ways an accurate description but they're very, very similar across this general class.

MR. SASSO: Mr. Chairman, with that, I have no objection to him being qualified as an expert.

THE CHAIRMAN: Thank you, Mr. Sasso. Miss Donato.

MS. DONATO: Yes, thank you. I just have one question, and that is are you also familiar with the aspects of toxicity that may exist with respect to some solar panels or --

THE WITNESS: Yes, it's something I've encountered in my career, and I'm able to --

THE CHAIRMAN: Speak up, sir.

THE WITNESS: Yes, I'm going to address that issue and try to provide some further explanation about the toxicity aspects of PV.

MS. DONATO: And are you also familiar with -- assuming that you're familiar with the potential toxicity in the panels, are you familiar with the effects of such potential toxicity?

THE WITNESS: That's not really my field of expertise so I would say no.

MS. DONATO: Thank you so much.

THE CHAIRMAN: Thanks, Miss Donato. Appreciate that, Mr. Rever.

MR. COLLINS: Mr. Chairman, I recommend the Board consider a motion to accept the qualifications of Mr. Rever --

THE CHAIRMAN: We'll do that.

MR. COLLINS: -- as a PV expert.

THE CHAIRMAN: So a motion -- is there are a motion to deem his qualifications acceptable by the Board?

A BOARD MEMBER: So moved.

THE CHAIRMAN: Is there second?

A BOARD MEMBER: Second.

THE CHAIRMAN: And a roll call.

MS. LINDSEY: Mr. Strakhov.

MR. STRAKHOV: Aye.

MS. LINDSEY: Mr. Rodelius.

MR. RODELIUS: Aye.

MS. LINDSEY: Mr. Olsen.

MR. OLSEN: Aye.

MS. LINDSEY: Chairman Boxer.

THE CHAIRMAN: Aye. Okay, Mr. Rever.

MR. HALL: Thank you.

Q. Why don't you, Mr. Rever, if you would, explain to the Board what's proposed here in whatever sequence makes sense to you.

A. Sure. So I thought that it might make sense given the type of questions that have arisen around PV technology to talk a little bit about some of the aspects of how it works, what are the basic components, what do they do, how some of these

things are made, especially the PV modules, themselves, which is a key element in one of these systems, and I think that might help to just give you some general background, and then we can open it up to questions.

Does that make sense?

THE CHAIRMAN: Sure.

A. So I think let me start out by saying that, you know, everyone I think is aware that basically a PV system consists of PV modules, which the active element is called a PV cell or a solar cell. Actually, it was invented not too far away from here around 60 years ago at Bell Labs with silicon solar cells that we're talking about here, and that's the type of technology that's under consideration for use in this project.

A module consists of a number of individual solar cells connected together usually in series. That's the configuration that's again being proposed for this plant. The individual PV module is an assembly of those cells put together mechanically and electrically, and then individual modules are connected together, again, mechanically and electrically, to make arrays of photovoltaic modules. Typically, you'll connect together in

groups of series strings. Those are then aggregated together in parallel and what are called combiner boxes. You know, large field like this, those combiner boxes then feed into other larger recombiner boxes. Those are fed in electrically to the inverters on the site, which convert the direct current electricity, which is what photovoltaic systems produce naturally, into alternating current, which is what we are familiar with and use in our houses. It's a standard current that's used in the mains. And then in this particular case, this generated AC current will then be stepped up by a transformers to a somewhat higher voltage and transmitted for use at Sanofi, which is a neighboring facility.

Q. And when you refer to solar modules, is that what we in lay terms call a panel?

A. Yeah. The terms are -- have become more or less interchangeable. I won't get into the technical details between what one is and what the other one is, but basically, yes, it's an individual unit, typically in this case something around 3-foot-by-5-foot in size, weighs around 40 pounds each.

Talk a little bit now I think about

maybe what's in a panel. The construction we're talking about here -- and this is what I'm saying -- is very, very standardized. It's actually been something that was developed basic design almost 30 years ago. It's been embellished over the years, and cells are far more efficient, but the fundamentals of this design came out of work at the jet propulsion laboratory in late 1970's, the early 1980's.

So in these designs, the front of the PV module is a sheet of low iron, low iron because it's high transmissivity for light. So it means a lot of light gets through the glass into the cells. There's a sheet of encapsulating polymer called ethylene vinyl acetate, which is a synthetic transparent rubber compound. So most commonly the application might be most familiar with is maybe in running shoes. So it's a basically a rubber, synthetic rubber. There is the matrix of solar cells, which is the interconnected range from the solar cells, I spoke about earlier then another layer of the EVA, and then finally a back sheet material, which is usually a polymer -- there's a number of different compositions, but typically something containing Tedlar or polyethylene and/or

both. What that does is seals -- all that, all those things are basically put together into a sandwich. It's put into a vacuum lamination process, and air is evacuated from that, and it's heated, and the EVA flows in between all the interstices with all the spaces in the module, and it becomes one, essentially one mechanical sealed unit.

After that, the final finishing of the module is putting on the aluminum frame, which is how it's mounted, how it's held up, provides mechanical strength, as well, and the attachment of the connectors on the back. So that's how a PV module and how is assembled.

The individual cells, themselves, start out as highly refined silicon wafers. The raw material for that is quartz sand initially. That's refined into what's called metallurgic grade silicate is the first step. There's then a subsequent set of chemical refining steps to take that silicate to a very high level of purity, which is needed to make good semiconductors and solar cells, and then that highly purified silicon is melted and solidified in a certain way basically in a big block typically, and that creates a big

crystalline block of silicon that has the right properties to make good solar cells. During that process of melting and casting, a small amount of impurity element called boron is added, which makes the silicon what's called p-type, which basically means it has a certain type of electronic properties. That then, when that is cast into those blocks, those are sawn into smaller bricks, of which the cross-section will become the ultimate solar cell. So in this case, each brick would be 156 millimeters on the side. That's the standard in the industry, which all of the makes under consideration use that. And then those bricks are then subsequently sliced into very thin wafers using what are called wire saws. Those wafers then get cleaned, etched, and begins the process of making individual solar cells.

So the wafer goes in the first part of the solar cell manufacturing process is what's called diffusion, where a small amount of another impurity, which contains phosphorous, is put into the front of the cell, and that creates what's called an n-type region, and it's the juxtaposition of the n-type and p-type which creates what's called a junction. So there's actually an electric field

existing within that silicon wafer, and when a photon of light goes into that silicon wafer, it's able to excite electrons, and the absence of electrons, which are called holes, form and move in the other direction, and those electrons are what are able to move out into an external circuit, give up some of the energy that was in the initial photon at the end of the silicon wafer, and that's what creates the PV power and energy.

So the -- once the junction is created in the silicon wafer, then the subsequent processes in the solar cell are essential to make it a better cell. So it's putting a metal grid on the front, a metal surface on the back for conductivity and attachments, and then subsequently interconnecting individual cells together with copper ribbons, and then that goes into making the PV modules that I described earlier.

Generally, it might make sense to talk a little bit about the composition. So a typical PV module of this type is about 75 percent glass by weight. It's about 10 percent aluminum by weight, and about 6 percent or so are the polymers that are used in it, and the rest are other materials, including silicon, which is like around 1 percent,

and some of the other things like copper and very small amounts of silver, for example, which is used in metalization of the cells.

So as designed, the typical PV module today, which I mentioned, you know, the design comes out of a design that was invented a long time ago, it's derivative of that, and today, all of the top tier manufacturers are certified to international standards. One of them is most -- the most important is called IEC 61215, which all of the models that are under consideration by the client meet that standard, as well as one called IEC 61730, which is also around safety.

So in a nutshell, what the standards do is they test the module under accelerated life conditions is one aspect, and that is to tease out any potential failure mechanisms. So all of these modern PV modules that meet these certifications have been tested and to these kind of standards, and what they are is things like cycling them to different temperatures and putting them into conditions of high humidity for long periods of time, putting them through freezing and high humidity cycles, putting them under different kinds of mechanical loads that simulate the effect of very

high winds or snow loads, for example.

MR. OLSEN: Can we get copies of those standards?

THE WITNESS: Sure.

MR. OLSEN: Can I just ask one question? When you're describing the physical configuration of the panels, you said that there were two polymeric strata, one on top and one below the actual cells.

THE WITNESS: Right.

MR. OLSEN: I'm trying to visualize. So wouldn't that make you have an opaque layer above the cell, itself? Why does not -- that does not inhibit the light from getting through?

THE WITNESS: It's actually transparent. That's the EVA is a transparent material.

MR. OLSEN: It's not really black like the bottom of a sneaker.

THE WITNESS: No, it's like a -- it's a transparent material.

MR. OLSEN: Thank you.

Q. You were talking about the standards, I think you said two different kinds?

A. One essentially is to qualify the modules for their environmental robustness, basically, so they're going to last in the field,

and then there's other standards around safety, so it's things like electrical isolation. They'll be able to withstand different kinds of fire situations, et cetera. So again, nowadays, there's many, many different modules that meet these standards.

MR. OLSEN: Is the safety about environmental safety or physical safety to people around it? What are the standards addressing?

THE WITNESS: It's generally the safety to people and property typically. So there are some environmental standards. Some companies, you know, follow them. Some don't. Let's say that each company follows its own path to some degree. I know that one of the key companies that is under consideration for this project in terms of environmental is qualified to ISO 14,001, which basically is a quality standard that includes environmental aspects, and they're also a part of a group called PV Cycle, which is oriented towards Europe because in Europe there are very rigorous standards for electronic and electrical equipment and responsibilities of manufacturers, but basically, it means that the company would take back the products at end of life and recycle essentially.

THE CHAIRMAN: Mr. Rever, I'm not sure if this is your field of expertise, but as you think about your comments, in the event of a major failure, whether it's electrical or it's mechanical, but if there was a chain of events that created massive destruction on the site, whether it be through hurricane or lightning, it was just a cascading event, I guess the word I'd use is toxic penetration, all these panels were to explode -- I don't even know how that would happen. I'm really thinking in a very worst case in a mega disaster, which is what we try to think about, are there studies or are there experiences that maybe you can talk about or defer to another expert as to the potential effects this may have on ground water in the area? So again, my question really may not be -- my question is broad and you may not be the expert. It may not be your area of expertise, but maybe you can comment on it.

THE WITNESS: Yeah. I think that what I would say is, as you, yourself, pointed out, it would be, you know, it would really be a catastrophe. These things are pretty rugged. Normally, I mean, it's -- if one breaks, it's an unusual circumstance. You know, most manufacturers,

just to give a number, like the typical return rate for module manufacturers is .1 percent.

THE CHAIRMAN: What does that mean, return rate?

THE WITNESS: Well, in other words, if they ship out a million modules in a year, they get .1 percent back, a hundred modules I think or a thousand modules, but .1 percent of a million. But --

THE CHAIRMAN: So your point is that based on their shipments, it appears that they get back everything they ship minus some small rounding error.

THE WITNESS: Essentially, nothing comes back. I mean, in other words, they're very, very rugged things. But, you know, I don't want to dismiss your question on that basis.

THE CHAIRMAN: No, I understand.

THE WITNESS: But I think if you did, like let me talk about what happens if a module does break, I mean, you know, if it would happen, I mean, for a variety of reasons, somebody can throw a wrench through a module even though they're pretty sturdy. Immediately there's not going to be any toxic element released, I mean, because all of these

materials are designed to be fundamentally inert. I mean, that's sort of how they achieve high levels of reliability, but if you put moisture on it, especially over time, you know, things can, you know, you can get chemical reactions, especially you have acid rain, for example, which can promote chemical reactions, and some of these materials would begin to have some leaching out. It's -- I'm not an expert enough to say exactly what degree that would be for the case you used, but in general, there's very minute quantities of anything that's very toxic in these modules.

THE CHAIRMAN: Okay. Thank you.

THE WITNESS: So I guess I'm moving to questions.

Q. Is that pretty much it on the panels, themselves?

A. Yes.

Q. Maybe makes sense to ask questions about that before you go to the inverter and the other components.

MR. HALL: I defer to you, Mr. Chairman. Does that make sense?

THE CHAIRMAN: Mr. Hall, we can also ask Mr. Sasso and Miss Donato how you would like to

handle this. We can wait until the end and they can certainly cross-examine.

Q. Well, why don't you just go through everything.

THE CHAIRMAN: Maybe that's better. We'll try to deal -- otherwise, we can get distracted.

Q. All right. So anything else you want to tell us about the panels? So let me back up. On what you're just talking about, are there different panel designs that some are potentially more, quote, toxic than others?

A. Within --

Q. Either historically or whenever?

A. The answer is yes looked very, very broadly across all PV technologies. So, you know, we're talking about one specific type of photovoltaic, which is the silicon wafer based technology. There are other technologies that have become commercial in the last half dozen years, specifically cadmium telluride based PV's, copper indium diselenide. These are all alternative semiconductors to silicate, and there's even more for silicon, which is another class, and there's starting to be more of these things coming out of

laboratories, but the wafer based crystal and silicon is 90 percent of the market. So, you know, some of these alternative technologies, each has its own characteristics, and it's distinct from the crystal and silicon technology I've been discussing. So I would say, yes, there can be differences in these areas, but they're not under consideration for this project.

Q. And the terminology of what's considered and what you've been speaking about is crystalline --

A. Yes.

Q. -- silicon wafer?

A. Yes, the wafer based -- silicon wafer based technologies.

Q. That's what's proposed and that's what you've been talking about?

A. Correct, yes.

Q. Not any other technology?

A. That's correct.

Q. Okay.

A. Yes.

Q. Okay. Does that cover the panels for now?

A. Yes.

Q. Okay.

MR. STRAKHOV: Can I just ask one very direct question. Does the glass get dirty over time? Does it need to be washed periodically, or does the rain take care of it, or how does that work?

THE WITNESS: It varies a lot by climate. So in this area, generally speaking, you don't need to clean panels. It can be locational. If you have a specific soiling situation giving place that might change that, but generally here there's enough rain that you -- the dirt generally washes off of them, and it's not generally necessary. I would say that typically now these systems are all monitored very carefully, and typically there are strong financial reasons to want the output of the systems to be maximized. So typically, if there's enough of a soiling condition that a drop in output is seen beyond a certain level, then people do go out and clean them.

MR. STRAKHOV: What's that procedure?

THE WITNESS: It's also quite variable. Typically, it can be --

MR. STRAKHOV: Well, what would it be in this case?

THE WITNESS: To be honest with you, I've not heard a cleaning process so I really wouldn't want to comment, but it could be as simple as simply washing them off.

THE CHAIRMAN: So we've talked at some points in this hearing about end of life, whatever end of life is -- I've forgotten -- 15, 20 years. What components, what elements remain inside the panels that might be relevant to decommissioning concern? So for instance, as the panels produce less electricity over time, what actually happens to the panel, and if it was 20 years from now and we were to take that same panel, is there less crystal? Is there less aluminum? Which components ultimately change to produce less electricity over the life of the panels?

THE WITNESS: That's a great question. Actually, you wouldn't -- unless there was generally a catastrophic failure, which would be really, really unusual, probably you would have a hard time seeing what is going on to reduce the power. Experts would be able to. You'd be able to with test equipment and so on. But you might be able to see some of the things. I mean, there's a couple of things that happen. So one of them is that the

encapsulation can degrade, and so you can get yellowing. So that obviously if it happens it's visible or can be visible. Probably more significant is the inner connection, the attachment of the interconnects to the cells begin to get higher resistance and, this is due to combination of the thermal cycling and some amount of corrosion that's starting to happen at the terminals inside the cell matrix. You may or may not be able to see anything. You could probably pick it up in certain types of scans to see hot spots within a module would be an example of that. But basically, it would look exactly, pretty much exactly the same as the day it was installed unless it's had some sort of catastrophic failure.

THE CHAIRMAN: Thanks.

Q. To follow up on that decommissioning was mentioned, if 20 -- you say 20 years and there's a lease and it's over, and so the KDC has to remove the panels, where do they go?

A. Well, that's an interesting question. I mean, I think that the anticipation within the industry is that there will probably be a recycling capability at that time. This is something that's incipient or embryonic today simply because we don't

have modules in any significant quantity reaching end of life, but like I was mentioning earlier, in Europe, where you've a had a little bit earlier deployment cycle and a pretty fair -- of PV deployed -- Germany alone is 37 gigawatts, for example -- I think we're going to see this much sooner, and so I think I've seen a number of papers at conferences recently, for example, showing how PV modules can be recycled so I think that would be the most likely disposal.

THE CHAIRMAN: Let me just ask you one question. Is there something inherent with solar broadly specific to this installation that concerns you that's either dangerous or odd or affects quality of life that we haven't asked you? So is there anything as an expert that you look at solar and say I wish if one thing could be changed, what would it be that would help the deployment, either make it safer, make it longer lasting? I'm not trying to get into a technical debate over the issues. I'm just trying to understand from your perspective is there something inherently wrong with solar that would affect quality of life that we haven't asked you and we should ask?

THE WITNESS: I would say no in the

quality of life at the deployment. I mean, I think you can ask questions about at the point of manufacture, although in all honesty, I think that's getting a lot better, but I think there was a period of time, I'll say roughly 5 years ago, when the Chinese manufacturing industry had just gone through an enormous burst, and I think there were shortcuts being taken by some -- not all, but some -- manufacturers in China.

THE CHAIRMAN: Are most panels made now in China?

THE WITNESS: Barely. It's the single largest location globally, but it's just a nudge over 50 percent I think of all the PV modules are made in China, but so -- but I think again, this is one of those things where sort of yesterday's story was some of these things that you might have read about back in that time frame, but now I think certainly the major actors have, quote/unquote, cleaned up their act, and I think they're much more sensitive to these environmental issues.

THE CHAIRMAN: I appreciate the answer. Thank you.

Q. Okay. So the panels, each panel generates direct current, right?

A. Correct.

Q. And where does it go?

A. Okay. So once the current is generated by the module, they're put together in series strings. So in this case, the proposed design is 11 modules in series. Those then go into combiner boxes. These are literally electrical boxes that you're familiar, probably seen in other electrical installations. That then goes into higher level aggregation, so these are using typical electrical industry wiring practices. There's wires specifically developed for PV's with UV resistant jackets and so on to allow relatively simple stringing of these arrays. And then that's fed into the next significant active component, which is the inverter, and the inverter is a very large basically solid state switching device that converts that direct current flow into an alternating current flow. It's got a few other functions, but that's the principal function. It's basically a large piece of solid state electric in a big metal box basically.

From that point, the output of the inverter goes to a transformer, again, a very standard piece of electrical equipment, which takes

that output up in voltage so you can transmit it longer distances, and that's a fairly very, very standard kind of technology just basically using electromagnetic principals. And then it's fed to the distribution panel where it will be used in this case because the system is a behind-the-meter system. It's a utility term actually because it means it's on the other side of the meter from the utility. So all the energy generated from this project is going to consumption on a facility that's nearby.

Q. So the first the combiner box, a number of those?

A. Yes.

Q. How many panels per combiner? Is that the way you -- how does that work?

A. Yeah, so you have strings, a number of series strings. I'm sorry, I don't happen to know that number off the top of my head for this project, but it's typically several dozen strings going into a box, and there's a practical number of how many you can put together, which is why you need series of different combiners to build it up to get to the inverter.

Q. Do you know how many inverters there

are?

A. Well, in this project there's three main inverters proposed.

Q. And one transformer or more than one?

A. I'm sorry, I'm getting beyond my -- I think there's two actually because in this case there's a need to split the output to be on different parts of the -- basically where it's tied into the utility grid, so I believe there's actually two.

Q. Okay. Now, the inverters and the transformers, are they dangerous? Are there protections that need to be considered there?

A. Well, basically, I mean, they're pieces of high power electrical equipment so they're something that have to be, you know, dealt with by qualified electricians and so on, which they are. So you wouldn't want to have a layperson going inside any of that equipment. But it's not anything that different from what you find in a HVAC room at a, you know, a shopping mall or something like that. It's in that same kind of power class and range.

Q. And they're within an area that's fenced in to keep --

A. Yes.

Q. -- people out.

A. Yes, exactly.

Q. And there's signage required, do you know?

A. Yes, yes. So, I mean, these things are labeled danger, high voltage, et cetera. So it's -- it's obviously a piece of electrical -- high powered electrical equipment that's to be avoided by the layperson.

THE CHAIRMAN: Mr. Rever, what does that really mean, though? So this is a facility that will be not guarded by 12-foot fences. There's fencing, but it's going to be limited. If somebody were to jump a fence, when you say it shouldn't be dealt with by lay people, where in this operation are the most vulnerable points, the most dangerous points? So for instance, if somebody was to go in and sit by a panel, is that dangerous or not?

THE WITNESS: No, no. I think where it gets dangerous is if someone were to interrupt the flow of current, i.e., you know, grab a wire, you know, then it gets dangerous.

THE CHAIRMAN: But the wires are connected in the inverters are inside buildings --

THE WITNESS: Right.

THE CHAIRMAN: -- and the transformers are also protected; is that correct?

THE WITNESS: Yes. There's locked enclosures and so on.

THE CHAIRMAN: If somebody was to be under a panel, if somebody was to walk over to a panel and touch it, there would be a nonevent; is that what you're saying?

THE WITNESS: Yes.

Q. And the electrical equipment, I think you said that any commercial building facility has something, maybe not the same thing, but --

A. Similar classes of equipment.

Q. Places where strangers shouldn't be touching things.

A. Exactly.

Q. Okay.

A. Yeah. I mean, I think that it's maybe worth pointing out that you could get into -- there's more risk of -- again, one of the certifications for PV modules is, in fact, like a wet resistant or insulation test, but the risk goes up if it's wet.

THE CHAIRMAN: What does that mean? Explain that.

THE WITNESS: Well, because, essentially, if the back -- if the back of the module -- you mention somebody coming up and touching the back of the module. Well, the ability to conduct current is much higher if there's moisture, you know, present. It's like almost anything electrical. It's the same principal. So there's a higher degree of risk. It doesn't say that something would happen, but there's a higher degree of risk if it were to be wet.

THE CHAIRMAN: I don't mean to probe and make this negative. I'm just trying to understand. If somebody were to touch a panel during a rainy day, would there be a chance of electrocution if they touched the primary panel, or they have to touch the other parts of the panel that are more dangerous -- obviously, everything is exposed, but are there specific parts that are more dangerous?

THE WITNESS: Probably, you know, this is where you get into -- you probably have to have a failure condition of some sort, but it wouldn't be a fail -- it may not be a failure that you would see otherwise. I guess that's where I'm kind of going, that you could have, you know, for example, a tear or something in the back sheet of the module that

you might not immediately detect otherwise or something like that, but if a person were to complete the circuit with that, that could conceivably be dangerous. So you could say under the normal operating conditions, no, but again, there's more risk if you get into something like a wet condition.

MR. OLSEN: How much power does an individual panel produce? What -- what's the capacity of that to generate a shock?

THE WITNESS: These are 300-watt panels, but the way the system is set up is 11 modules and series, and each one is around 35 volts, so it's 400 volts typically to ground. So it's enough to be dangerous.

MR. STRAKHOV: Does the power shut off at some dual level of cloudiness like as it gets rainy or darker?

THE WITNESS: It's proportional.

MR. STRAKHOV: So doesn't something say, oh, it's too long, going to zero.

THE WITNESS: You get low enough, it does, but, I mean, that's a fairly low point.

MR. STRAKHOV: It would compensate for the less energy.

THE WITNESS: It's pretty linear, pretty far down the scale.

Q. Does it shut off, or does it just stop generating, producing, I guess?

A. Yeah, I think it gets tricky because, I mean, in a sense, a PV panel, as long as there's light on it, always has some electrical potential there, but the inverter would not be able to track it at that very, very low level so there would be no output coming out of the system after a certain point is reached, but, you know, there's still some small amount of electricity there at the panel.

Q. So in a rain storm where it's cloudy, you probably wouldn't have any juice; is that fair to say?

A. Yeah, it would be producing quite a bit less power, if not zero, if it were very, very dark, but you'd be surprised. You can still make 10 percent power on an overcast day.

Q. Have we missed anything that you want to share with the Board?

A. I don't think so. I think we've covered -- I mean, I'm open to your questions.

Q. Okay.

THE CHAIRMAN: Thank you, Mr. Rever.

Thank you, Mr. Hall. Why don't we start with Mr. Sasso or Miss Donato, and then we can go to the public.

MR. SASSO: Thank you, Mr. Chairman.

CROSS-EXAMINATION BY MR. SASSO:

Q. Mr. Rever, with regard to your opinions today concerning what happens at the end of the cycle or life cycle of the panels, you indicated that the industry in general has this recycling of panels. It's in the embryonic stages, correct?

A. Correct.

Q. In fact, if we talk about this issue, Europe is way ahead of the United States in that regard.

A. Yes, that's true.

Q. All right. This technology that we're talking about, I know you told us about the 60's. It was actually 1954 at Bell Labs that they discovered the ability to convert the solar synergy into electricity; correct?

A. That's absolutely right.

Q. And, in fact, by 1958, they had already started using that technology in certain applications, correct?

A. Yes.

Q. And this panel that is being proposed for use here in Bedminster is a silicon?

A. Yes, it's a silicon based PV.

Q. Okay. And you indicated to us that's basically the old technology, and 90 percent of the existing panels in the market are those silicon based units; is that right?

A. Absolutely, yes.

Q. Is that true also in Europe, by the way?

A. Yeah, I believe the market share is very similar over there.

Q. Okay. So that when we're talking about the recycling efforts in both Europe and the United States, we'd have to conclude that they're dealing with the vast majority of those panels needing to be recycled as those silicon based units.

A. That's correct.

Q. Similar to the ones that are being proposed here.

A. That's correct, yes.

Q. Now, you told us during your testimony that with regard to the panels that KDC has not chosen a particular panel yet.

A. Not a specific one, yes.

Q. And you were given a, quote, short list.
A. Yes.
Q. Do you have that with you here today?
A. Actually, it was part of the exhibits that were presented here earlier I believe.
Q. You rendered a report, correct?
A. It was from the engineering firm.
Q. Okay.
MR. HALL: There are several plan sheets that had some specs, and back in May, I believe we filed a -- some illustrative cut sheets.
Q. Okay. But again, getting back I guess to my voir dire questions, as you sit here today and give your opinion before the Board, you don't know the exact panel that's going to be used; is that accurate?
A. That's correct.
Q. All right. Let's talk about these panels at the end of their useful life because that's when recycling is required, right?
A. Sure.
Q. Recycling at that time, again, not governed by standards here in the United States. You hope that the company is still in existence at the end of the cycle of 15 or 20 years to do the

recycling, correct?

A. Well, that's correct. Different companies have -- because of the turmoil in the industry in the last few years, a lot of companies have essentially backed up things like product warranties with external insurance and so on. I agree with your concern, but I think that there are a number of companies that have figured out essentially ways around or basically they've insured against those kinds of issues.

Q. But not all the manufacturers.

A. Not everyone, of course.

Q. In fact, why don't you tell the Board, you know, the percentage of manufacturers that actually agree to do that is actually below 10 percent; isn't that right?

A. I'm sorry, I don't know the answer.

Q. Well, okay. So you're telling us that some manufacturers insure the recycling of the product. You mentioned even a particular name of a manufacturer earlier for the Board. But would you agree with me that the vast majority of manufacturers as it exists today do not give that representation or warranty based on your knowledge in the industry?

A. I agree with that.

Q. So in other words, these panels that are being suggested on this short list, many of those companies, if not the majority of those companies, don't have that specific warranty that you told us about; isn't that right?

A. Yes.

Q. Okay. So in this particular case, do you know who the Applicant is?

A. Sorry?

Q. Sure.

A. The Applicant?

Q. Yes, the Applicant in the -- in this particular application in Bedminster that wants to install this solar farm, do you know who the Applicant is?

A. KDC Solar.

Q. And if I told you that it was KDC Solar SA55, LLC, would that surprise you?

A. No.

Q. And if I told you that my research indicates there's over 20 KDC --

MR. HALL: I object to that because I don't care about his research. He's not testifying.

MR. SASSO: I'm not testifying.

MR. HALL: Well, you are, you are.

MR. COLLINS: I think the objection will be sustained then, Mr. Sasso. Why don't you go ahead and ask a question instead of --

MR. SASSO: Well, I'm trying to, actually. So can I have this marked, please.

MR. COLLINS: It will be an O exhibit. I do not have the list. So I don't actually so see if you have a list of any in the A list. There may not be any.

MS. DONATO: I'm thinking there is not, Mr. Collins, but I'm checking my notes.

MR. COLLINS: I kind of remember somebody trying to use a picture of something. We couldn't accept it because we didn't have any basis for it. So let's make it -- we can make it easy by making it OS for Mr. Sasso -- make it OF for Forbes, 1, with today's date, 12-11-2014, and if there's another O-1, we'll know that this is different by being OF-1. I think you better show it to Mr. Hall and see if there's anything necessary to just admit it because I have my doubts about this witness knowing anything about the --

MR. SASSO: Well, that's the point, isn't it, Mr. Collins?

MR. COLLINS: It's all right to make a point, sir.

MR. SASSO: I am trying to.

MR. COLLINS: You need to now just focus in on let's see if it's admitted into evidence, okay, so --

MR. SASSO: -- submit it into evidence yet. I want to show it to the witness and ask him if he's aware of the companies.

MR. COLLINS: Why don't you show it to Mr. Hall.

MR. HALL: I'm looking at it. It's a list of KDC Solar entities, and I don't know the relevance of this. I don't know what it's -- says it's from Hoovers apparently.

MR. SASSO: The relevancy I would submit the proffer is that it's extremely relevant to this application. We're being told that the Applicant is KDC and then a different LLC than what exists as an entity on here in Bedminster. So the question becomes and the relevance becomes what company is going to do this project, and will this particular company be viable at the time that recycling is called for in accordance with your ordinance, okay. That's how it matters.

MR. HALL: But that has nothing to do with this witness's testimony.

MR. SASSO: Well, he --

MR. HALL: That's argument, and, you know --

MR. SASSO: It's not argument.

MR. HALL: Yes, it is.

MR. SASSO: According to you. I need to find out if he knows who he's working for and who the Applicant is.

MR. HALL: And he testified KDC Solar.

MR. SASSO: That's not the Applicant, Mr. Hall, based on the application.

MR. HALL: I believe we filed an ownership disclosure form way back when that -- I don't have it with me -- that presumably listed KDC Solar as a parent entity.

MR. SASSO: It may be.

MR. HALL: If there are any issues about that, and if we ever get an approval, that can be dealt with then as far as other entities. It has nothing to do with this witness's testimony.

MR. COLLINS: Yeah, I think you could -- you know, you have a problem that this witness doesn't know anything about that form that you put

in front of him. At least you want to get him to admit that, go ahead and ask, but it doesn't sound like he's going to know anything about it.

MR. SASSO: I agree, Mr. Collins, completely.

MR. COLLINS: Why don't we do the first --

MR. SASSO: The point is that we need to make a record --

MR. COLLINS: I'll take care of this right now. Mr. Rever, do you recognize that exhibit?

THE WITNESS: No, I do not.

MR. COLLINS: So no further questions. Let's go on.

MR. SASSO: Mr. Collins, I'm not asking him --

MR. COLLINS: He doesn't know what it is. He can't even identify it.

MR. SASSO: I'm not asking him if he can identify the document. I'm asking him --

MR. COLLINS: You have to ask him --

MR. SASSO: -- if he can identify the companies. It's totally --

MR. COLLINS: That's not the question.

The question -- this is whether it is a document that will be admitted into evidence.

MR. SASSO: No, I'm not covering it in evidence.

MR. COLLINS: Then fine, go ahead.

MR. SASSO: Yeah, I mean, and I can do this rather quickly.

MR. COLLINS: But it's not going into evidence yet.

MR. SASSO: I'm not asking to go in evidence. We're asking if he knows who he's working for, okay. Let me show you --

MR. COLLINS: That isn't what the question is. You have to focus your question. If you would like --

MR. SASSO: It's very focused.

Q. On this particular document, go through the list and tell us whether or not you recognize any of those different companies that are listed on the three pages, if you would.

A. I do not recognize these specific companies, but it's not my area of expertise.

Q. No, I under -- well, your expertise deals with whether or not according to your testimony this project would be safe for the

Township of Bedminster, correct?

A. Yes.

Q. That's one of the reasons why you're here.

A. Yes.

Q. Let's go back to what I was asking you about, recycling. I mean, in the industry, as you know, and you started touching on it earlier, there have been a series of company failures along the way in the solar industry.

A. Absolutely.

Q. I mean, we can mention Solyndra, for instance, in California.

MR. HALL: I object. He's testifying again.

MR. SASSO: It's cross-examination. I'm asking him if he knows about Solyndra.

MR. COLLINS: It's a fair question. Go ahead, Mr. Sasso.

MR. SASSO: I don't appreciate this.

Q. So Solyndra, not only was it a manufacturing facility, which is, I mean, admittedly different than what we have here, they also had panels on the site, correct?

A. Yes.

Q. And, okay, tell the Board in terms of the industry -- and I apologize, maybe I should move over.

A. It's okay. I'm good.

Q. Okay. In terms of what happened at Solyndra, did they effectuate a cleanup after they went bankrupt?

A. Unfortunately, I can't answer. I don't know.

Q. All right, and Solyndra was the solar company that was funded with $535 million by the U.S. government?

A. I believe that's correct.

Q. Yeah, and they were guaranteed loans under President Obama. Now, this was located in Fremont, California, correct?

A. That is correct.

Q. All right. Were you familiar -- are you familiar with the issue of the solar panel waste that was left on the property?

A. I'm sorry, I'm not familiar with that issue.

Q. Okay. The issue of the recycling of the panels again bears directly on the solvency of the solar company in general 15 years down the road;

would you agree?

A. Yeah, I agree that it -- it's a -- yes.

Q. I mean, in other words, if the company puts these panels out there, and useful life -- we've had earlier testimony, and maybe I'm misspeaking, but I believe it was like 15 to 20 years; is that about right?

A. Yeah, the panels under consideration are typically warranted for 25 years, but the commercial terms of this project are 15 with potential extensions 5 and 5 beyond that. So I would say that the -- you know, there could be a shorter commercial life. The technical life is 25 years.

Q. And in terms of the particular Applicant or company that's doing the work, is it possible for a bankrupt company to do the recycling that you're talking about?

A. It seems like an impossibility, but I think that this is an area kind of beyond my ken.

Q. Let's talk about your ken. Let's talk about your ken. Your ken is you're telling us tonight that this solar situation, the solar panel project that is being proposed by one of KDC's companies is safe here in Bedminster, correct?

A. Yes, I agree with that.

Q. All right. And in the industry, because you've been in there so long, you understand that there's a concern generally in the industry with regard to hazardous waste resulting from solar panels, correct?

A. I would rephrase that slightly. I would say that there's an issue with hazardous materials used in manufacturing of panels and potentially certain types of PV panel technologies, their disposal.

Q. Well, let's exclude manufacturing out of fairness, okay. Would you agree with me that there would be no necessity, either in Europe or the United States, to have any concern about recycling these panels if there wasn't some type of environmental problem with leaving the panels on site, no longer being utilized?

A. I would agree with that, yes.

Q. Okay. So let's talk about that concern because we really haven't talked about that tonight. Tell us with regard to this old technology that is going to be employed on the panels here in Bedminster, what happens and what toxins develop in the panels at the end of their useful life?

A. Okay. Well, as I was just earlier

addressing, the Chairman had a very, very similar question. Generally speaking, at the end -- you know, again, this depends on whether the end of life is generally a technical end or whether it's, in fact, a commercial end. One thing I would want to comment on is that these types of panels could, in fact, last very long periods of time. They could last upwards of 30 or more years. So I think that, in fact, it's entirely possible there be a commercial end of life before a technical end of life, but that we don't know. I think if there's a technical end of life and it's due to sort of this sort of gradual degradation over time, there's really no significant toxic material buildup or whatever within these modules that wasn't, you know, something that might not or that wasn't present in the initial condition. So you're having things like oxidation, for example, occurring at some of these interconnections between cells. That's a resisted element that's going to reduce the power of the PV modules, but it's not necessarily a toxic element. So I don't -- in my mind, I don't see that a PV module is anymore toxic 20 years down the road than it is essentially the day it's produced.

Q. All right. Then could you tell me

whether or not you're familiar with the association that is related to solar panel manufacturers known as Solar Energy Industries Association?

A. Yes, I am.

Q. Are they basically the hallmark organization for photo cell or photo solar units in the country?

A. Yeah. I would describe them as the leading national trade association for solar in the United States.

Q. Okay. And you're familiar also with the general press that has come out over the years concerning solar panels and solar energy, correct?

A. Yes.

Q. And you're familiar with the Associated Press piece that talked about, you know, hazardous waste, the dirty secret of the solar industry; you're familiar with that?

A. I believe so, but I'd have to see the specific article you're referencing to make sure that it's one that I'm familiar with.

Q. Okay. Well, let's talk about the one that you're familiar with. What was the toxicity that they were referring to in connection with the solar industry?

A. The article that I'm remembering -- again, this is related to some testimony I provided a little bit earlier this evening -- was relating to a Chinese manufacturer of poly silicon and their dumping of one of the waste streams from that particular refining process into the countryside in China, but I'm not sure that's the same article you're referring to.

Q. All right. You told us earlier about -- you testified to some standards. What were the standards?

A. Yeah, the standards I was referring to are basically around the initial integrity and robustness of the PV module and ability to withstand different kinds of environmental stresses. So that was the IEC 61215 certification.

Q. And what's ISO -- for instance, ISO 1400 as an industry standard? Can you speak to that?

A. Sure. That's a little bit different. That actually is a set of standards that ISO -- it's actually 14,001. Basically, if a company has been certified to that standard means that they follow very well defined procedures for both quality and environment and essentially have been externally audited to confirm that they comply with those

standards.

Q. Okay. Now, on an SEIA site, it speaks to not a 14,000 but a standard called ISO 1400, 1400. Is that the one you're referring to?

A. No. That's -- I'm not sure -- I don't know 1400. I know 14,001 and 9,0001.

Q. I don't see that anywhere on their site, but how about ISO 2600, again, not in the 10,000, but 2600.

A. I'm not familiar with that.

Q. Okay. Do you know in terms of proposed life cycle standards, what does SEIA say in that regard in terms of what their members should do, if you know?

A. I do not know.

THE CHAIRMAN: Mr. Sasso, would you -- I think I thought it might be just a good time to take an 5-minute break, let the stenographer rest her hands, and get everybody back. Maybe 5, 10 minutes the most. We need to get going. Thank you.

(Board recess)

THE CHAIRMAN: Ladies and gentlemen we're going to start. Mr. Sasso is back. Ladies and gentlemen, if we can get started. All right. Thanks very much. Okay, Mr. Sasso, it's back to

you.

MR. SASSO: Thank you.

Q. Mr. Rever, we're talking about that Associated Press article again, and do you remember it listing that there's a movement in California to compel this recycling that you referred -- you described for us earlier?

A. I've heard of that, yes.

Q. And also that in California, which is one of the leading states in terms of environmental regulations, is compelling the solar companies to report on the environmental waste that is being produced; is that correct?

A. I have heard of that, yes.

Q. Okay. And do you know in the industry what the scientists call life cycle analysis?

A. Yes.

Q. What is that?

A. It's looking over the entire life cycle of a product and trying to understand different aspects of that in terms of its environmental impact.

Q. Okay. Do you remember in the AP article the -- basically reporting in the article that a small majority -- small number of the solar

manufacturers had actually reported the amount of waste that they created in California?

A. I'm sorry, I don't remember that.

Q. Okay. And when you consider as a scientist the life cycle analysis -- and that's what your degree is in in terms of solar energy -- one of the things that's not being considered would be the carbon footprint score, which talks about or speaks to the issue of the amount of fossil fuels that would be required to transport the waste materials that are produced from the solar industry; is that correct?

A. I would say that a properly done life cycle analysis would, in fact, include that.

Q. Okay, so you agree with that.

A. Yeah.

Q. All right. Let's talk about the individual panels again. Now, could you tell us in terms of the individual panels at the end of their life whether or not there are any toxins within the panel.

A. I would say that it depends on the details of the -- exact details of the design.

Q. Okay. Could you -- are you unable to do that and testify directly to this Board since you do

not know the exact design of the solar panel that would be placed in Bedminster in accordance with this application?

A. Yeah. I mean, I couldn't give an absolute 100 percent assurance because, you know, that could vary with the model. So there's a small -- there's a small possibility that there might be some material specific, you know, in a module type, so yes.

Q. But we also discussed before the fact that the reason why the recycling is important both in Europe and the United States is because you don't want something to happen to the -- basically the panels that are no longer being utilized at the end of the project, correct?

A. Yeah. I think maybe it makes sense for me to -- I know a little bit about the motivations, and, you know, there's different motivations actually for this. I mean, one is -- as you identified, is make sure that there's not toxic materials going into the environment. I think actually in Europe, there are probably larger motivations around. One is simply the volume of materials because these are anticipated to be fairly large quantities when you get a few decades down the

road, and the other thing and as we talked about earlier, most of this material is stuff like glass, aluminum, plastics, et cetera, that we're all familiar with, and so it's mainly an issue just like in ordinary recycling about just reducing the volume of that stuff.

And then the other thing is that there are some high value materials contained in PV's, like silver, copper, et cetera, that, you know, people want to reduce the environmental impact by not having to continue mining, if you will, so much and having to extract so many new materials. So those are the other issues also involved in wanting to promote the recycling of PV's. It's not just about the toxic aspect.

Q. And there are other elements actually that could be within those panels that would also be concern, for instance lead, correct?

A. Some types of PV modules do have small amounts of lead, that's correct.

Q. All right, but you didn't tell us about that before. In other words, I'm trying to find out from you what would happen if the panels let's say were taken to a landfill because there is no bona fide recycling plan in effect for KDC or the other

basically installers. So if the -- if the landfill contained solar panels that are then broken --

MR. HALL: I object to the question. There's no testimony they could even take it to a landfill. So many things are regulated now. I don't know. It's far afield of what he's --

Q. So we illuminate Mr. Hall, in other words, these solar panels that you and the industry -- is one of the concerns in the industry at this time that these solar panels are being taken to landfills?

A. You're asking me?

Q. Yeah.

A. I think that, you know, it's a very, very case-by-case situation I think. I think that in some -- it's up to the people that are handling those panels. I don't think there's a general industrywide -- anyway, I'm not sure -- remember exactly what you just said exactly, but I --

Q. Is there a concern in the industry, just so we're clear --

A. Concern?

Q. -- about, yeah, recycling panels, in lieu of recycling, putting them in a landfill?

A. I think that there's -- the answer to

that would be yes because there's certainly some entities and so on in the industry that have concern about that. So yes.

Q. And then the group that we talked about before, which was the landmark or Hallmark Group Solar Energy Industries Association, do you know if KDC is even a member of that association?

A. I am not positive, but I believe they are.

Q. And you base that on what?

A. I believe I've seen their name on a list.

Q. Okay. And on the CEIA site, are you aware of the issues and policies section that deal with recycling, PV recycling, and what is being proposed in the industry?

A. I'm not familiar with SEIA's position. I'm familiar with some of the technical proposals that have been made by different organizations for accomplishing PV recycling and some of the initiatives that have been taken towards doing that, but I'm not familiar with the SEIA position.

Q. And you admitted before that with regard to the recycling situation that that is important because the materials that are in these panels

should not be left to either being exposed to the environment, including water, or any other type of situation where they're placed into the ground, correct?

MR. HALL: I object to the characterization of his testimony. I don't think he said that.

MR. SASSO: Well, he can tell us what he said.

A. Could you repeat that again, please.

Q. Yeah. In other words, the reason why recycling becomes important is that you don't want a situation where these panels are simply left on the property and could be, for instance, the glass broken, okay, and then the contents then go into the ground and contaminate the soil; how's that?

A. I think, you know, my view would be that the conscientious management of a project like this includes the decommissioning, which I believe KDC has already submitted a plan for. It's not unlike -- in my view it's not unlike any other aspect of something that we build in the environment. So building a house, whatever, if you left it derelict for a long period of time, you're potentially going to have an impact on the environment that's

negative.

Q. Right. And is this the first application you've worked on for KDC?

A. Yes, it is.

Q. Okay. Do you know anything about KDC's finances?

A. I do not.

Q. Okay. In terms of the element cadmium chloride, is that present in silicon wafer type panels?

A. Not to my knowledge.

Q. What other than the lead we talked about before -- and you mentioned one other thing -- what other possible elements are there in the solar panel at the end of its useful life?

A. Well, as I mentioned earlier, I mean, most of the degradation processes don't really change things all that much. They change things enough to affect the electrical output of a panel, but you still have -- the polymers are present I mentioned earlier in my testimony. You still have obviously the glass is unchanged pretty much. You have the aluminum. And that's -- when you talk about those three factors, you're talking about something like 98 percent of the weight of the PV

panel. And then, you know, the silicon wafers, themselves, are pretty much unchanged at that point in time. You have the small amounts of the metallic pastes that are on the surface of the cell, which things like aluminum and silver, and then you have copper ribbons and tin on the copper ribbons typically. So those materials would all still be present in the module.

Q. Okay.

MR. STRAKHOV: What about the boron and the phosphorus?

THE WITNESS: Yeah, those are --

MR. STRAKHOV: Those are so small that they don't count?

THE WITNESS: Very tiny. I mean, it's one part of a hundred thousand in the silicon so it's very, very small.

Q. Okay. How about gallium arsenide?

A. The modules we're describing will not contain that compound.

Q. Okay. Now, in terms of the testing that you described for us earlier in your testimony, you talked about testing of the panels in terms of what would happen in the event of, for instance, a failure, an electrical failure; is that right,

putting them into a high humidity?

A. Yes.

Q. Freezing?

A. Well, there's different -- yeah, there's different tests that are designed to -- essentially, it's called a qualification test to qualify the module for application, and so that includes these, you know, what we talked about the accelerated life testing, for example, where you cycle a module repeatedly between minus 40 and plus 85 degrees Celsius. That's one aspect of it. There's a cycle where the module is subjected to 85 percent relative humidity at 85 degrees Celsius for a long period of time, a thousand hours, as which point its electrical performance is measured, as well as the electrical isolation of the cell circuit. There are other tests where high potentials are applied to the frame and cell matrix to verify the integrity of the electrical insulation between those, you know, essentially the cell circuit. There are mechanical load tests where the module is subjected to various levels of force to simulate things like wind load and snow load. So those tests. And then there's also a test for hail, for example, which subject's the module to the equivalent of a 1-inch hail

strike. So all of the modules that are under discussion would have to pass all of those tests.

Q. Okay. Well, how about the catastrophic event that the Chairman was asking about. Are you testifying here tonight that the glass panels on the proposed solar panels, whatever solar panel happens to be chosen by the Applicant later, is impregnable?

A. Not at all. I mean --

Q. In other words, let's talk about what he -- the Chairman was talking about. We have another -- we have a hurricane with 120-mile-an-hour winds, and, you know, this is a -- Somerset County is a wooded mountainous area. If there were tree limbs, if there were things that get picked up in a hurricane, that type of storm, and it hits the panels, are you telling the members of the Board and the public that they cannot be broken?

A. Not at all.

Q. Okay. And if these type of elements went into prime farmland soil, just like any other soil, they would have the ability to contaminate it; would you agree?

A. Yes, I think if you put crushed PV modules into soil, you would consider that contaminated.

Q. Okay. All right. Now, being involved in this area for as long as you have, do you also take a look at and have an interest in any type of papers or treatises that come out with regard to the solar industry? And I'm going to ask you about a specific study. Would you agree with me that you find them interesting?

A. Of course, I follow the industry.

Q. All right. How about Silicon Valley Toxics Coalition, out of California, obviously. Are you familiar with the report they rendered in 2009?

A. I'm not sure. No, I don't believe I am.

Q. Okay. Are you familiar with that association?

A. Yes, I'm familiar with the organization.

Q. Let me just talk about a few things that are in there that I read.

MR. HALL: I'll object. He said he's not familiar with it so how can he answer questions about it.

MR. SASSO: He's familiar with the association. I can ask him about subject matter.

MR. COLLINS: Not the way that you phrased the question, so if you rephrase the question --

MR. SASSO: Sure.

MR. COLLINS: -- you might be able to proceed in general.

Q. Based on your knowledge in the industry as you come before us this evening, can you tell us whether or not this is correct or not, that current solar PV products contain many toxic materials that should not enter the waste stream when products are decommissioned. Do you agree or disagree with that statement?

A. I agree with that statement, but it's very broad so --

Q. I understand it's broad, but do you agree with the statement?

A. I do, yes.

Q. Okay. And when they talk about the panels containing many toxic materials that should not enter the waste system when they're decommissioned, what are they -- what in generally, based on your knowledge, what is that referring to?

A. Well, I think they're mainly, because of just you have to think back to sort of the timing of that and what was going on in Silicon Valley at the time, there were a lot of companies that were starting up in nonsilicon based technologies at the

time because silicon was actually -- let's say refined silicon was undergoing a very severe shortage because of the huge growth in global demand for PV's and a limited supply of that material. So what that created was tremendous interest in finding alternative semiconductors and especially in the Silicon Valley community where there was a lot of development, and you mentioned one of the companies that was involved in that, Solyndra -- there were many, many others -- and I think that as that was growing and that seemed to be a potential new area of industrial activity for the companies in that region based on their experience with things like flat panel displays and so on, they were looking to commercialize things like copper indium diselenide, which was, in fact, the Solyndra technology. Many companies were starting to try to commercialize that. There were other companies that were trying to commercialize high concentration photovoltaics based on things like gallium arsenide cells because these are opportunities or these companies believed there were opportunities for these very high technology materials to take their place in the industry and compete with the sort of mass produced silicon based technology.

Q. Including those from China?
A. Correct, yes.
Q. And you told us before that about 50 percent of the solar panels that are on the market here in the U.S. are made in China?
A. It's 50 percent on a global basis. I think it's probably slightly less here in the U.S. it's close to that.
Q. Yeah. I mean, China is producing about 50 percent of the panels throughout the world.
A. That's correct.
Q. And in terms of our environmental manufacturing requirements in the U.S., obviously, they don't -- they are inapplicable to those panels constituting 50 percent of the panels being distributed in the world.
A. They are -- they are not applicable in their manufacturing sites, that's correct.
Q. Right, that's what I'm talking about. Okay. I just want to ask you about a few other elements. They were talking about -- and you told us lead because in that Silicon Valley Toxics Coalition report they speak to -- and I want you to tell me --
MR. HALL: I object again to referring

to something --

Q. -- based on your knowledge whether it's true.

MR. COLLINS: Why don't you start over, Mr. Sasso.

Q. Are there companies, a significant number of companies that use lead in the manufacturing of the panels?

A. Yes.

Q. Okay. And out of the short list that you have from KDC or actually KDC Solar SI55, LLC, that any of those panels contain lead?

A. I don't know specifically.

Q. All right. So before you came here to tell us that this would be safe for Bedminster, you don't know whether or not any of the proposed panels contain lead, correct?

A. It's not clear. They may or they may not.

Q. Right, but they may contain lead.

A. Yes.

Q. And what's cadmium?

A. Cadmium is a heavy metal that's used in a number of different types of industrial things and manufacturing and some types of solar cells, but not

the ones under consideration here.

Q. Okay. How about nitrogen trifluoride?

A. Nitrogen trifluoride is an industrial gas. It's used in certain parts of PV manufacturing.

Q. And if a panel is broken, does the gas get released?

A. No, there's no nitrogen fluoride present in a PV panel.

Q. Okay. In terms of what is being proposed here, do you know which units on the short list have the manufacturers' warranty that they will take them back?

A. Well, as I was mentioning earlier, I mean, one of the companies, LDK, is a member of a group called PV Cycle, which is a European based organization of manufacturers that have agreed to take PV modules back, and so I would, you know, anticipate that they would have that ability or could have that ability in the future. I'm sure frankly that some of the others on the list do, too. I just don't know all the details on those companies.

Q. But you said before that's a minority of the companies.

A. Yeah. I think that you get different situations because in Europe where you have laws that are basically requiring the manufacturer of the PV product to take stewardship, those manufacturers are, in fact, doing that. I think here we don't have that kind of overarching law, and therefore, it becomes much more fragmented.

Q. Okay. As you sit here today, can you enlighten the Board in terms of any pending U.S. legislation that you're aware of that would compel companies like KDC 55 whatever it is to post any type of bond or anything else as to guaranteeing recycling at the end of the life cycle of the solar panel?

A. I'm not aware of it.

Q. All right. In terms of the manufacturers taking back the solar panels at the end of their cycle, would you agree with me that that is not going to take place if 15 years from now, 10 years from now, or even 5 years from now, the -- that manufacturer is out of business?

A. It seems obvious, yes.

Q. Right. Okay. And you said before there were many other companies, a couple answers ago, besides Solyndra that went bankrupt in the solar

industry, correct?

A. Yes.

Q. All right. That's all I have, Mr. Chairman.

THE CHAIRMAN: Thank you. Miss Donato.

CROSS-EXAMINATION BY MS. DONATO:

MS. DONATO: Should there be a microphone here?

Q. Mr. Rever, I am the farthest thing from a scientist so obviously you are quite a knowledgeable scientist, but I'm going to ask you some kind of fundamental questions because I don't really even know what silicon is. What is it?

A. Well, silicon is what's called a semi-metal. It's an element in the periodic chart that falls under carbon and basically has properties that in some ways are like metals and some ways are like nonmetals, and that makes it one of the most ideal semiconductors.

Q. Okay. Does silicon have any toxic properties?

A. Well, it depends. You know, like a lot of things, it depends on the physical form. So in the form we're talking about in a PV module where

it's a solid crystalline form, I would say the answer is no. On the other hand, you know, if you made a fine dust of silicon or something like that, you could create something that, you know, you wouldn't want to be breathing that for the rest of your life.

THE CHAIRMAN: Mr. Rever, just make sure you speak into the mic.

MS. DONATO: It's so awkward. I feel bad for the witness.

THE CHAIRMAN: Well, maybe Mr. Rever can turn around.

Q. So then other than the dust, is there anyway that this silicon can be degraded and enter into the environment?

A. Not easily because when silicon interacts with the environment, the first thing that happens is it forms an oxide, and that oxide is insoluble. Essentially, it's quartz. It's very impermeable. It doesn't easily degrade.

Q. Okay. Now, when you originally testified when you started this evening, you indicated that you saw a short list of panels that would be used.

A. Yes.

Q. And you said this is the same fundamental product.

A. Yes.

Q. So what's not the same about -- you know, they're fundamentally the same. What are the differences?

A. Well, you know, there's some sort of obvious ones, like there can be minor differences in the exact size. They're not exactly the same size. They're -- the cells may not produce exactly the same amount of power from one model to the next. The precise details of the way which individual cell or some of the materials are slightly different. They're slightly different uses of material in back sheets, for example, is a good example. Within a certain envelope, they're quite similar.

Q. Have you examined these specifications of each of the product types that are on the short list?

A. I've looked at them. Some of them -- I haven't memorized them is I guess the way I would put it, you know, so I know in general what's -- what they do, but I don't know all the details by heart.

Q. I'm most interested in the question of

the component parts, the materials that are used.

A. Okay.

Q. So with respect to the materials, are they fundamentally the same?

A. Yes.

Q. So what then are the differences in the materials?

A. No significant differences across these different makes.

Q. You said that the panels are then -- they have like a metal grid.

A. Yes.

Q. Okay. What type of metal?

A. Well, the cells, themselves, on the surface of the cells, there's a grid that's made -- on the front of it that's made out of silver paste, which has basically glass and silver put together into a frit, and it's fired under the surface of the cell. The back of the cells is typically an aluminum paste that's similar in structure. It's aluminum instead of silver.

Q. Okay. And are either of these products susceptible to any corrosion?

A. Not in a sort of -- not in the, quote -- I would say not under normal circumstances, but when

you -- if you had a moisture, for example, especially in the case where these things are illuminated so that creates electrical potentials, you have different to similar metals, and that can cause electrochemical action, and so in that circumstance, there is a degradation of some of these things or oxidation essentially reaction.

Q. Right. And isn't -- can aluminum degrade in a manner that it kind of gets a little dusty?

A. Yeah, and that's what I was referring to. That's an oxidation reaction from --

Q. So then if that were to occur, then that aluminum would then kind of leach off of the panel and go into the ground?

A. Well, we're talking about two different things. I was thinking about the cell. The module frame, itself, is also aluminum, but the aluminum on the module frame is anodized so that means that it's basically got a coating, which usually consists of an aluminum oxide essentially is anodization coating, and what that does is that is an impermeable material. It's because it's essentially it's already chemically reacted with oxygen. So in that case, you're not going to have a continuous

stream of that material coming off of the module because the aluminum is essentially inherently protected by its own oxide.

Q. And that oxide never deteriorates?

A. Well, it's a protective layer. It's not soluble. So it's one of the reasons why aluminum is such a good material for these types of things because once it has that oxide form, it doesn't continue because the oxide, itself, is a barrier.

Q. So you're saying that that oxide, the anodized --

A. Yes.

Q. -- aluminum aspect of it, that just never deteriorates?

A. Well, I will say that under certain, you know, you can have certain environmental conditions like a marine atmosphere where you have salt. Now, salt because it has chlorine in it can corrode aluminum, for example. So that would be an example where the aluminum would be -- you'd have to have the right alloy for a situation like that. This obviously is a not a marine situation so you don't need anything special like that.

Q. Okay. Now, when you were describing the components of a typical PV module, the first thing I

really -- again, this is something I just do not really understand or know what it is. You said there was a certain type of glass that it was.

A. Yes.

Q. What is the type of glass that you indicated?

A. Well, it's low iron is the key attribute of it so it means that it's high transmissivity, and that's basically going to increase the performance of the panels. It's also tempered glass so that makes it much, much stronger than an equivalent thickness of nontempered glass. It's roughly 6 times stronger than an equivalent thickness of nontempered glass.

Q. Okay. So what is put into the glass to make it tempered?

A. Tempering is a heat treatment process.

Q. That's all?

A. Yes.

Q. Okay. All right. So you said it was 75 percent glass, right?

A. By weight, yes.

Q. By weight.

A. Yes.

Q. Not by content.

A. No, that's -- I mean --
Q. Well, it's kind of like if you read the ingredients on a label of food --
A. Yes.
Q. -- and it doesn't tell you how much weight is in each of it. It just says the percentage of it. So this is all by weight. I just want to clarify?
A. If you looked at -- if you had a food labeling agreement on a PV module, the first thing would be glass.
Q. Okay. But you gave us these numbers. These numbers are by weight.
A. Correct.
Q. Okay. Then you said it was 10 percent aluminum?
A. That's correct.
Q. And you said it was 6 percent polymers?
A. Polymers.
Q. So that's a total of 91 percent, right?
A. Right.
Q. So you said the other 9 percent --
A. Wait a minute. Let me do the math here.
Q. Seventy-five plus 10 is 85 plus 6 is 91.
A. Right.

Q. So where is the other -- what's the other 9 percent?

A. Well, you've got things like the module junction box, for example, which is itself another type of polymer, but it's a plastic. You've got the silicon solar cells, which roughly -- I'd have to -- again, I'd have to do the math. So the silicon would be the next element after the polymers in terms of total weight. Then you'd get to probably the copper bus bars would be next because copper is quite a dense material so it's got a lot of weight, you know, and then you get into sort of things like the aluminum pastes and the things like I talked about earlier, silver.

Q. Has what you have described that constitutes the total of that remaining 9 percent in weight?

A. We just talked about all those things.

Q. There's nothing else?

A. No.

Q. Nothing else. Well, because in response to a question from Mr. Sasso, you said you didn't know if there was any lead.

A. Well, there could be. I mean, some modules use lead in their -- in the soldering on the

rivets.

Q. Isn't that common practice to use lead to solder electric?

A. It's a mix. I mean, there are some that don't use it and some that do. So it's not clear whether it's used or not in these specific models.

Q. So in your examination of the specifications of the short list --

A. Right.

Q. -- there was no disclosure as to the presence of lead?

A. No.

Q. Is there any requirement for the manufacturer to disclose the presence of lead?

A. I'm not aware of that, actually.

Q. All right. Now, let's assume that I were to ask you based on food labeling approach, there's some things like you know the old joke, what's heavier, a pound of lead or a pound of --

A. Right.

Q. -- feathers, okay, is there anything that doesn't weigh much or negligible weight that is in the PV module that is not disclosed in the weight list?

A. I think we've pretty much covered them

because when you get into like, for example, the lead that's -- when you get to the lead that's on the solder, I mean, you're talking about something that's on the order of 12 -- for those that are using lead, something like 12 grams. So it's like a third of an ounce per module so it's not a very high number, but I think we've kind of talked about all those.

Q. Right, but you're aware of the health concerns regarding leaded paint, right?

A. Of course.

Q. So do you know how much lead is in a gallon of leaded paint?

A. I don't. I'm sorry.

Q. No, you don't. So you don't know that they make people take lead off of windows --

A. Of course.

Q. -- painted windows, maybe far less than what you're indicating.

A. Sure, sure. I guess I would argue that it's kind of a -- it's a very different situation.

Q. Well, it isn't a different situation, is it, if the panel were to somehow become broken.

A. Right.

Q. Would become damaged in some way,

whether it was catastrophic or not, that this lead would then come into what is essentially a fairly pristine environment here.

A. It takes action beyond that I guess would be my response. In other words, you've got to have something that's going to actually have a chemical action with the lead so it begins to come out of the PV module. I know in many cases -- I don't know in New Jersey specifically, but I know in many cases, you know, PV modules are not considered hazardous waste, for example.

Q. If it has lead in it, it's still not considered a hazardous waste?

A. No, it depends on the details.

Q. Right. The devil's in the details.

A. The devil's in the details. There's actually a test because I know because we used to make PV panels. There's actually a test called the TCLP test, which basically tests for leaching, and depending on the exact details of what you're doing and whatnot, you may or may not pass that test, even if you have lead in the product.

Q. So is there a TCLP test for what is being proposed here so there could be some assurance as to this -- does T stand for toxicity?

A. Yes, it's -- I'm sorry the acronym eludes me, but it's a test that involves testing things for leaching out of toxic materials, and, you know, so typically, if you're going to put something into a waste stream, it's one of the things that -- it's a test that you would do on something.

Q. All right. You referred to top tier manufacturers that are -- of these PV modules that are certified to certain standards.

A. Correct.

Q. That -- you did say that, right?

A. Yes.

Q. And did you say that all of the models under consideration meet these standards?

A. That's correct.

Q. What is this top tier?

A. In round -- in the general description, these are the largest manufacturers typically. So they're the ones that, you know, frankly have usually the best combination of performance at the product level and value, as well.

Q. Okay. Now, you also said that all of the models are under consideration. Okay. Is there any other model that's under consideration?

A. I can't answer. I'm not privy to that.

Q. Okay. So it's your understanding that there is no choice other than this short list. That's your testimony is based on that?

A. Yes. I mean, what I've -- I've been told that there's -- these are the ones that are under consideration, and, you know, it makes sense to me that they would be.

Q. But I think it's the ambiguity of the term under consideration.

A. Yes.

Q. I think I'm looking for -- I'm trying to find out from you if there's something more definitive than under consideration.

A. Unfortunately, I don't think so because I don't believe that the actual full design -- there has not been that level of full design on the system where a specific module would be selected and a specific -- the process hasn't gone that far.

Q. And you did say that you would provide certain spec sheets that I think one of the Board members asked you said you would supply?

A. Standards.

Q. What is it specifically, the standards?

A. I think what was asked for was the standards.

MR. HALL: You mentioned two of them is my recollection.

A. Yeah, IEC 61215 and IEC 61730.

Q. Okay. All right. Now, there was something I didn't understand. In response to the question from the Chair regarding potential impacts from some type of catastrophic event, you then said there is less than a .1 percent return rate.

A. Correct.

Q. What does that have to do with a catastrophe? Did I misunderstand something?

A. Well, I think what I was trying to provide some information on is just how likely is it that these things are going to fail or break, the, quote, infant mortality of these things, and I think that's, you know, that's -- so my experience both in -- as being part of a manufacturer and also now outside of that and seeing the numbers from other manufacturers is that, you know, that's a fairly representative kind of number that -- in other words, there's a very, very few modules that get out of the factory gate that don't perform correctly when they're first installed.

Q. So but you're talking about being returned for a warranted defect; is that correct?

Is that what you're referring to?

A. Yes, but it could be, you know, something breaks or something like that. So I'm kind of basically saying that, you know, you're going to have to have a -- and I could go into more details about these particular qual standards. I mean, just to give you an example, the modules under consideration here pass a load test that is -- that is equivalent to 112 pounds per square foot of load. That's pretty intense. I mean, that's equivalent to something like 30 foot of snow or something. I mean, these are intense levels of stress that are applied in these tests, you know, and so I just wanted to convey that we are really talking about, you know, Armageddon if you have an entire PV array like this destroyed by some kind of environmental situation.

Q. But you're not suggesting that a solar operator would return a solar panel to the manufacturer if, you know, a 200-pound weight fell on top of the panel --

A. No.

Q. -- and broke it so it -- there was a disconnect between that topic. I just wanted to make sure. Okay. Are you aware of the fact that

there's an airport in close proximity to this property?

A. Yes, I am.

Q. Do you know how many flights a day?

A. I do not know.

Q. Would you be surprised to know that there's about 80 flights a day?

A. I'm not -- sorry, I'm not familiar with the area so I don't know.

Q. And I presume then that you're not aware of the fact that there have been several crashes involving that airport over the years, small airport?

A. No, I'm not.

Q. And do you know that there's a big hot air balloon festival that's like the biggest I think in the whole east coast or something in close proximity?

A. No, I did not know that, no.

Q. So if a plane fell on this solar array, that might be one of the type of solar events that the Chair was referring to?

A. Sure, but I think again, like we're talking about literally acres and acres of PV panels. It would take out a certain section, but

it's not going to take out the entire array.

Q. Okay. Well, if -- has there been any incidents where there's been a fire or some type of a catastrophic event where it then becomes a conflagration for the entire solar array or a larger portion of it than what was originally -- I mean, fire does have a tendency to spread.

A. It does. I've not heard of that in these types of systems. You do hear sometimes of fires in buildings with the solar, but you've got to be careful because sometimes it's not even the solar that's, you know, that's causing the fire. It's --

Q. Right, and I know that firemen have had trouble getting access because of the panels on the roofs and the disconnect systems that they have now.

You know that there's been a proposal by the Applicant to plant certain types of grass is under and around these panels?

A. Yes.

Q. So you know what happens to the grasses in the fall, how they dry out. So have you taken that into consideration in looking at potential of fire affecting these panels?

A. Well, yeah, I think, you know, that certainly is an issue, but I think that the first

step, like any kind of fire prevention, the first step is preventing it in the first place. So that's things like modules that meet these standards. It's the system design being done to the best industry practice because the fires are, you know, fires and PV are not normal by any means. They're caused by the improper installation or, you know, sometimes materials and workmanship at the module level, but that's why it's important to choose things that follow these certifications and so on.

Q. Well, do you think the manufacturers considered in their testing that you would have this meadow grass that dries out, becomes dry and very flammable at the end of a summer or even potentially in the summer where you have drought conditions, have they considered the possibility of fires under these panels then spreading through the grasses, the dry grasses, and its effect on the panels; has that even been anything they tested?

A. Well, PV modules do have to pass a fire test. I mean, the second standard I cited was -- includes a fire rating. So, yeah, it's normally something that is done, but I'm not sure about the specific situation, you know, that you've talked about, but there's a lot -- obviously, there's a lot

of PV panels installed on buildings so there's a very high concern for, you know, reducing to absolute minimum the chance of fire because of risk to property and life.

Q. But if one were to examine all the New Jersey codes that are applicable potentially or actually to the installation of the solar panels, is there anything that really addresses that situation?

A. I'm not aware of it, but I have to say it's not my specific specialization.

Q. Okay. I'd like to just touch again on this electronic, the waste. You acknowledged that there is a kind of a global problem with the disposal of electronic waste.

A. Absolutely.

Q. Okay. And so it is not required in the United States that there be any recycling for these panels; am I right?

A. That's correct.

Q. And you indicated that it's the anticipation of the industry that recycling the occur, right?

A. I think most people are sort of figuring that it's a classic thing, that until there's a market, you're not going to have providers coming in

to fulfill the need, you know, so there's no -- there's such a small market.

Q. So there may be a need, but if there's no requirement, someone doesn't really have to recycle the panels.

A. That's true, but I think without getting into a long treatise, I think that what people are anticipating is that as these processes get developed and honed that, you know, it will be something where the cost of sending a panel to a recycler will be lower than the cost of landfilling it, and I think -- I actually think that's likely with some development. So I think it's not necessarily going to be the same economic choice we have today.

Q. So but either of those choices, sending it to a landfill or recycling it, is going to be dependent on a municipal requirement for decommissioning that is backed up by some kind of monetary bond or some other security. Otherwise, it's the choice of the --

A. Probably. It's -- I mean, it could be any of our different levels of government, but yeah.

Q. So if that were not done, it would kind of be like the anticipation of the nuclear industry

since post World War II that we were going to have someplace to dispose of the radioactive waste. We don't to this day, do we?

A. I'm not sure I want to take the analogy there.

Q. It's waste. It's just maybe far more toxic or --

A. Hazardous.

Q. -- hazardous, but it still has -- the industry certainly thought there was going to be a method to dispose, didn't they?

A. Sure. I guess the way I would put it is that to me a crystalline silicon PV module is more like a car windshield or, you know, the glass that's in the side of an office building or these things that are really common in our lives. So I don't -- I think that, you know, again, to what degree is the siding on your house recycled when you do a remodel or whatever. I think it all falls into sort of the same deck. These are items that from a societal viewpoint, it would certainly be good if we recycle these things, but it depends on the right policies being in place to make that happen.

Q. And 75 percent is the glass. The rest of it is something else --

A. Right.
Q. -- potentially some lead, as well.
A. Right.
Q. Okay. Now, you indicated that the interconnection to the cells that, you know, that that's where they scan them?
A. Uh-huh.
Q. To detect hot spots?
A. Correct.
Q. What's a hot spot?
A. Well, basically, when these things are under operation, you have electrical current flowing, and so a place where you have more resistance in that circuit is going to get hotter; therefore, it's a hot spot.
Q. So when do they find out if there -- and if it's a hot spot, then it's something that's more likely to cause electrical fire; is that correct?
A. Well, it could. You know, it depends on how hot it is.
Q. So when do they perform this scan to see if there are any hot spots?
A. They can be performed at almost any time.
Q. And when you have a product that's out

in the open subjected to the weather for, you know, I guess for 25 years let us say, so is it more likely they might develop hot spots as age approaches and corrosion occurs?

A. Yes, yes, absolutely.

Q. So there -- would there be some recommended regular testing for hot spots?

A. I would say that the norm is that it's only under an off normal condition so like if you start to see a power loss, because the same resistance increases that occur in the circuit, they're going to diminish the power. Literally, the power is being dissipated in these places. So typically with monitoring, you're going to start to see a loss of power and, you know, so the normal practice would be that when you have a loss of power, you go in and you diagnose it, and that would be one of the methods that would be used.

Q. So in order to effectuate that safety concern, it would be dependent on the integrity of the operator to say there is a loss of power and I better take a look at what this is.

A. Yes.

Q. I'm making sure I don't ask anything that Mr. Sasso asked. At least I'm trying. You

said that the solar industry has had turmoil.

A. Yes.

Q. What did you mean by that?

A. Well, there's been a period of very rapid change in -- across all different parts of the value chain. I mean, overall it's enormous amount of growth, but there's been a lot of, to quote Professor Schumpeter, created destruction, so there have been entities that disappear and there have been entities that appear, and the industry as a whole has grown, and it's maturing and so on, but basically there have been entities that disappear.

Q. And it's really grown because of the impetus to try to provide an alternative energy source, right?

A. Yes.

Q. Policy basis government has encouraged the installing of solar. As you know in New Jersey, they made it inherently beneficial. They said these panels aren't impervious. So they did all these things to encourage it. So they give grants, they give money.

A. Yes.

Q. How much do they regulate the industry?

A. Well, I think it's under the same degree

of regulation as many other industries.

Q. Well, do they do a cradle-to-grave analysis of the impact, the environmental impact of the manufacturer, installation, and disposal of solar panels?

A. No, I'm not aware of that.

Q. Did they require recycling of solar panels?

A. No.

Q. Did they prohibit the importation of solar panels that had this celluride or -- whatever that is -- cadmium telluride I think?

MR. HALL: Excuse me. Can I have a clarification of who they refers to.

MS. DONATO: The government.

MR. HALL: Are you talking about New Jersey, the federal, the world?

Q. Is there any regulation, either federal, state, local government, that said you can't import these panels with cadmium?

A. In the United States, I don't believe so, no.

Q. Now, you kept referring to commercial life. Do you mean the life of the lease?

A. Well, I mean the core commercial aspect

of this is the sale of the power. So my understanding is -- and again, this is only I know just from background -- is that it's 15 years in this case. So there's a 15-year agreement to sell that power to Sanofi.

Q. So there's like at least a 25-year warranted life.

A. That's correct.

Q. That will produce electricity for 25 years.

A. That's the expectation.

Q. So what happens to the next 10 years? Let's say Sanofi decides to close up shop there and doesn't want to stay there any more in what's that, Bridgewater I guess it is?

A. Then they would have to follow a decommission.

Q. Have you examined this township's ordinances regarding decommissioning?

A. I have not.

Q. What are you familiar with in terms of -- when you say decommissioning, what do you think would -- what is required in your knowledge?

A. Well, I believe KDC's filed a plan on this, and they have a standard that they follow in

other sites, which is what they plan to follow here. It basically means removal of all the equipment from the site and restoring it to its previous condition.

Q. Other than being a promise, is there any enforceable mechanism to assure that that promise is fulfilled?

MR. HALL: If you know.

Q. If you know, of course.

A. This is beyond my knowledge.

MR. HALL: That's what I was trying to get to.

A. It's a commercial aspect.

Q. That's fair.

MS. DONATO: I don't have any questions. Thank you.

THE CHAIRMAN: Mr. Rever, could I just ask you one follow-up question.

THE WITNESS: Sure.

THE CHAIRMAN: Mr. Sasso asked you a question earlier about -- and I want to make sure I have it right -- if modules would be crushed into the soil, you responded to him that there would be some level of contamination.

THE WITNESS: Yes.

THE CHAIRMAN: I'd like to follow up on

that and try to understand what you meant by that.

THE WITNESS: Sure. I guess, you know, kind of going back to my earlier statement, I think if you, you know, crush up a bunch of automobile windshields and put them in the ground, you'd have a contaminated place. I don't think that -- again, in my mind, there's materials that you're not going to normally find in soil in there. There's nothing specifically that's going to be an enormous, you know, toxic kind of issue on any kind of short-term, you know, even significant basis, you know, but I think -- I'm just being logical -- you've got, you know, plastics, you've got glass. You know, it's going to be a bit of a mess, you know. You're not going to want to leave it there. It might over some really, you know, geological time period degrade into something, but it might take that kind of time frame.

THE CHAIRMAN: Thank you. I appreciate that. Okay. Let me ask the audience if there's any citizens that would like to come up and question Mr. Rever. The process is -- sure. Come on up, ma'am. The process is you'll come up, you'll get sworn in, you'll state your name and address, and we would ask that you try and focus on questions that haven't

been asked of the witness by our attorneys and the Board. We think that would be the most efficient.

MS. FORT: I'll try not to.

THE CHAIRMAN: Thank you, ma'am.

MS. FORT: Susan Fort.

S U S A N F O R T, sworn.

MR. COLLINS: Please spell your last name.

MS. FORT: Fort, F-o-r-t, 210 Country Club Road.

Michele, thanks for asking about the airplane because that is such a huge consideration to us, and also the helicopter that comes several times back and forth. What I'm confused about, if you have this large array of solar, I'm not satisfied at all as to what happens if there's a fire or a plane or something lands in the middle of the field. I have friends that happen to, you know, work in fire departments in very near townships, and they tell me when they get to a home and it has solar, you can't turn off that solar so they can fight the fire, that it is stored in these panels. So now if they see a house with solar panels, the terminology is let it burn. And what happens when

we have woodlands? We have, you know, our homes very close to all of these panels. I don't at all feel satisfied with how you can tell us they're going to be put out as a solar expert. It's been dodged all night long.

THE WITNESS: To be perfectly honest, I don't think anybody has asked that, so thank you for asking a different question, but in all seriousness --

MS. FORT: I think Michele was definitely asking that. I think she was very much referring to if a plane crashes, what happens.

THE WITNESS: So I think in terms of fire suppression, you know, there's a big distinction between a PV array on a building and a PV array on a field, and the main distinction, in a PV array on a field, you can extinguish the fire without coming up through the array. You can pump water onto the --

MS. FORT: And how does the fire department do that if it's this big a field and there's panels all there? How does the truck get in there? I don't understand that. If a plane is in the middle of this solar field, how do you get there? You just try to shoot the hose real hard?

THE CHAIRMAN: I'm not sure he's the fire expert.

MS. FORT: I know, but he's a solar expert.

THE CHAIRMAN: But I'm not sure he's the fire expert.

THE WITNESS: I think this is, you know, probably beyond my knowledge at this specific site and plan, but, yeah, it would be that basically you would project out a stream of water and get it onto the combustibles, and you would certainly, you know, surround whatever the fire area was.

MS. FORT: So you're telling me that a fire department can put water on these panels without any kind of issue, because local townships around here, they won't do that. They're afraid of being electrocuted, themselves.

THE WITNESS: I'm sorry. I'm not an expert.

MS. FORT: Okay. Well, it is out there, and I just want to bring that up.

It's very hard for us to ask direct questions to you because I feel like we've been so generalized on the information that we've been given. For instance, this evening, there's a list

of solar companies, so it's hard for us to do our research, but I want to go back to when this all started -- you rung a bell so hard in my head -- that I read there's a dust particle that comes off of these panels, and they're not only extremely dangerous to people that have any kind of breathing or lung issue, that they can also cause lung infections and lung cancers. What can you testify about that as the expert?

THE WITNESS: That does not strike me as correct in terms of the finished module, itself. There are certainly certain parts of the PV manufacturing process where, for example, silica powder is used to make crucibles where the silicon is melted, but that material is not present at all in the finished PV module.

MS. FORT: Okay. Again, it's very hard because we don't know the exact solar panel, but in my research, I definitely read that, and --

MR. HALL: I'll object to the testimony as part of the question.

MS. FORT: I'm not being testimony.

MR. HALL: You are, you are.

MS. FORT: I'm questioning him.

Secondly, I've also read that insects multiply and

their reproductive cycles are interrupted so that if they normally hatch a million eggs a month, they are now multiplying to like 3 times as much or 3 million a month, and that is from these panels being put on fields like this. Could you tell me anything about that?

THE WITNESS: I've not heard that phenomenon.

MS. FORT: Okay. Again, it's research we have done. And I find it very unsettling that you said it's not going to be an enormous toxic mess. What is it going to be, just a little toxic mess?

THE WITNESS: Well, I guess where I'm going with this is it's all relevant.

MS. FORT: I guess it is relevant unless you live there. Then it becomes very relevant. So that --

THE WITNESS: I would argue that you've got -- I'm going to argue that a standard home you've got more toxic materials than you have in an equivalent plan area.

MS. FORT: I don't think any of that's been proven, but that's all opinions.

Last but not least, I want to ask the

Board -- and it is a little off the subject -- but we have gone to the township numerous times, at least once a month. For the last year and a half that KDC has been leasing this piece of property, we have watched it completely disintegrate. We have begged them to mow the lawn every single month through last spring. We can't get them to mow the lawn. We -- I know they have put cameras up recently, but we've had all summer long people knowing that the property is an abandoned piece of property and going behind the buildings and parties or doing whatever. I know they put cameras up, but we've had a lot more police action in our neighborhood because it looks like an abandoned building and it's not maintained. That affects me and my safety in that neighborhood and anybody else that lives in Bedminster, and I beg this Board to fine them or do something where they are forced to maintain it. If I grew my grass as long as they have and maintained my home like they did, I think I would have a problem, and since the day they, you know, they paid no respect whatsoever to the piece of property, and I can't imagine what they would do once they have the project down and the money in their pockets. Why would they have to care then.

That's all I have to say.

THE CHAIRMAN: Thank you. I'm sure if I was a neighbor, I would be --

MS. FORT: I'm very disturbed. And the township's doing nothing.

THE CHAIRMAN: I'm not sure that -- Mr. Ferriero can certainly --

MR. FERRIERO: Just to be clear, the township --

MS. FORT: I don't mean to say you're doing nothing, but I don't feel like --

MR. FERRIERO: The township does not have a property maintenance code. If you grew your grass long, we couldn't come out and give you a summons. We can't give them a summons for that. The zoning officer has made contact and has requested that certain things be done, and some things have been done, but the ordinance in the town is very limited.

MS. FORT: As you can see, we have police, you know, action and things that we have never had in that neighborhood before, and at least in my opinion, it's because of the way the piece of property looks, and it looks abandoned. There's not a light on ever in the house. There is nothing on

that piece of property that makes it look like anybody is paying attention to it.

MR. HALL: And that might change if we're allowed to build our project.

MS. FORT: Well, then it might not. You might just walk away, as well, and say I've got the money and who needs to do anymore.

THE CHAIRMAN: Well, it's unfortunate that the Kirby property has been disintegrating over the years. It's a shame for the town, and I feel for you, and I know if I was sitting there --

MS. FORT: Every day I open my window, I have to look at that building, and it's boarded up windows, and I know that was part of the regulations, but consider that when you consider --

THE CHAIRMAN: I wish --

MS. FORT: -- the plan or the application because it's been an eyesore for all of us.

THE CHAIRMAN: Understand. We appreciate your comments. I know that I -- and Mr. Ferriero has commented. Unfortunately, we just don't have the capacity as a board to go to any applicant and tell him to take care of property, or any citizen. It's really hopefully a

self-responsibility that they have.

MS. FORT: And I agree, and I feel a sense of pride --

THE CHAIRMAN: You should.

MS. FORT: -- by living in this township and maintaining my property, and like I've spoke before, having my children help maintain it, and it is a family effort to do that, and it is a slap in the face to have somebody across the street that is applying for something and is an application that -- they wouldn't want to set an example of how they're going to maintain it. You could see the way they will maintain it. That just speaks for itself is all I want to say.

THE CHAIRMAN: Understand, ma'am. Appreciate you coming up. Okay. Mr. Hall, let me ask you, what would you like to do next. Do you have another witness?

MR. HALL: Yes, we have --

MR. COLLINS: Are we done? Is there anyone else?

THE CHAIRMAN: I'm sorry. We have more. I didn't realize. You just need to then raise your hands and come up. We'll take -- Joe, why don't you come up and introduce yourself. I'm sorry, I

thought we had nobody else.

MR. CIRONA: Joe Cirona, Country Club Road, Bedminster.

MR. COLLINS: Joe, were you previously sworn in this case? You're still under oath.

J O S E P H C I R O N A, having been previously sworn, resumed.

MR. CIRONA: I'm sorry, I got here a little late. I didn't get your name.

THE WITNESS: Bill Rever.

MR. CIRONA: Okay. First of all, not required to cleaning the panels that in this area is not that much effect on them. You wouldn't want to tell my wife that.

THE WITNESS: Do you have one on your house?

MR. CIRONA: No, just the windows.

THE WITNESS: Oh, okay. Yeah.

MR. CIRONA: Something else that the Chairman had referred, you know, about something catastrophic happening to the panels. I don't think it was fully addressed, you know, to some extent, and what would happen with the toxic whatever anything into the soil, but --

THE WITNESS: I guess my -- let me be more clear about that. What I was saying is the panels are -- even panels that have -- that might contain lead on the solder, for that to begin to go out into the environment requires a process and requires some of the acid rain hitting the broken -- so that can get into that and start that process.

MR. CIRONA: Which we have.

THE WITNESS: It takes time so this is not something where it's not like a canister of gas that you puncture, and boom, it's all over the place. You know, if you had a situation where like an entire array was destroyed or even a small portion of an array, you could clean it up, and, you know, there's really going to be no immediate impact because it takes time for these processes to happen, these chemical degradation processes to begin to act on these materials and leach them out. So it's really a matter of, you know, acting on that catastrophe and cleaning it up, basically, but it's -- there's not going to be any immediate impact from that.

MR. CIRONA: And I understand what you're saying. What puzzles me, if I buy one of the new bulbs and they tell me don't throw it in the

garbage, you got to bring it back to where you bought it, a bulb, a bulb compared to a panel or panels, and to bring a bulb back. What about these panels?

THE WITNESS: Well, you'd be surprised. You're talking about different strokes, as the saying goes. I think the bulb you're talking about, talking about CFL's you're talking about that contain mercury, that's a different thing. It's a gaseous form. It's a really different animal, you know. We're talking about something that's really --

MR. CIRONA: Imagine how many people bring them bulbs back to the store?

THE WITNESS: Yeah, yeah.

MR. CIRONA: That was my only. The other thought I had also was on these -- the electricity flows from the panels to the --

THE WITNESS: Combiner boxes.

MR. CIRONA: The boxes, okay. I know there are places where these panels and these boxes, same set up, the noise level, the humming is 24 hours a day, day and night. That's a lot of noise.

THE CHAIRMAN: Mr. Cirona, do you have a question for the witness?

MR. CIRONA: Well, I don't think we addressed that at all.

THE CHAIRMAN: That's not his area of expertise.

MR. HALL: That's our next witness.

MR. CIRONA: Sorry about that. That was it.

THE CHAIRMAN: We appreciate it, sir. Thank you. Is there anybody else that has any questions? If you do, come on up.

MR. YINGLING: Jeff Yingling, Country Club Road.

MR. COLLINS: You're still under oath.

J E F F Y I N G L I N G, having been previously sworn, resumed.

MR. COLLINS: Just spell your last name again.

MR. YINGLING: Sure. Y-i-n-g-l-i-n-g.

Mr. Rever, question. You mentioned that the panels collect the energy from the sun, feed the energy then to an inverter, converts from DC to AC power, converts through a transformer, increases the voltage, three inverters on site, two transformers to split the power. Why would the power need to be

split?

THE WITNESS: My understanding is that because of the feed into the utility grid, basically they want to have it split up in different feeders. So it's -- I think I'd probably defer that to the engineering firm. I think that's my understanding.

MR. YINGLING: Because previous testimony indicated that the power was going to go directly to KDC and that was the extent of it. It wasn't going back to the grid.

THE WITNESS: I think that --

MR. HALL: You mean Sanofi.

THE WITNESS: Sanofi. It is going to the Sanofi main power, but the issue is it's a grid interactive system. So if you had a situation like Sunday afternoon on a bright spring day or something like that, there is going to be some energy potentially flowing back out onto the grid. So in that circumstance, they want to have it balanced. But I'm sorry. I'm not an expert on all that detail. I'll defer -- maybe be better if you asked the engineering firm.

MR. YINGLING: So that similar question, so say 5 years down the road when Sanofi is gone, all that excess power will go back to the grid

forever?

MR. HALL: If you know.

MR. YINGLING: If you know. In theory.

THE WITNESS: In theory -- no, it's not -- well, they would have to have a different commercial arrangement from what they have today.

MR. YINGLING: But essentially, the system wouldn't just be -- if Sanofi moved out, the system -- somebody wouldn't come out flip a switch, and turn the solar farm off?

THE WITNESS: Yeah, they would have to. Sorry, I'm getting out of my expertise. I'm going to say I don't know.

MR. YINGLING: Thank you.

MR. COLLINS: Whoa, whoa, whoa. Now that can't be totally outside your expertise so you're going to have to explain your answer better than you just did.

MR. HALL: Well, I think he was -- they always ask about the business arrangement.

MR. COLLINS: Stay on the question. The question was I think if Sanofi wasn't operating there, the power would automatically go to the grid. That's basically what he was asking you, and you said that's not within your expertise, but that is

within your expertise, isn't it?

THE WITNESS: Well, you know, the commercial --

MR. COLLINS: You know about --

MR. HALL: But that assumes another occupant wouldn't take the power instead. How does he know that?

MR. COLLINS: Well, but he knows --

MR. HALL: Has nothing to do with --

MR. COLLINS: He knows enough about the system of New Jersey's power supply to know that this is net zero.

THE WITNESS: I guess what I was alluding to is that --

MR. COLLINS: Net zero meter.

THE WITNESS: Yeah, I just -- I don't know -- you know, it's a kind of hypothetical situation. I don't know enough about, you know, what they would do commercially, you know, under that circumstance.

MR. COLLINS: But your understanding about this project is that this electricity is being generated to solely serve the Sanofi property --

THE WITNESS: Yes.

MR. COLLINS: -- in Bridgewater. That's

your understanding, isn't it?

THE WITNESS: Yes.

THE CHAIRMAN: But then you said the infrastructure is in place to go directly to the grid, right, should you flip a switch. That's what you said.

THE WITNESS: What I meant was, obviously, Sanofi is connected to the grid. So under, you know, under conditions where there's a flow of energy back and forth that, you know, the grid -- you would want to control where that goes.

THE CHAIRMAN: I think a bigger question is under oath at some point we're going to need to have your witnesses be very clear, Mr. Hall, about the application here because the intent early on was to be very specific to Sanofi, and we're starting to hear comments, even though it may not be your intent to comment, but the comments that you're making are a little troubling because it talks about power being fed back to the grid, maybe bought by the grid in days when Sanofi may not need it, or it might be split to the grid if there was a sunny day and there was excess power. It's not important right now, but, Mr. Hall --

MR. HALL: From the beginning we said

that. By definition a net meter project is you -- this was the testimony way back when. It's been a long time. The total production of the solar facility can't exceed the total annual use --

THE CHAIRMAN: I understand that.

MR. HALL: -- of the receiver, which means on a hot summer day, which somebody mentioned, the solar field's producing more power than is being used, and by definition under net meter, the excess goes to the grid.

THE CHAIRMAN: I understand. I just think at some point through this hearing process we're going to need to have --

MR. HALL: That's fine.

THE CHAIRMAN: -- the commercial experts, the planners really talk about this a little bit.

MR. RODELIUS: And he also said at the end of 15 years it certainly could go into --

MR. HALL: Excuse me?

MR. RODELIUS: He also said that if the lease was up, it could go there, too.

MR. HALL: I don't think he said that.

MR. RODELIUS: I have one other question.

MR. COLLINS: I think there was a statement in the course of testimony about that. At the end of 15 years it could go to the grid. Maybe you could help us understand.

MR. HALL: We'll clarify that. I think that's a business issue.

THE WITNESS: If I said that, I didn't mean to say that.

MR. RODELIUS: Mr. Rever, thank you so much for your expert testimony. I just got a question kind of in a general sense. You wrote a paper called Economic Optimization of Building Integrated Photovoltaic Systems.

THE WITNESS: I did.

MR. RODELIUS: I just had a question about one of the things you mentioned in the paper. You said that rarely would a ground mounted array be considered against a roof mounted one, and I just -- what is the rarely there?

THE WITNESS: I'm sorry, you're stretching my memory. That's from 1996, I believe.

MR. RODELIUS: That's why we hate to write things. So in essence, you're saying that rarely would a ground mounted array be considered against a roof mounted one.

THE WITNESS: I guess I --

MR. RODELIUS: I'm just -- what type of situation would that be?

THE WITNESS: Gosh, I'm trying to remember. I think what I was really referring to there is that it's not very common to have a situation where a ground mounted array and a roof mounted array are options under consideration on the same project. You know, usually, there's a constraint where you've only got the roof and that's the only place you've got to work with, or you've got land, and if you've got land, you know, then you're going to go for a ground mounted array typically or potentially even both. I've seen facilities where you've got ground and roof in the same mount.

MR. RODELIUS: The ground could be a parking lot, too.

THE WITNESS: The ground could be a parking lot. So, sorry, it's been a long time since I looked at that, but I think that's what I was referring to is it's not common to have a choice of those for an equivalent project.

MR. RODELIUS: But when you do have a choice, rarely would a ground mounted array be

considered; that's what you said, right?

THE WITNESS: I hate to say it, but I don't really remember. I think the context of that article was really -- or the paper -- was really talking about building integrated photovoltaics, and I think in that context -- but it's a long, long time ago, and, you know, so there's different economic conditions for PV's today than there were in those days, really very different, and I think I was looking at with the economics of that time and PV modules were, you know, 5 to 6 times more expensive than they are today.

MR. RODELIUS: What are the differences in the economics today?

THE WITNESS: Very, very different situation.

MR. RODELIUS: Legislation, how does that affect the economics?

THE WITNESS: Significantly. I mean, basically, you've got a couple of major things that have happened that almost 20-year period. You know, obviously, one of the things is that the cost of systems are dramatically lower, you know. So as I was just mentioning, in real dollar terms, you know, PV modules are 15 percent of the cost they were even

half a dozen years ago. So that's a huge factor.

The other thing, of course, as you just mentioned is the policy environment. So in this country, we've had the solar investment tax credit, a 30 percent rate, an accelerated depreciation basically for the last half dozen years, and that has created, you know -- a combination of those factors has created a real economic case for PV's, which, you know, in back in the 90's what we were having to do is we were having to find special circumstances where we could make PV work economically, and one of the things we were looking at heavily in those days was trying to displace building materials because that was -- that created value for the PV material. If you can displace a high value building material on a building, then you've basically, you know, penny saved is a penny earned, so you basically earned that value. So I think that, you know, today that's one of the reasons why we've seen the proliferation of PV across a whole range of applications, but, you know, especially the larger systems where they -- they're economic today, and they certainly weren't 10 or 15 years ago.

MR. RODELIUS: Thank you.

THE WITNESS: Sure.

THE CHAIRMAN: Sir, come on up.

MR. GRAVEN: Bob Graven, Country Meadow Farm.

MR. COLLINS: Mr. Graven, you're still under oath.

B O B G R A V E N, having been previously sworn, resumed.

MR. GRAVEN: One of the numbers I haven't heard in this long testimony is the efficiency of silicon panels. This speaks to the size of the array. If we have -- what range of efficiency are the present silicon panels?

THE WITNESS: The ones under consideration for this project are between 15 and 16 percent.

MR. GRAVEN: Okay, 15 to 16 percent --

THE WITNESS: That's correct.

MR. GRAVEN: -- is the current commercial grade?

THE WITNESS: Correct.

MR. GRAVEN: But it can go up to what number for higher efficiency, higher purity silicon?

THE WITNESS: I would say for commercial

products, it's around 20 percent. It's kind of upper.

MR. GRAVEN: So the difference between 15 and 20 percent on a relative basis, this is a lot of panels to get the same amount of power.

THE WITNESS: That's correct.

MR. GRAVEN: So the whole field could shrink --

THE WITNESS: Right.

MR. GRAVEN: -- with the higher efficiency. Now, can we go to a yet higher efficiency with 20 percent with other materials?

THE WITNESS: It's debatable. I could get you into the theory here, but, you know, you can -- the issue is really the module efficiency under the circumstances here in New Jersey. I happen to have just come from the world conference on photovoltaic energy conversion in Japan 2 weeks ago, and at that conference, one of the -- there were a lot of milestones announced in efficiencies, but one of them was 35 percent module efficiency for concentrator photovoltaics, which is pretty impressive, right, but the thing is you need a certain kind of climate and solar resource in order to use that, and that's what's called a high direct

normal insolation environment, which is typically in the United States it's in the southwest and so on. You wouldn't find that here. Here you have a lot of diffuse light, and those types of modules would not actually work properly here because you don't have sufficient direct normal insolation.

MR. GRAVEN: Do you have a set of numbers for direct normal versus diffuse, how many -- in the southwest, yes, we get 320, 330 days of direct normal. And here we get how many days?

THE WITNESS: I know the numbers for flat installations. I don't know the numbers for concentrators specifically, but I can tell you from my experience in system design that you have -- when you have a climate like here where you have roughly 1,400 equivalent sun hours per day of, you know, kilowatt hours per square meter per year of insolation, you have a high diffuse component, and you know that from your own weather, and so it's probably something like half of that is DNI, so, I mean, you'd have to look it up. I don't have the number off the top of my head, but the general rule of thumb is you need to have climates like the southwestern U.S. to have concentrators make sense.

MR. GRAVEN: And utility scale,

certainly concentrators -- if the value of the area is high --

THE WITNESS: Sure.

MR. GRAVEN: -- then you want to go to concentrators to get more power from less area.

THE WITNESS: But the trick you get into -- it's really tricky because, you know, as soon as you get into concentrators, you've got to do very accurate tracking because it's effectively like telescopes following the sun. So, you know, you have to have two access tracking, which means that all of a sudden you can't have dense arrays of modules. You have to have them pretty spaced out so you don't have the shadow of one getting on another one. So when you really start looking at amount of kilowatt hours per land area, which I think is the critical factor, it's debatable unless you get into a high DNI climate whether that's successful technology to use.

MR. GRAVEN: I think that would be an interesting debate. Thank you very much.

THE CHAIRMAN: Thank you. Mr. Cirona, I think we're going to be --

MR. CIRONA: It's one quick question.

THE CHAIRMAN: If it's quick.

MR. CIRONA: If I may, will KDC provide a specific list of all components in the panels that are proposed?

THE WITNESS: Say again, please.

MR. CIRONA: Will KDC provide a list of all the components that are in the panels that are proposed to be used, all the components that are --

MR. HALL: I think he already testified to that more than once.

MR. CIRONA: Well, we don't have anything --

THE WITNESS: I guess I would say --

THE CHAIRMAN: I'm sure in your design everything will be provided.

MR. HALL: We can provide a list, but he testified to that.

MR. CIRONA: Will there be -- will we be able to get a list.

THE WITNESS: Once the project is designed, there will be much more detail.

MR. CIRONA: A detailed list of what the components are in the panel that's being proposed.

THE WITNESS: Yeah.

THE CHAIRMAN: We don't have the panels yet. We don't really know yet.

THE WITNESS: I think I need to defer that to KDC.

MR. HALL: I think he testified they're the same components, and just so we're all clear as to why one hasn't been selected, we submitted a letter back in May that explained that KDC bids out when it buys the panel so if it identified one they are definitely going to use now, it would be not commercially reasonable to do that because then they couldn't bid it out. So anyway, just so we're clear. But we can provide what he testified to. It will be in the transcript, as well.

THE CHAIRMAN: Thank you. Miss Donato.

MS. DONATO: Mr. Boxer, if I may, I think that the witness candidly admitted he didn't know if there was lead or anything. It would be really helpful if you take the short list that he's referring to and just tell us what are the materials that are in each of these different manufacturers' products because we don't really know that completely. We have -- so I think that it could be very helpful to understand that because we spent a long time, but we still have not really certain.

THE CHAIRMAN: Understand. Thank you. Sir, come up and introduce yourself.

MR. METZ: Tom Metz is the name, 104 Preston Terrace.

T H O M A S M E T Z, sworn.

MR. METZ: Question, do solar panels reflect sunlight like a mirror?

THE WITNESS: Well, I guess the way I would answer that is the panel in general is going to absorb around 92 percent of the light so it's a very dark item, but at very high incident angles, so glancing angles, then you have a higher degree of reflection. So it's like reflecting off the surface of a pond or something like that.

MR. METZ: The reason I ask that question is because we have an airport right next to the site. We got approximately 85 flights in and out every day. I would think we have a disaster in the making with blinding pilots coming in for a landing. Is that a possibility?

THE WITNESS: Well, I think -- I wouldn't want to say there's no possibility of something like that, but I think in general the low angle of the PV panels means that you're not going to have that kind of specular reflection under -- I mean, there could be in certain angles to the array

I guess, but --

MR. METZ: What you're saying -- excuse me for interrupting -- but it is a possibility.

THE WITNESS: Yeah, I mean, I guess I would really sort of defer. I think that there's FAA guidelines that have been issued around this. I think it would be up to KDC to follow those guidelines.

MR. METZ: Okay. Thank you.

THE CHAIRMAN: Yes, sir, come on up.

MR. FRANTZ: Steve Frantz, Preston Terrace.

MR. COLLINS: Were you previously sworn? You understand you're still under oath.

S T E V E F R A N T Z, having been previously sworn, resumed.

MR. FRANTZ: Frantz, F-r-a-n-t-z. In the event that the power has nowhere to go, the -- Sanofi leaves, the new tenants don't want the power, and if it's not going to the grid, can you actually shut down the facility? Do the panels still produce energy if they're just stagnant sitting there?

THE WITNESS: No, it's one of the interesting things about PV's is that if you just

open circuit them, i.e., turn them off, they don't produce any power. It has to do with their current voltage characteristic. So essentially, if you open up the circuit, there's no power.

MR. METZ: So they're standing in a sunny day --

THE WITNESS: They're standing there, exactly.

MR. METZ: Okay. Thank you.

THE CHAIRMAN: Come on up, ma'am.

MS. CIZMAR: My name is Anna Cizmar.

MR. COLLINS: Do you understand you're still under oath?

MS. CIZMAR: Yes.

MR. COLLINS: And just spell your last name.

MS. CIZMAR: C-i-z-m-a-r, Cizmar. You talked about a solar panel being made of glass aluminum. You also aware that also have cadmium?

THE WITNESS: Well, these types of modules do not have cadmium. There are some types that do, but --

MS. CIZMAR: Majority of solar panel on the market has cadmium.

THE WITNESS: I would not say it's a

majority. It's a type that's made in the U.S. It is popular, but it's not under consideration for this project.

MS. CIZMAR: So you're definitely sure that the panels that you're going to install here does not have cadmium.

THE WITNESS: That's correct.

MS. CIZMAR: Because cadmium is very toxic to the --

THE WITNESS: Yes.

MS. CIZMAR: And so what kind of chemicals in it?

THE CHAIRMAN: Ma'am, I think we went through this before. I think he gave a fairly long list of what was in them.

MS. CIZMAR: Can we have a copy of that?

THE CHAIRMAN: Well, you can get the transcripts.

MS. CIZMAR: I would like to know what's in --

THE CHAIRMAN: You can get the transcripts from the town. It's not a problem. That would be not a problem at all.

MR. COLLINS: Mr. Chairman, I did have some questions that came up because of the questions

on cross, and the first question was there was a question about the efficiency, and you said that there are some panels that are commercially available that probably would be commercially efficient for this project or for the projects like this that might have efficiencies up to about 20 percent; is that --

THE WITNESS: Well, let me just be correct. I say there are commercially available modules with efficiencies up to 20 percent. You know, the choice of their viability for this particular project, you know, is really up to KDC and the engineering firm, but generally speaking, there's a trade-off with cost and performance, and so it really becomes an economic decision as to exactly what class of module is used. Those types of modules are typically today mostly commercially reserved for applications where there's very limited area, such as home roofs is the principal application or other kinds of rooftop applications. Not exclusively, but it's the most common, and it just has to do with the project economics.

MR. COLLINS: Are any of those products among the list of the modules that is on the short list provided in this application?

THE WITNESS: No, they're not.

MR. COLLINS: Are any of those the same technology of silica wafer, silicon wafer?

THE WITNESS: Yes, they're related. I would call them specialized variations of the crystalline wafer technology using different types of silicon wafers, using different cell processes, et cetera.

MR. COLLINS: And they would have similar constituents of the other ones that you talked about.

THE WITNESS: Yes.

MR. COLLINS: And that increase in efficiency from 15 to 16 percent to about 20 percent, that -- is that about a 33 percent increase in efficiency of the panels?

THE WITNESS: Well, I would say it's more like a 25 percent increase.

MR. COLLINS: Okay, and does a 25 percent increase in the efficiency of panels result in a 25 percent reduction in the area that the panels need?

THE WITNESS: It would if you wanted to generate the same power. I think that in a condition -- in a situation like this, what the

designer would actually look at is actually putting more power on the site if it made sense in terms of the user demand because that would probably make more sense economically.

MR. COLLINS: But if the Board were interested in trying to reduce the disturbance of land, the efficiency of the panel could have some relationship to that goal of reduction of the disturbance of land; is that correct?

THE WITNESS: Yes.

MR. COLLINS: Thank you.

THE CHAIRMAN: Thanks, Mr. Collins. Okay. Thank you, sir. Mr. Hall, I think given the late hour, we'll probably not get into new witnesses. We do have some housekeeping items for next month, and we want to try to get some dates scheduled so we can be a little bit more certain of when you guys are going to come forward. We do have the reorganization meeting. Trina, we're thinking of putting a special meeting on, right, in January?

MS. LINDSEY: For the 15th you discussed it.

MR. HALL: She had told me about it.

MS. LINDSEY: We don't have anything scheduled for that.

THE CHAIRMAN: Right.

MR. HALL: She had told me that, and I think probably on the 8th I know we have some other -- I have a conflict either time, but the 15th is fine with me.

THE CHAIRMAN: Okay.

MR. COLLINS: Check with the other attorneys, and let's see if we can get -- make sure our witness is available, and let's decide the date certain we'd be carried to.

MR. HALL: Fifteenth?

MR. COLLINS: Michele and Mr. Sasso, are you both available on January 15, the third Thursday, because we can't meet on the first Thursday.

MS. DONATO: I'm not available on that night.

MR. COLLINS: Thought it would be perfect for you. Are you available on the --

MS. DONATO: I am available on the 8th, yes. I'm available on the 8th. I'm available on the 22nd. I'm available on the 29th.

THE CHAIRMAN: I'm not here on the 8th so I'm not sure that that matters.

MR. COLLINS: No. We have George,

assistant vice chair.

THE CHAIRMAN: Yeah, I mean, I would say we should try and get dates scheduled for all of you that work so we can try to get a little bit more planning done. So maybe we can think about January and even talk about February. So if you're not good for the 15th and you're not good for the 8th --

MR. HALL: I think the one thing probably to factor in -- I mean, we do have -- we filed a report. I don't think that would take the whole night. In which case then we would intend to do clean-up with the storm water. I think the 15th would be a better date. It would give another week for -- with the holidays for all the engineers to meet. I know -- I'll defer to Mr. Ferriero. I know he got some more information today. The goal is that they all meet before the next meeting so we can --

THE CHAIRMAN: Right, and I know Miss Donato would probably have specific interest in storm water. Would it be possible to look at the 22nd?

MR. HALL: Is that -- what day of the week is that?

MS. DONATO: It's a Thursday.

MR. HALL: That's fine.
THE CHAIRMAN: Mr. Collins.
MR. COLLINS: Let me just check.
THE CHAIRMAN: Mr. Ferriero.
MR. COLLINS: I usually have a meeting. January, what date are you trying for?
THE CHAIRMAN: The 22nd would be an alternative to that.
MR. FERRIERO: I know I have a meeting that night. I'll have to see if I can --
MR. COLLINS: I know I have a regular reorganization meeting. I would doubt that -- I'd prefer the 8th.
MS. DONATO: January has five Thursdays.
THE CHAIRMAN: We could try. We can keep probing a little bit. We can do it -- what about the 29th?
MS. LINDSEY: We have nothing scheduled for February yet. If you're going to go to the 29th, why not just go to the first meeting in February?
MR. HALL: I think we'd like to do two meetings. One possibility I guess would be if we could just do Mr. Dotti on the 8th and then planning and storm water on the 29th.

THE CHAIRMAN: We're willing to work with you.

MR. HALL: I'm just trying to throw out because I know we --

MR. FERRIERO: I know we have -- for the 8th, we have reorganization. We have Elite Equestrian coming back, too. So it's not like it's all your night.

MR. HALL: Twenty-ninth?

MR. COLLINS: I can do the 29th, Mr. Chairman. I think Frank can, too.

THE CHAIRMAN: You'd be okay for the 29th? Why don't we do the 29th.

MR. HALL: Then hopefully we can do one of the February meetings. We need to talk about that tonight.

THE CHAIRMAN: Why don't we talk about that now.

MR. HALL: If you want to talk about it now.

THE CHAIRMAN: So we have the 29th, and then what would be the February.

MS. LINDSEY: We meet February 5 and February 12.

THE CHAIRMAN: So do you have a

preference?

MR. HALL: The 5th because I have the second Thursday conflict, but we can --

THE CHAIRMAN: What about --

MR. HALL: If I'm freed up in January, I can do that.

MR. SASSO: Whatever date.

THE CHAIRMAN: What about you, Miss Donato?

MR. HALL: Do you still have a second Thursday problem.

MS. DONATO: I have a problem with the first and the third. That's what it's been all the way along.

THE CHAIRMAN: So you can do the 12th.

MR. HALL: Let's do the second in February because we're clearing up January. Nobody is having a conflict.

THE CHAIRMAN: So you'd be okay on the 12th?

MR. HALL: In February, yes.

MR. SASSO: Is that for storm water and noise?

MR. FERRIERO: Noise is going to be --

MR. HALL: -- 29th of January.

THE CHAIRMAN: Twenty-ninth of January we'll do storm water. We'll have one witness. We're not going to do the 8th.

MR. SASSO: This is my question, Mr. Chairman. I want to schedule the next meetings, too, and it's not clean-up, though, which we always hear. In other words, has the high water table been established with the new information. I know Najarian keeps telling me that the high water table still hasn't been established in your system. Your storm water management system gets designed around that. So it's not clean-up. The question is was the fundamental information that the Board requested --

THE CHAIRMAN: We don't know, and I'm not sure I would use clean-up. Let's get to the meeting dates.

MR. HALL: That gives us more time to hopefully get to that point.

THE CHAIRMAN: So let's just lock some dates in. Really, the Applicant can proceed in whatever way they want.

MR. FERRIERO: So you want to do noise on the 29th and storm water on the 12th?

MR. HALL: Let me ask if we can do noise

on the 8th. You have some things. Hopefully that's only not a long thing.

THE CHAIRMAN: I don't know. How much do we have on the 8th?

MR. FERRIERO: We have reorganization, and we have Elite Equestrian.

MS. LINDSEY: Depends on what they come back with, I guess.

THE CHAIRMAN: We can put it on, but it will have to be after Elite Equestrian. We just don't know how long it's going to be. You can try it.

MR. HALL: I prefer. I mean, I don't want to belabor the storm water. I know it's going to take some time. So if we can get the noise out of the way before that.

MR. FERRIERO: So you want to do noise on the 8th, storm water on the 29th.

MR. HALL: Yes, if we can do that.

MS. DONATO: Mr. Chairman, may I please address that? The last time we -- this Board was very, very clear in June. You wanted comprehensive data on storm water. So we've been still trying to get to that. We haven't seen it. You haven't seen it. Your engineer hasn't seen it. We were supposed

to come here and address it and, you know, late in the afternoon we found out --

THE CHAIRMAN: We understand all that.

MR. HALL: We got a letter. Let's not waste our time on this. We're beyond that.

MS. DONATO: We're not beyond that.

MR. HALL: We're scheduling storm water for the 29th, which gives you plenty of time to complain more.

MS. DONATO: Mr. Hall, I think that's really rude and unnecessary.

MR. HALL: I think your letter to me was rude.

MS. DONATO: You have an application that you haven't established the seasonal high water table on. It's fundamental. So don't start getting nasty.

THE CHAIRMAN: Well, let's not argue this tonight. I think all I want to focus on is dates. If we're not prepared on the 29th, we'll deal with it on the 29th. Right now I want to make sure we lock some dates in. We want the citizens to be aware of it. And we'll try to work through this the best we can. I understand all the issues that revolve around storm water.

So we're gonna do the 8th for noise, the 29th for storm water. We're going to do the 12th for KDC. And we'll figure out what you guys will do then.

MR. HALL: That's great.

MS. DONATO: We have the 8th, the 29th, and February 12.

THE CHAIRMAN: Yes, ma'am.

MS. DONATO: The 8th is noise, Mr. Chairman?

THE CHAIRMAN: It was always noise.

MS. DONATO: Always noise.

THE CHAIRMAN: But we'll specifically focus on noise on the 8th.

MR. HALL: And we did file a report way back when.

THE CHAIRMAN: That will give us I think a good launch point for the year and get a lot of meetings in.

MR. HALL: Appreciate that.

THE CHAIRMAN: Yeah, no problem. Thank you.

MS. DONATO: Thank you very much.

THE CHAIRMAN: We're done with comments tonight.

FROM THE FLOOR: Just a quick question.

THE CHAIRMAN: We have no more time for questions.

FROM THE FLOOR: A quick question for the Board about the date. If they're not going to be ready again like they were --

THE CHAIRMAN: I'm sorry, sir, we're not taking anymore questions. Not responding to anymore questions. We're done for the evening. Motion to adjourn. So moved. Thank you.

(Proceedings concluded at 10:10 p.m.)

LAND USE BOARD
TOWNSHIP OF BEDMINSTER
COUNTY OF SOMERSET
STATE OF NEW JERSEY

In the Matter of)
The Application of:) CERTIFICATE
CASE LUB# 12-015 (BOA))
KDC SOLAR SA55 LLC)
Solar Project -)
Country Club Road)
Block 71.02, Lot 1)
Block 62, Lot 10)
Block 69, Lot 4)

I, DEBORAH A. MASTERTON, a Certified Court Reporter and Notary Public of the State of New Jersey, certify that the foregoing is a true and accurate transcript of the proceedings in the above entitled matter at the time and place aforesaid.

DATE: December 23, 2014

License No. XI001655

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