COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

| | | |
|---|---|---|
| ELECTRONIC APPLICATION OF LOUISVILLE GAS AND ELECTRIC COMPANY FOR AN ADJUSTMENT OF ITS ELECTRIC AND GAS RATES, A CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY TO DEPLOY ADVANCED METERING INFRASTRUCTURE, APPROVAL OF CERTAIN REGULATORY AND ACCOUNTING TREATMENTS, AND ESTABLISHMENT OF A ONE-YEAR SURCREDIT | ) | CASE NO. 2020-00350 |

## NOTICE OF FILING

Notice is given to all parties that the following materials have been filed into the record of this proceeding:

- The digital video recording of the evidentiary hearing conducted on August 17, 2021 in this proceeding;

- Certification of the accuracy and correctness of the digital video recording;

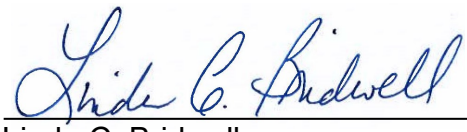
- All exhibits introduced at the evidentiary hearing conducted on August 17, 2021 in this proceeding;

- A written log listing, inter alia, the date and time of where each witness' testimony begins and ends on the digital video recording of the evidentiary hearing conducted on August 17, 2021.

A copy of this Notice, the certification of the digital video record, and hearing log have been served upon all persons listed at the end of this Notice. Parties desiring to view the digital video recording of the hearing may do so at https://youtu.be/qLILl0xrJcw.

Parties wishing an annotated digital video recording may submit a written request by electronic mail to pscfilings@ky.gov. A minimal fee will be assessed for a copy of this recording.

Done at Frankfort, Kentucky, this 8th day of September 2021.



Linda C. Bridwell
Executive Director
Public Service Commission of Kentucky

ACOMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

| | | |
|---|---|---|
| ELECTRONIC APPLICATION OF KENTUCKY UTILITIES COMPANY FOR AN ADJUSTMENT OF ITS ELECTRIC RATES, A CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY TO DEPLOY ADVANCED METERING INFRASTRUCTURE, APPROVAL OF CERTAIN REGULATORY AND ACCOUNTING TREATMENTS, AND ESTABLISHMENT OF A ONE-YEAR SURCREDIT | ) | CASE NOS. 2020-00349 & 2020-00350 |
| ELECTRONIC APPLICATION OF LOUISVILLE GAS AND ELECTRIC COMPANY FOR AN ADJUSTMENT OF ITS ELECTRIC AND GAS RATES, A CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY TO DEPLOY ADVANCED METERING INFRASTRUCTURE, APPROVAL OF CERTAIN REGULATORY AND ACCOUNTING TREATMENTS, AND ESTABLISHMENT OF A ONE-YEAR SURCREDIT | ) | |

## CERTIFICATION

I, Candace H. Sacre, hereby certify that:

1. The attached flash drive contains a digital recording of the Formal Hearing conducted in the above-styled proceeding on August 17, 2021. The Formal Hearing Log, Exhibit, and Exhibit List are included with the recording on August 17, 2021;

2. I am responsible for the preparation of the digital recording;

3. The digital recording accurately and correctly depicts the Formal Hearing of August 17, 2021; and

4. The Formal Hearing Log attached to this Certificate accurately and correctly states the events that occurred at the Formal Hearing of August 17, 2021, and the time at which each occurred.

Signed this 1st day of September, 2021.

Candace H. Sacre
Administrative Specialist III

Stephanie Schweighardt
Notary Public State at Large ID#: 614400
Commission Expires: January 14, 2023

# Session Report - Detail

**2020-00349 and 2020-00350**
**17Aug2021**

**Kentucky Utilities Company (KU) and Louisville Gas and Electric Company (LG&E)**

| Date: | Type: | Location: | Department: |
|---|---|---|---|
| 8/17/2021 | Public Hearing\Public Comments | Hearing Room 1 | Hearing Room 1 (HR 1) |

Witness: Daniel Arbough; Stephen Baron; Beth McFarland; David Sinclair; John Wolfe
Judge: Kent Chandler; Amy Cubbage
Clerk: Candace Sacre

| Event Time | Log Event | |
|---|---|---|
| 9:10:02 AM | Session Started | |
| 9:10:11 AM | Chairman Chandler | |
| | Note: Sacre, Candace | Good morning, on the record in Case Nos. 2020-00349 and 2020-00350, Kentucky Utilities Company and Louisville Gas and Electric Company. |
| 9:10:26 AM | Chairman Chandler | |
| | Note: Sacre, Candace | On June 30 2021 an Order was entered that decided all issues other than net metering and qualifying facilities tariffs. Order entered on 8-12 regarding rehearing on items that will be addressed today. Walmart, Kroger, Louisville Metro, Lexington-Fayette Urban County Government, and U.S. Department of Defense excused from participation in hearing. |
| 9:10:53 AM | Chairman Chandler | |
| | Note: Sacre, Candace | My name is Kent Chandler, Chairman of the Public Service Commission, and I will be presiding today. Joining me is Vice Chairman Amy Cubbage. |
| 9:11:01 AM | Chairman Chandler | |
| | Note: Sacre, Candace | COVID and teleconferencing recommendations. (Click on link for further comments.) |
| 9:13:10 AM | Chairman Chandler | |
| | Note: Sacre, Candace | Entry of appearance by counsel. |
| 9:13:14 AM | Atty Riggs KU/LG&E | |
| | Note: Sacre, Candace | Kendrick Riggs, Allyson Sturgeon, and Sara Judd. |
| 9:13:36 AM | Asst Atty General Horne | |
| | Note: Sacre, Candace | Larry Cook on line, John Horne in person. |
| 9:13:53 AM | Atty Kurtz KIUC | |
| | Note: Sacre, Candace | Mike Kurtz and Jody Kyler Cohn. |
| 9:14:01 AM | Atty Spenard KYSEIA | |
| | Note: Sacre, Candace | Randal Strobo and David Spenard. |
| 9:14:16 AM | Atty Fitzgerald Joint Intervenors | |
| | Note: Sacre, Candace | Tom Fitzgerald. |
| 9:14:32 AM | Atty Miller Sierra Club | |
| | Note: Sacre, Candace | Matthew Miller and Joe Childers. |
| 9:14:48 AM | General Counsel Vinsel PSC | |
| | Note: Sacre, Candace | Nancy Vinsel for Staff. |
| 9:14:53 AM | Chairman Chandler | |
| | Note: Sacre, Candace | Public notice given. |
| 9:15:02 AM | Chairman Chandler | |
| | Note: Sacre, Candace | Outstanding motions. (Click on link for further comments.) |

| | | |
|---|---|---|
| 9:17:58 AM | Chairman Chandler | |
| | Note: Sacre, Candace | In addition to petitions for confidentiality, other motions. (Click on link for further comments.) |
| 9:25:18 AM | Chairman Chandler | |
| | Note: Sacre, Candace | Public comments. (Click on link for further comments.) |
| 9:34:12 AM | Chairman Chandler | |
| | Note: Sacre, Candace | Schedule for the day. (Click on link for further comments.) |
| 9:36:33 AM | Chairman Chandler | |
| | Note: Sacre, Candace | First witness? |
| 9:36:35 AM | Atty Riggs KU/LG&E | |
| | Note: Sacre, Candace | Daniel Arbough. |
| 9:36:48 AM | Chairman Chandler | |
| | Note: Sacre, Candace | Witness is sworn. |
| 9:36:55 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | Examination. Name and address? |
| 9:38:48 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Direct Examination. Identify documents you have? |
| 9:39:39 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Also have access to laptop? |
| 9:40:02 AM | Atty Riggs KU/LG&E | |
| | Note: Sacre, Candace | Three documents distributed to parties last night, exhibits to introduce. |
| 9:40:21 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Job title? |
| 9:40:24 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | How long? |
| 9:40:32 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Prepared written testimony and exhibits? |
| 9:40:40 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Sponsor responses to data requests? |
| 9:40:51 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Opportunity to review? |
| 9:41:01 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Relate to legal expense? |
| 9:41:07 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Kind of information convey? |
| 9:41:47 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Affidavit and exhibits joint petition for partial rehearing and clarification of final orders? |
| 9:42:02 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Adopt contents? |
| 9:42:07 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Adopt responses sponsored on legal expense? |
| 9:42:20 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Who responsible for forecast legal expense for company? |
| 9:42:35 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Describe process how legal expenses budgeted? |
| 9:46:08 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Consider each individual matter when budgeting? |
| 9:46:27 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Account for future, unknown matters? |
| 9:47:26 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | How ensure arrived at reasonable budget, legal expense? |

| | | |
|---|---|---|
| 9:47:56 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Used same basic method for budget for many years? |
| 9:48:12 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Forecast amount reasonable to actual legal expense? |
| 9:48:30 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Hand you document marked Five-Year Legal Expense by Company. |
| 9:48:48 AM | Atty Riggs KU/LG&E | |
| | Note: Sacre, Candace | Marked as Arbough Rehearing Exhibit 1. |
| 9:48:54 AM | Chairman Chandler | |
| | Note: Sacre, Candace | Any objection? Mark as such. |
| 9:49:30 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Updated version of chart contained in companies' rehearing petition? |
| 9:49:46 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | What is different? |
| 9:50:27 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Adopt and incorporate as testimony? |
| 9:50:32 AM | Atty Riggs KU/LG&E | |
| | Note: Sacre, Candace | Ask admitted into evidence. |
| 9:50:38 AM | Chairman Chandler | |
| | Note: Sacre, Candace | Any objection? That's fine. |
| 9:50:39 AM | ARBOUGH REHEARING EXHIBIT 1 | |
| | Note: Sacre, Candace | ATTY RIGGS KU/LG&E - WITNESS ARBOUGH |
| | Note: Sacre, Candace | 5-YEAR HISTORIC LEGAL EXPENSE BY COMPANY |
| 9:50:44 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | What does chart tell about consistency of forecast with historic actual legal expense? |
| 9:51:28 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Exhibits B-1 and B-2 filed with affidavit, schedules shown represent legal matters managing/expected to manage at time budgeted? |
| 9:52:00 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Forecasted expense for each category? |
| 9:52:09 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Schedules reflect some matters resolved? |
| 9:52:22 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Mean no longer incur legal expense for matters? |
| 9:52:34 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Other matters arisen since prepared? |
| 9:52:41 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Describe new matters and nature? |
| 9:53:28 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | As treasurer, do number of cases high, low, typical? |
| 9:54:47 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | New cases, typical level? |
| 9:54:55 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Additional evidence? |
| 9:55:14 AM | Atty Riggs KU/LG&E | |
| | Note: Sacre, Candace | Updated schedules to B-1 and B-2, distributed to all parties. |
| 9:56:00 AM | Atty Riggs KU/LG&E | |
| | Note: Sacre, Candace | Mark Arbough Hearing Exhibits 2 and 3. |
| 9:56:20 AM | Chairman Chandler | |
| | Note: Sacre, Candace | That's fine. |
| 9:56:25 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Describe inititial table by category? |

| | | |
|---|---|---|
| 9:57:09 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Base period figures juriscitionalized? |
| 9:57:16 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | How impact comparison? |
| 9:57:37 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Why are figures base period amounts not available for matters of categories? |
| 9:58:21 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | What evidence say in Arbough Direct Rehearing 2 and 3 reasonableness of legal expense in forecasted test period? |
| 9:58:52 AM | Chairman Chandler | |
| | Note: Sacre, Candace | Technical difficulties, off the record. |
| 9:59:03 AM | Session Paused | |
| 10:00:26 AM | Session Resumed | |
| 10:00:30 AM | Chairman Chandler | |
| | Note: Sacre, Candace | Back on record, reask last question. |
| 10:00:41 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Additional evidence presented Exhibits 2 and 3 say about reasonableness of legal expense in forecasted test period? |
| 10:01:15 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Still consider forecasted expense as reasonable? |
| 10:01:23 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Any adjustments? |
| 10:01:31 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Affidavit stated no willful misconduct? |
| 10:01:47 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Still true today? |
| 10:01:49 AM | Atty Riggs KU/LG&E - witness Arbough | |
| | Note: Sacre, Candace | Any new matters not reflected in exhibits/updated versions rehearing exhibits involve any acts or omissions subject to KRS 278.990? |
| 10:02:19 AM | Chairman Chandler | |
| | Note: Sacre, Candace | Questions? |
| 10:02:45 AM | General Counsel Vinsel PSC - witness Arbough | |
| | Note: Sacre, Candace | Cross Examination. Follow up forecasting, none matters involve actions or omissions, expand what mean by that? |
| 10:03:35 AM | General Counsel Vinsel PSC - witness Arbough | |
| | Note: Sacre, Candace | Not asking legal opinion, civil penalties violations, negligence issues also omitted? |
| 10:04:09 AM | General Counsel Vinsel PSC - witness Arbough | |
| | Note: Sacre, Candace | Follow up, invoices for fees, file invoices for legal services? |
| 10:04:30 AM | General Counsel Vinsel PSC - witness Arbough | |
| | Note: Sacre, Candace | Garrett? |
| 10:04:45 AM | General Counsel Vinsel PSC - witness Arbough | |
| | Note: Sacre, Candace | Response to Staff First Data Request, question 6, either company/same response, provide analysis for services base period, sentence, reading, (click on link for further comments), agree what says? |
| 10:06:00 AM | General Counsel Vinsel PSC - witness Arbough | |
| | Note: Sacre, Candace | Attachment 3, Response PSC 1-6, first page, list compiled from invoices? |

| | | |
|---|---|---|
| 10:06:29 AM | General Counsel Vinsel PSC - witness Arbough | |
| | Note: Sacre, Candace | Include name of firm, attorney/staff providing services, rates confidential, timekeeper title, 2020 rate increase date, items rate increase not requested omitted from forecasting, explain what means? |
| 10:07:27 AM | General Counsel Vinsel PSC - witness Arbough | |
| | Note: Sacre, Candace | KU/LG&E asked include detailed analysis, agree no detailed analysis service provided on list? |
| 10:07:58 AM | General Counsel Vinsel PSC - witness Arbough | |
| | Note: Sacre, Candace | Description of services provided in data request? |
| 10:08:11 AM | Atty Riggs KU/LG&E | |
| | Note: Sacre, Candace | Will provide whatever Commission needs. (Click on link for further comments.) |
| 10:09:49 AM | Chairman Chandler | |
| | Note: Sacre, Candace | Let me ask, think you are asking me and VC more than Vinsel, question said detailed analysis, part said at minimum provide work papers, should show payee, dollar amount, voucher number, account charged, hourly rates and time charged, description services provided. (Click on link for further comments.) |
| 10:10:51 AM | Atty Riggs KU/LG&E | |
| | Note: Sacre, Candace | Trying to cooperate, communicate with Commission, provide more detail description. (Clink on link for further comments.) |
| 10:11:38 AM | Chairman Chandler | |
| | Note: Sacre, Candace | Request in writing if going to request. |
| 10:11:41 AM | Atty Riggs KU/LG&E | |
| | Note: Sacre, Candace | Want to provide all information Commission needs. (Click on link for further comments.) |
| 10:12:28 AM | Chairman Chandler | |
| | Note: Sacre, Candace | Finish examination of Arbough. Questions? |
| 10:12:40 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | Examination. Item 1-6 asks for detailed analysis, indicated what would include? |
| 10:12:52 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | Base period costs? |
| 10:13:01 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | Staff Fifth Request, test year expenses for legal fees? |
| 10:13:17 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | What data request response? |
| 10:13:26 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | Read request Item 2? |
| 10:14:04 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | Your response? |
| 10:14:12 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | Provided chart shown top of B-1? |
| 10:14:36 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | Start at top, read categories? |
| 10:14:51 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | Below listed matters, generic areas noted, fire, casualty issues, vehicle accidents, specific or general under five or six categories? |
| 10:15:31 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | Could have provided more information on that item? |
| 10:15:52 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | Privilege issue to all or some? |

| | | |
|---|---|---|
| 10:16:03 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | Have discussion other information could have been provided other than concern privilege amount of each item? |
| 10:16:37 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | Way calculate test year legal fees, (click on link for further comments), accurate? |
| 10:18:09 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | C-suite level review COO and CFO? |
| 10:18:19 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | Each known matter taken into account? |
| 10:18:24 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | Attorneys on ground expect case to settle, amount included? |
| 10:18:53 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | Settlement amount? |
| 10:19:02 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | Expect to settle, not include estimate of legal fees litigating? |
| 10:19:16 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | If case settles, those amounts included in any test year expenses? |
| 10:19:35 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | For forecasting, lot based off of known period, updated for future periods? |
| 10:19:52 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | Settlements paid in past baseline level when proposing rates in future? |
| 10:20:31 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | Is or isn't taken into account test year? |
| 10:20:40 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | Past amount pulled forward? |
| 10:20:50 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | Where located? |
| 10:21:06 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | KRS 278.990, ever reviewed? |
| 10:21:14 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | Have affidavit? |
| 10:21:26 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | Make assertion regarding 278.990? |
| 10:21:34 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | What is that assertion? |
| 10:21:43 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | How make assertion not related 278.990 when have not reviewed 278.990? |
| 10:22:04 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | Making assertion that not penalized under penalties or assertion based on discussion with counsel understanding company unaware or forecasted no expenses related to Commission order or regulation? |
| 10:23:01 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | Hypothetically, claim or matter forecasted test year, claiming tort claim company/agents acted willfully led to injury, Commission thought unreasonable customers pay litigation related to that matter, how would Commission made adjustment for any those specific matters? |

| | | |
|---|---|---|
| 10:24:09 AM | Chairman Chandler - witness Arbough | |
| | Note: Sacre, Candace | Any of the list provided response to DR 5-2, Smith v KU, unreasonable to recover legal fees defending claim, with information provided, how Commission make adjustment? |
| 10:25:03 AM | Chairman Chandler | |
| | Note: Sacre, Candace | These are the legal questions I have. (Click on link for further comments.) |
| 10:39:19 AM | Chairman Chandler | |
| | Note: Sacre, Candace | That's fair, and why asked Arbough about it, evidentiary, legal argument, what due process requires. (Click on link for further comments.) |
| 10:49:55 AM | Chairman Chandler | |
| | Note: Sacre, Candace | Very specific as to detailed analysis, broader item following first data request, legal fees were at issue. (Click on link for further comments.) |
| 10:52:10 AM | Chairman Chandler | |
| | Note: Sacre, Candace | Last question, from company perspective, distinction between Commission putting company on notice verse questions from Commission Staff, questions more specific, Staff questions satisfy due process? (Click on link for further comments.) |
| 11:01:56 AM | Chairman Chandler | |
| | Note: Sacre, Candace | Commission has statutory deadline to rule upon proposed tariffs in this case. (Click on link for further comments.) |
| 11:03:58 AM | Chairman Chandler | |
| | Note: Sacre, Candace | Mr. Kurtz? |
| 11:04:03 AM | Atty Kurtz KIUC | |
| | Note: Sacre, Candace | If company position granted, will raise rates of clients. Believe company correct on this, rate case stay-out. (Click on link for further comments.) |
| 11:04:33 AM | Chairman Chandler | |
| | Note: Sacre, Candace | Questions? |
| 11:05:18 AM | Chairman Chandler | |
| | Note: Sacre, Candace | Break, back at 11:15. |
| 11:05:43 AM | Session Paused | |
| 11:17:15 AM | Session Resumed | |
| 11:17:18 AM | Chairman Chandler | |
| | Note: Sacre, Candace | Redirect? |
| 11:17:31 AM | Atty Riggs KU/LG&E | |
| | Note: Sacre, Candace | Do not. Accept Commission statement to provide additional evidence. |
| 11:17:48 AM | Chairman Chandler | |
| | Note: Sacre, Candace | Witness excused. |
| 11:19:02 AM | Chairman Chandler | |
| | Note: Sacre, Candace | Next witness? |
| 11:19:05 AM | Atty Riggs KU/LG&E | |
| | Note: Sacre, Candace | David Sinclair |
| 11:19:14 AM | Chairman Chandler | |
| | Note: Sacre, Candace | Witness is sworn. |
| 11:19:21 AM | Chairman Chandler | |
| | Note: Sacre, Candace | Examination. Name and address? |
| 11:19:36 AM | Atty Riggs KU/LG&E - witness Sinclair | |
| | Note: Sacre, Candace | Direct Examination. Title? |
| 11:19:46 AM | Atty Riggs KU/LG&E - witness Sinclair | |
| | Note: Sacre, Candace | How long? |

| | | |
|---|---|---|
| 11:19:49 AM | Atty Riggs KU/LG&E - witness Sinclair | |
| | Note: Sacre, Candace | Testify in hearing in April, May? |
| 11:20:04 AM | Atty Riggs KU/LG&E - witness Sinclair | |
| | Note: Sacre, Candace | Order June 30 2021 cause to be prepared supplemental testimony? |
| 11:20:34 AM | Atty Riggs KU/LG&E - witness Sinclair | |
| | Note: Sacre, Candace | Cause to be prepared supplemental rebuttal? |
| 11:20:44 AM | Atty Riggs KU/LG&E - witness Sinclair | |
| | Note: Sacre, Candace | Also file supplemental sur rebuttal? |
| 11:20:56 AM | Atty Riggs KU/LG&E - witness Sinclair | |
| | Note: Sacre, Candace | Same questions, same answers? |
| 11:21:01 AM | Atty Riggs KU/LG&E - witness Sinclair | |
| | Note: Sacre, Candace | Adopt and affirm testimony? |
| 11:21:40 AM | Atty Riggs KU/LG&E - witness Sinclair | |
| | Note: Sacre, Candace | State documents before you? |
| 11:22:01 AM | Atty Riggs KU/LG&E - witness Sinclair | |
| | Note: Sacre, Candace | Access to records on screen? |
| 11:22:07 AM | Chairman Chandler | |
| | Note: Sacre, Candace | Questions? |
| 11:22:22 AM | Atty Kurtz KIUC - witness Sinclair | |
| | Note: Sacre, Candace | Cross Examination. Testimony filed five days ago, DSS-3, active solar/solar battery projects, explain what projects are? |
| 11:23:45 AM | Atty Kurtz KIUC - witness Sinclair | |
| | Note: Sacre, Candace | Approximately 20 projects in transmission queue? |
| 11:24:00 AM | Atty Kurtz KIUC - witness Sinclair | |
| | Note: Sacre, Candace | Don't expect all be built? |
| 11:24:17 AM | Atty Kurtz KIUC - witness Sinclair | |
| | Note: Sacre, Candace | Could be built as well as additional in future? |
| 11:24:45 AM | Atty Kurtz KIUC - witness Sinclair | |
| | Note: Sacre, Candace | Exhibit DSS-1, Table 2, took Barnes' proposed on-peak capacity rates companies required to pay for QFs and translated into energy and capacity pricing on Table 2? |
| 11:25:40 AM | Atty Kurtz KIUC - witness Sinclair | |
| | Note: Sacre, Candace | Table 2 tranche 1 PJM energy pricing 2026 all-in price to QF $63.55? |
| 11:26:13 AM | Atty Kurtz KIUC - witness Sinclair | |
| | Note: Sacre, Candace | What good capacity factor for technology, at that price 80 mW single action cost consumers? |
| 11:26:49 AM | Atty Kurtz KIUC - witness Sinclair | |
| | Note: Sacre, Candace | $12 million a year? |
| 11:27:13 AM | Atty Kurtz KIUC - witness Sinclair | |
| | Note: Sacre, Candace | Maximum allowed under PURPA statute? |
| 11:27:25 AM | Atty Kurtz KIUC - witness Sinclair | |
| | Note: Sacre, Candace | 20-year contract $240 million power purchase agreement? |
| 11:27:39 AM | Atty Kurtz KIUC - witness Sinclair | |
| | Note: Sacre, Candace | How work, sign contract with developer and bring to Commission for approval or just contract without Commission involvement? |
| 11:29:04 AM | Atty Kurtz KIUC - witness Sinclair | |
| | Note: Sacre, Candace | Big contract not have Commission review, agree? |
| 11:29:45 AM | Atty Kurtz KIUC - witness Sinclair | |
| | Note: Sacre, Candace | Look at counter-party strength when negotiating contract like this? |
| 11:30:32 AM | Atty Kurtz KIUC - witness Sinclair | |
| | Note: Sacre, Candace | Sanctions for noncompliance condition negotiate? |
| 11:30:50 AM | Atty Kurtz KIUC - witness Sinclair | |
| | Note: Sacre, Candace | In 20 years, not perform, something in contract nonperformance? |

| | | |
|---|---|---|
| 11:32:15 AM | Atty Kurtz KIUC - witness Sinclair<br>Note: Sacre, Candace | Counter-party strength go bankrupt, get out of contract, sell for more elsewhere? |
| 11:32:28 AM | Atty Kurtz KIUC - witness Sinclair<br>Note: Sacre, Candace | Something want to guard against? |
| 11:32:50 AM | Atty Kurtz KIUC - witness Sinclair<br>Note: Sacre, Candace | Rhudes Creek, put out for competitive before signed? |
| 11:33:32 AM | Atty Kurtz KIUC - witness Sinclair<br>Note: Sacre, Candace | Company practice competitive solicitations new generation? |
| 11:34:18 AM | Atty Kurtz KIUC - witness Sinclair<br>Note: Sacre, Candace | East Kentucky ended up with Bluegrass? |
| 11:34:28 AM | Atty Kurtz KIUC - witness Sinclair<br>Note: Sacre, Candace | Company expect continue competitive solicitations? |
| 11:34:57 AM | Atty Kurtz KIUC - witness Sinclair<br>Note: Sacre, Candace | Rhudes Creek, companies have RECs renewable energy certificates? |
| 11:35:14 AM | Atty Kurtz KIUC - witness Sinclair<br>Note: Sacre, Candace | $27.82 mWh levelized fixed 20 years plus RECs? |
| 11:35:47 AM | Atty Kurtz KIUC - witness Sinclair<br>Note: Sacre, Candace | Indicated price for solar RECs $7.80 per kWh? |
| 11:36:04 AM | Atty Kurtz KIUC - witness Sinclair<br>Note: Sacre, Candace | Rhudes Creek net cost $27.82 kWh minus $7.80 or approximately $20? |
| 11:36:36 AM | Atty Kurtz KIUC - witness Sinclair<br>Note: Sacre, Candace | $27.80 fixed, RECs higher or lower than $7.80 over time? |
| 11:37:16 AM | Atty Kurtz KIUC - witness Sinclair<br>Note: Sacre, Candace | National industry standard? |
| 11:37:24 AM | Atty Kurtz KIUC - witness Sinclair<br>Note: Sacre, Candace | DSS-2 purport to show? |
| 11:39:33 AM | Atty Kurtz KIUC - witness Sinclair<br>Note: Sacre, Candace | Don't see 719? |
| 11:39:36 AM | Atty Kurtz KIUC - witness Sinclair<br>Note: Sacre, Candace | Table 2? |
| 11:40:17 AM | Atty Kurtz KIUC - witness Sinclair<br>Note: Sacre, Candace | Using Rhudes Creek as proxy market price, consumers pay over 20 years $719.3 million above avoided cost? |
| 11:40:38 AM | Atty Kurtz KIUC - witness Sinclair<br>Note: Sacre, Candace | If Commission went with Barnes approach? |
| 11:40:50 AM | Atty Kurtz KIUC - witness Sinclair<br>Note: Sacre, Candace | Add $7.80 mWh for RECs, would multiply by $2,272,676? |
| 11:41:02 AM | Atty Kurtz KIUC - witness Sinclair<br>Note: Sacre, Candace | Times 20, what would that be? |
| 11:41:58 AM | Atty Kurtz KIUC - witness Sinclair<br>Note: Sacre, Candace | Additional nominal amount above avoided cost, $360 million plus $719.3 million? |
| 11:42:20 AM | Atty Kurtz KIUC - witness Sinclair<br>Note: Sacre, Candace | Same analysis Table 2B using Barnes analogy? |
| 11:42:38 AM | Atty Kurtz KIUC - witness Sinclair<br>Note: Sacre, Candace | Total extra cost over 20 years amount above avoided cost $1,093,000,000? |
| 11:42:46 AM | Atty Kurtz KIUC - witness Sinclair<br>Note: Sacre, Candace | Plus $360 million for RECs? |
| 11:43:04 AM | Atty Kurtz KIUC - witness Sinclair<br>Note: Sacre, Candace | Federal law, consumers not required pay above avoided cost? |

| | | |
|---|---|---|
| 11:43:11 AM | Atty Kurtz KIUC - witness Sinclair | |
| | Note: Sacre, Candace | FERC regulation or state regulation? |
| 11:43:23 AM | Atty Kurtz KIUC - witness Sinclair | |
| | Note: Sacre, Candace | Otherwise, QF subsidized? |
| 11:43:37 AM | Atty Kurtz KIUC - witness Sinclair | |
| | Note: Sacre, Candace | Otherwise, consumers pay more than otherwise pay? |
| 11:44:04 AM | Chairman Chandler | |
| | Note: Sacre, Candace | Questions? |
| 11:44:43 AM | Atty Fitzgerald Joint Intervenors - witness Sinclair | |
| | Note: Sacre, Candace | Cross Examination. Supplemental rebuttal in front of you? |
| 11:44:50 AM | Atty Fitzgerald Joint Intervenors - witness Sinclair | |
| | Note: Sacre, Candace | Page 5, supplemental rebuttal, lines 9-13, review, when customer installs rooftop solar, neighbors involuntarily obligated "pay for part of the project," see that? |
| 11:45:29 AM | Camera Lock Witness Activated | |
| 11:45:35 AM | Atty Fitzgerald Joint Intervenors - witness Sinclair | |
| | Note: Sacre, Candace | What costs company incur when customer puts solar on roof? |
| 11:45:50 AM | Atty Fitzgerald Joint Intervenors - witness Sinclair | |
| | Note: Sacre, Candace | Company have new technical costs, actual measured costs voltage regulation, harmonics, other technical costs, when somebody puts solar on roof and takes service under net metering tariff? |
| 11:46:40 AM | Atty Fitzgerald Joint Intervenors - witness Sinclair | |
| | Note: Sacre, Candace | Your testimony that neighbors pay for part of project, what payment required of other neighbors, companies new administrative costs with billing/collections not otherwise incurred? |
| 11:46:44 AM | Camera Lock Comm Center Activated | |
| 11:46:45 AM | Camera Lock Deactivated | |
| 11:47:51 AM | Atty Fitzgerald Joint Intervenors - witness Sinclair | |
| | Note: Sacre, Candace | Assumption neighbor subsidizing by paying them more than value of the solar? |
| 11:48:52 AM | Atty Fitzgerald Joint Intervenors - witness Sinclair | |
| | Note: Sacre, Candace | Assuming payment going from nonparticipating customer to participating customer? |
| 11:49:48 AM | Atty Fitzgerald Joint Intervenors - witness Sinclair | |
| | Note: Sacre, Candace | Saying if install solar panel, go over and ask neighbor pay some of installation project? |
| 11:51:30 AM | Atty Fitzgerald Joint Intervenors - witness Sinclair | |
| | Note: Sacre, Candace | Neighbors paying for part of project, agree person generates rooftop energy not being paid but being credited? |
| 11:52:20 AM | Atty Fitzgerald Joint Intervenors - witness Sinclair | |
| | Note: Sacre, Candace | Trying to be precise, statute provides for credit not payment? |
| 11:52:46 AM | Atty Fitzgerald Joint Intervenors - witness Sinclair | |
| | Note: Sacre, Candace | Can be cashed out? |
| 11:52:56 AM | Atty Fitzgerald Joint Intervenors - witness Sinclair | |
| | Note: Sacre, Candace | Suggestion neighbors paying solar customers, meaning refer costs approved by Commission for recovery by utility or suggesting automatic payment assess neighborhood association? |
| 11:53:37 AM | Atty Fitzgerald Joint Intervenors - witness Sinclair | |
| | Note: Sacre, Candace | Not sure understand testimony, if install solar, automatically change neighbor's rates? |
| 11:53:57 AM | Atty Fitzgerald Joint Intervenors - witness Sinclair | |
| | Note: Sacre, Candace | Conversely, if value of energy exceeds rate credited, subsidy go other way? |
| 11:55:01 AM | Atty Fitzgerald Joint Intervenors - witness Sinclair | |
| | Note: Sacre, Candace | Assuming something not paying that someone else paid for? |

| | | |
|---|---|---|
| 11:55:56 AM | Atty Fitzgerald Joint Intervenors - witness Sinclair | |
| | Note: Sacre, Candace | Agree if install rooftop solar neighbors don't hand me money, assume cost to serving exceeds value of solar, Commission decides whether approve rate/charge? |
| 11:57:12 AM | Atty Fitzgerald Joint Intervenors - witness Sinclair | |
| | Note: Sacre, Candace | Calculated payment believe nonparticipating paying for rooftop solar customer? |
| 11:57:27 AM | Atty Fitzgerald Joint Intervenors - witness Sinclair | |
| | Note: Sacre, Candace | Assuming paying for part of project, what basis? |
| 11:58:06 AM | Atty Fitzgerald Joint Intervenors - witness Sinclair | |
| | Note: Sacre, Candace | Indicated neighbors rooftop solar customer involuntarily obligated to pay for cost, calculated what cost, what is basis for assertion that neighbors being forced to pay anything for solar customer's participation? |
| 11:59:57 AM | Atty Fitzgerald Joint Intervenors - witness Sinclair | |
| | Note: Sacre, Candace | Not said where energy going, neighbors involuntarily having to pay for part of project, generating solar energy being used by neighbors and offsetting kW hour would be providing? |
| 12:00:42 PM | Atty Fitzgerald Joint Intervenors - witness Sinclair | |
| | Note: Sacre, Candace | Trying understand what referring to when say neighbors paying for project, still billing neighbor for kWh consumed? |
| 12:01:11 PM | Atty Fitzgerald Joint Intervenors - witness Sinclair | |
| | Note: Sacre, Candace | Neighbor getting kW generated by solar customer, charging a premium for kW? |
| 12:02:02 PM | Atty Fitzgerald Joint Intervenors - witness Sinclair | |
| | Note: Sacre, Candace | Finally have explained, analogizing relationship of generation for use by rooftop customer with generation for sale in wholesale market by power purchase agreement? |
| 12:02:59 PM | Atty Fitzgerald Joint Intervenors - witness Sinclair | |
| | Note: Sacre, Candace | Rooftop customer exports energy, goes to neighbor next door, serves neighbor, passes through meter? |
| 12:03:20 PM | Atty Fitzgerald Joint Intervenors - witness Sinclair | |
| | Note: Sacre, Candace | When does, charge for that? |
| 12:03:28 PM | Atty Fitzgerald Joint Intervenors - witness Sinclair | |
| | Note: Sacre, Candace | Neighbor paying retail rate? |
| 12:03:43 PM | Atty Fitzgerald Joint Intervenors - witness Sinclair | |
| | Note: Sacre, Candace | Agree evaluation consisting only of costs incurred deficient if evaluation failed to consider known or reasonably expected measurable positive benefits accrue from fed-in solar? |
| 12:04:39 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Noted and marked Arbough 2 and 3, move for introduction now? |
| 12:05:07 PM | Atty Riggs KU/LG&E | |
| | Note: Sacre, Candace | Move introduction Arbough Rehearing Exhibits 2 and 3. |
| 12:05:12 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Objections? So entered. |
| 12:05:17 PM | ARBOUGH REHEARING EXHIBIT 2 | |
| | Note: Sacre, Candace | ATTY RIGGS KU/LG&E - WITNESS ARBOUGH |
| | Note: Sacre, Candace | UPDATED EXHIBIT B-1 (KU) TO AFFIDAVIT - TAB 59 FR 16(8)(f) - SCHEDULE F-6 - LEGAL FEES IN FORECASTED TEST PERIOD |
| 12:05:18 PM | ARBOUGH REHEARING EXHIBIT 3 | |
| | Note: Sacre, Candace | ATTY RIGGS KU/LG&E - WITNESS ARBOUGH |
| | Note: Sacre, Candace | UPDATED EXHIBIT B-1 (LG&E) TO AFFIDAVIT - TAB 59 FR 16(8)(f) - SCHEDULE F-6 - LEGAL FEES IN FORECASTED TEST PERIOD |
| 12:05:30 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Recess until 1 pm. |

| | | |
|---|---|---|
| 12:05:49 PM | Session Paused | |
| 1:03:15 PM | Session Resumed | |
| 1:03:19 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Back on the record in Case Nos. 2020-00349 and 2020-00350. (Click on link for further comments.) |
| 1:03:38 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Virtual counsel present. (Click on link for further comments.) |
| 1:04:10 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Witness still under oath. |
| 1:04:17 PM | General Counsel Vinsel PSC - witness Sinclair | |
| | Note: Sacre, Candace | Cross Examination. In supplemental direct, calculate new SQF and LQF rates? |
| 1:04:39 PM | General Counsel Vinsel PSC - witness Sinclair | |
| | Note: Sacre, Candace | LG&E/KU proposing those rates be approved to be in effect in this case? |
| 1:05:21 PM | General Counsel Vinsel PSC - witness Sinclair | |
| | Note: Sacre, Candace | In both direct and rebuttal, referenced 2021 business plan to develop avoided costs? |
| 1:05:42 PM | General Counsel Vinsel PSC - witness Sinclair | |
| | Note: Sacre, Candace | What 2020 business plan consists of? |
| 1:06:08 PM | General Counsel Vinsel PSC - witness Sinclair | |
| | Note: Sacre, Candace | Was 2021 business plan filed with Commission? |
| 1:06:21 PM | General Counsel Vinsel PSC - witness Sinclair | |
| | Note: Sacre, Candace | Was document itself filed in rate case? |
| 1:06:44 PM | General Counsel Vinsel PSC - witness Sinclair | |
| | Note: Sacre, Candace | Are business plans reviewed, expressly reviewed, by Commission? |
| 1:08:06 PM | General Counsel Vinsel PSC - witness Sinclair | |
| | Note: Sacre, Candace | Business plan underlying document from which other data compiled and filed? |
| 1:09:25 PM | General Counsel Vinsel PSC - witness Sinclair | |
| | Note: Sacre, Candace | When filed IRP, Commission not approve, accept, open case, determine reasonableness, would business plan go through same process? |
| 1:10:09 PM | General Counsel Vinsel PSC - witness Sinclair | |
| | Note: Sacre, Candace | So much based on baseline plan, some separate document? |
| 1:10:18 PM | Atty Riggs KU/LG&E | |
| | Note: Sacre, Candace | Ask questions of Mr. Conroy. |
| 1:10:40 PM | General Counsel Vinsel PSC - witness Sinclair | |
| | Note: Sacre, Candace | Mentioned in business, calculated correct market price and single-cycle CT, how calculate current market price? |
| 1:16:20 PM | General Counsel Vinsel PSC - witness Sinclair | |
| | Note: Sacre, Candace | Current market price methodology not used outside KU/LG&E entity? |
| 1:17:18 PM | General Counsel Vinsel PSC - witness Sinclair | |
| | Note: Sacre, Candace | Excel file in response Staff's Second Request, Item 34, profiles looking at tabs for solar and wind 80 mW capacity? |
| 1:19:55 PM | General Counsel Vinsel PSC | |
| | Note: Sacre, Candace | Mark PSC Staff Exhibits 1 and 2. |
| 1:20:49 PM | Chairman Chandler | |
| | Note: Sacre, Candace | So marked. |
| 1:21:08 PM | General Counsel Vinsel PSC - witness Sinclair | |
| | Note: Sacre, Candace | 80 mW capacity on module capacity or inverter capacity? |
| 1:21:31 PM | General Counsel Vinsel PSC - witness Sinclair | |
| | Note: Sacre, Candace | Difference between module capacity and inverter capacity? |

| | | |
|---|---|---|
| 1:22:30 PM | General Counsel Vinsel PSC - witness Sinclair | |
| | Note: Sacre, Candace | Brown as an example, 80 mW panel capacity or inverter capacity? |
| 1:22:51 PM | General Counsel Vinsel PSC - witness Sinclair | |
| | Note: Sacre, Candace | Solar single-axis tracking, 80mW inverter capacity? |
| 1:23:17 PM | General Counsel Vinsel PSC - witness Sinclair | |
| | Note: Sacre, Candace | Can PV system designed produces maximum capacity certain times of day? |
| 1:24:24 PM | General Counsel Vinsel PSC - witness Sinclair | |
| | Note: Sacre, Candace | PSC Staff Exhibit 2, spreadsheet, explain how generation profiles for PV created for table? |
| 1:29:16 PM | General Counsel Vinsel PSC - witness Sinclair | |
| | Note: Sacre, Candace | Possible simulation solar power plant capacity factor change depending on weather year chosen? |
| 1:30:30 PM | General Counsel Vinsel PSC - witness Sinclair | |
| | Note: Sacre, Candace | Move to table tab, Exhibit 2, other technologies, last column, 100 percent availability all hours of year? |
| 1:31:19 PM | General Counsel Vinsel PSC - witness Sinclair | |
| | Note: Sacre, Candace | Steam presumed to have 100 percent availability? |
| 1:31:58 PM | General Counsel Vinsel PSC - witness Sinclair | |
| | Note: Sacre, Candace | Response to Staff's Eighth Request, Item 21, state, reading, (click on link for further comments), what replacement units referring to, assumptions used? |
| 1:34:08 PM | General Counsel Vinsel PSC - witness Sinclair | |
| | Note: Sacre, Candace | Sounds like renewables not included, all life-cycle? |
| 1:35:08 PM | General Counsel Vinsel PSC | |
| | Note: Sacre, Candace | Move into evidence PSC Staff Exhibits 1 and 2. |
| 1:35:38 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Let be entered. |
| 1:35:39 PM | PSC STAFF EXHIBIT 1 | |
| | Note: Sacre, Candace | GENERAL COUNSEL VINSEL PSC - WITNESS SINCLAIR |
| | Note: Sacre, Candace | ATTACHMENT TO RESPONSE TO PSC-7 QUESTION 34 |
| 1:35:40 PM | PSC STAFF EXHIBIT 2 | |
| | Note: Sacre, Candace | GENERAL COUNSEL VINSEL PSC - WITNESS SINCLAIR |
| | Note: Sacre, Candace | SUPPLEMENTAL EXHIBIT DSS-2 PAGE 9 OF 16 |
| 1:35:51 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Questions? |
| 1:35:55 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Examination. Page 9 of 16, Table 8, capacity factors or availability factors? |
| 1:37:18 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | This chart at interconnection amount of capacity provided, percentage of name plate inverter can provide at exact hour? |
| 1:37:54 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Corresponds to PSC Staff Exhibit 1? |
| 1:38:06 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | PSC Staff Exhibit 1 feeds into this table? |
| 1:38:16 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Every hour of every year for next 30 years? |
| 1:38:21 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Column for other technologies capacity factory 100 percent of all those hours? |
| 1:38:48 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Not weather dependent, only take into account weather? |

| | | |
|---|---|---|
| 1:39:15 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Realistic to assume for technology that depend on thermal process? |
| 1:40:17 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Does not ambient temperature have impact on capacity of resource that uses thermal resource to produce electricity? |
| 1:40:46 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Expect build 80 mW facility or produce 80 mW electricity? |
| 1:41:25 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Limited to 80 mW because maximum under PURPA? |
| 1:41:35 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Aware instances under PURPA issue what capacity actual generator is, whether qualifies under PURPA as 80 mW unit? |
| 1:42:30 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Other technology unit 80 mW unit some sort of thermal process create electricity, agree any given peak ability output 80mW changes based off weather? |
| 1:43:35 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Aware of resource both do that and comply with PURPA? |
| 1:44:01 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | And still comply with PURPA? |
| 1:44:50 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Supplemental testimony taking into account two factors companies have adequate generation and no significant retirements, nothing over 50 mW, no capacity additions for 15 years, where companies were in 2017? |
| 1:45:49 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | If companies in that position, your position that companies' avoided capacity costs is zero dollars? |
| 1:46:44 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Aware of fixed O&M and stay-open capital costs as expenses? |
| 1:47:02 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Analysis companies do or have done compare resource decisions retire or replace replacement more expensive than stay-open cost? |
| 1:47:34 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Wilson did something similar environmental surcharge case? |
| 1:48:01 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Do you continue spend costs know incur to keep plant open or do something different, effectively the analysis? |
| 1:48:33 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Second part, not spending money, spending stay-open costs avoid incurring stay-open costs? |
| 1:49:03 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Two units similarly situated, one exists, one doesn't, $10 million current CT capital costs and fixed O&M, but CT available last just as long going forward cost $15 million a year rather than $20 million, procure additional capacity unit for less than stay-open cost current unit, assume no costs avoided, would never buy new CT? |
| 1:50:45 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Even if have adequate generation, if costs of replacement capacity less than current generation, going to procure replacement capacity? |
| 1:52:09 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Why if company has adequate generating capacity and no retirements, is avoided cost not stay-open cost of marginal generating unit? |

| | | |
|---|---|---|
| 1:52:38 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Marginal unit stay-open cost zero dollars? |
| 1:53:17 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | If company has adequate generating capacity and no additions/retirements next 15 years, why avoided generation capacity cost not stay-open cost of companies' marginal generation unit? |
| 1:54:19 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Presumption is require generation upon retirement marginal unit avoided generation capacity cost is stay-open cost most expensive unit? |
| 1:55:07 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Nothing presumed cost of replacement generation, what is companies' avoided generation cost? |
| 1:56:05 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Alternative to replacement capacity is stay-open cost of most expensive unit? |
| 1:56:10 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Alternative to replacement capacity are stay-open costs, going forward capital cost and fixed O&M, of companies marginal generating unit? |
| 1:56:43 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | The next one retire one most expensive? |
| 1:57:36 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Is that $100 amount of money avoid if replacement less than $100, net difference between $100 and cost of replacement? |
| 1:57:53 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Compared to $100, that bird in the hand, capacity you have? |
| 1:57:59 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Alternative 1, stay-open capital cost? |
| 1:58:10 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Comparing replacement costs to? |
| 1:58:20 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | If replacement cost is $60 instead of $100, exchanging for like kind and saving $40? |
| 1:58:41 PM | Atty Riggs KU/LG&E | |
| | Note: Sacre, Candace | Take break? |
| 1:58:58 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Break until 2:10. |
| 1:59:14 PM | Session Paused | |
| 2:14:34 PM | Session Resumed | |
| 2:14:43 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Back on record in Case Nos. 2020-00349 and 2020-00350. |
| 2:15:05 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Questions? |
| 2:15:15 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Examination (cont'd). Made differentiation between marginal unit most expensive to retire most likely to retire or highest stay-open cost, difference retiring it no capacity need versus retirement and need capacity, different calculus? |
| 2:16:35 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Different calculation, implied cost that is different? |
| 2:17:11 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | The alternative number one no replacement zero cost, alternative two whatever replacement cost is? |

| | | |
|---|---|---|
| 2:18:14 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Companies next retirement Mill Creek 1? |
| 2:18:34 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Two more slated for retirement late 2030 or late 2020? |
| 2:19:38 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Magical unit with $1 mW cost, didn't say what overnight capacity cost $100? |
| 2:20:12 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Doesn't matter regardless get endless supply from magical unit, that cost compared to going-forward stay-open and marginal cost, cheaper than all other alternatives? |
| 2:20:52 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | Whatever magical unit is, even if company has adequate 20 to 25 mW no additions planning horizon, what calculation do whether replacement capacity or continue on current path with current fleet? |
| 2:22:29 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | What looking at? |
| 2:23:33 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | When comparing replacement generation to current fleet, avoided cost keeping fleet open zero dollars each year, the avoided generation cost keeping open current unit compared with replacing ever zero dollars? |
| 2:25:17 PM | Chairman Chandler - witness Sinclair | |
| | Note: Sacre, Candace | When Mill Creek 1 retire, be fixed expenses companies expected incur if stayed open not that companies not incur upon retirement? |
| 2:26:20 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Questions? |
| 2:26:54 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Witness excused. |
| 2:27:01 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Another witness? |
| 2:27:04 PM | Atty Riggs KU/LG&E | |
| | Note: Sacre, Candace | John Wolfe. |
| 2:27:15 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Witness is sworn. |
| 2:27:26 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Examination. Name and address? |
| 2:27:40 PM | Atty Riggs KU/LG&E - witness Wolfe | |
| | Note: Sacre, Candace | Cross Examination. Title? |
| 2:27:52 PM | Atty Riggs KU/LG&E - witness Wolfe | |
| | Note: Sacre, Candace | How long? |
| 2:28:12 PM | Atty Riggs KU/LG&E - witness Wolfe | |
| | Note: Sacre, Candace | Cause to be prepared and filed supplemental direct? |
| 2:28:21 PM | Atty Riggs KU/LG&E - witness Wolfe | |
| | Note: Sacre, Candace | Supplemental rebuttal testimony? |
| 2:28:34 PM | Atty Riggs KU/LG&E - witness Wolfe | |
| | Note: Sacre, Candace | Same questions, same answers? |
| 2:28:39 PM | Atty Riggs KU/LG&E - witness Wolfe | |
| | Note: Sacre, Candace | Adopt and affirm? |
| 2:29:00 PM | Atty Riggs KU/LG&E - witness Wolfe | |
| | Note: Sacre, Candace | Have access to computer screen? |
| 2:29:08 PM | Atty Riggs KU/LG&E - witness Wolfe | |
| | Note: Sacre, Candace | Constitute entire amount of material in front of you? |

| | | |
|---|---|---|
| 2:29:38 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Questions? |
| 2:29:54 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | Cross Examination. Know whether companies ever evaluated installation of distributed generation or other distributed resources alternative to alternative to conventional infrastructure? |
| 2:30:20 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | Describe what evaluations consisted? |
| 2:33:57 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | New buzz phrase non-wires solutions. Demand response? |
| 2:34:12 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | Distributed generation? |
| 2:34:20 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | Energy efficiency? |
| 2:34:33 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | Energy efficiency on other side of meter? |
| 2:34:47 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | Micro grids a non-wires solution? |
| 2:34:57 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | Do you do cost benefit analysis when considering non-wires solutions? |
| 2:36:03 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | Only if engineers looks like in ballpark, then do cost benefit analysis? |
| 2:37:34 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | Know whether engineers have done cost benefit assessments? |
| 2:38:36 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | Considering least cost option, what horizon looking at in terms of planning period? |
| 2:39:12 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | Looking distribution horizon, generation horizon might be different? |
| 2:39:33 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | Is there standardized cost benefit analysis applied to integrated resource planning, repair, replacement, applied? |
| 2:40:25 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | Suggestion other witnesses the rooftop generation and value of rooftop generation done incidental rooftop customer generating excess fed into grid at retail should be compared solar array cost of production, recall? |
| 2:41:34 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | Any point incurred new expenses related to addition of rooftop solar customer in system additional lines or transformers or other equipment to serve customer? |
| 2:43:37 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | Discussing incremental cost serving just net metering customers or all distributed generation? |
| 2:44:29 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | Net metering customers pay fee to cover costs? |
| 2:44:44 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | No fee for net metering customer under current interconnection and net metering guidelines? |
| 2:45:20 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | If were requirement to upgrade to accommodate customer, customer would pay? |
| 2:45:49 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | None of cost paid by other ratepayers? |

| | | |
|---|---|---|
| 2:46:22 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Questions? |
| 2:46:28 PM | General Counsel Vinsel PSC - witness Wolfe | |
| | Note: Sacre, Candace | Cross Examination. Seelye rebuttal, April 12 2020, page 25, reading, (click on link for further comments), agree? |
| 2:51:40 PM | General Counsel Vinsel PSC - witness Wolfe | |
| | Note: Sacre, Candace | Having problems on your system now from DG ? |
| 2:52:38 PM | General Counsel Vinsel PSC - witness Wolfe | |
| | Note: Sacre, Candace | These resources, talking about DERMs? |
| 2:53:45 PM | General Counsel Vinsel PSC - witness Wolfe | |
| | Note: Sacre, Candace | When you say advice from out west, somewhere in particular? |
| 2:54:57 PM | General Counsel Vinsel PSC - witness Wolfe | |
| | Note: Sacre, Candace | Comparing DG penetration in KU/LG&E not comparable to AZ or CA? |
| 2:55:20 PM | General Counsel Vinsel PSC - witness Wolfe | |
| | Note: Sacre, Candace | DER terminology? |
| 2:55:35 PM | General Counsel Vinsel PSC - witness Wolfe | |
| | Note: Sacre, Candace | KU peak DER capacity 0.19 percent system peak load? |
| 2:55:40 PM | General Counsel Vinsel PSC - witness Wolfe | |
| | Note: Sacre, Candace | LG&E 0.26 percent system peak load? |
| 2:55:48 PM | General Counsel Vinsel PSC - witness Wolfe | |
| | Note: Sacre, Candace | Peak DER/DG capacity? |
| 2:56:18 PM | General Counsel Vinsel PSC - witness Wolfe | |
| | Note: Sacre, Candace | Response to Staff Seventh Request, Item 36, reading, (click on link for further comments), need DERMS for smart inverters to support grid during disturbances and normal operations? |
| 2:59:10 PM | General Counsel Vinsel PSC - witness Wolfe | |
| | Note: Sacre, Candace | Familiar IEEE 1547 2018 standard? |
| 2:59:25 PM | General Counsel Vinsel PSC - witness Wolfe | |
| | Note: Sacre, Candace | Generally aware IEEE 1547 2018 standard requires/recommends DG capable of autonomously adjusting reference voltage? |
| 3:02:00 PM | General Counsel Vinsel PSC - witness Wolfe | |
| | Note: Sacre, Candace | Aware other state allows DG operate with autonomous smart inverters rather than DERMS? |
| 3:02:35 PM | General Counsel Vinsel PSC - witness Wolfe | |
| | Note: Sacre, Candace | Mentioned Commission Staff sent out Minnesota interconnection implementation process, familiar with that? |
| 3:03:05 PM | General Counsel Vinsel PSC | |
| | Note: Sacre, Candace | Introduce January 22 2020 E-999/CI-16-521 and E-999/CI-01-1023, establishing technical interconnection and interoperability requirements, PSC Staff Exhibit 3. |
| 3:03:47 PM | General Counsel Vinsel PSC | |
| | Note: Sacre, Candace | State of Minnesota Technical Interconnection and Interoperability Requirements, PSC Staff Exhibit 4. |
| 3:04:45 PM | General Counsel Vinsel PSC - witness Wolfe | |
| | Note: Sacre, Candace | In this order, recommend TIIR work group discuss voltage, turn to page 21 of Exhibit 4, 5.4 Voltage and Active Power Control (volt-watt), agree table sets out autonomous voltage regulation? |
| 3:06:01 PM | General Counsel Vinsel PSC - witness Wolfe | |
| | Note: Sacre, Candace | Given what happening with smart inverters KU/LG&E looked at smart inverters rather than DERMS programs? |
| 3:07:38 PM | General Counsel Vinsel PSC - witness Wolfe | |
| | Note: Sacre, Candace | Studied this? |
| 3:07:44 PM | General Counsel Vinsel PSC - witness Wolfe | |
| | Note: Sacre, Candace | Formal evaluation gone on? |

| | | |
|---|---|---|
| 3:08:42 PM | General Counsel Vinsel PSC | |
| | Note: Sacre, Candace | Move PSC Staff Exhibits 3 and 4 into record. |
| 3:09:07 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Sustained. |
| 3:09:13 PM | PSC STAFF EXHIBIT 3 | |
| | Note: Sacre, Candace | GENERAL COUNSEL VINSEL PSC - WITNESS WOLFE |
| | Note: Sacre, Candace | MINNESOTA PUBLIC UTILITIES COMMISSION DOCKET NOS. 3-999/CI-16-521 and E-999/CI-01-1023 ORDER ESTABLISHING UPDATED TIIR |
| 3:09:15 PM | PSC STAFF EXHIBIT 4 | |
| | Note: Sacre, Candace | GENERAL COUNSEL VINSEL PSC - WITNESS WOLFE |
| | Note: Sacre, Candace | STATE OF MINNESOTA TECHNICAL INTERCONNECTION AND INTEROPERABILITY REQUIREMENTS (TIIR) |
| 3:09:21 PM | Vice Chairman Cubbage - witness Wolfe | |
| | Note: Sacre, Candace | Examination. Supplemental, page 7, congestion distribution system along grid, net metering no measurable impact on congestion either way? |
| 3:10:00 PM | Vice Chairman Cubbage - witness Wolfe | |
| | Note: Sacre, Candace | Opposite Seelye rebuttal testimony? |
| 3:10:14 PM | Vice Chairman Cubbage - witness Wolfe | |
| | Note: Sacre, Candace | Page 25, right after cover sheet, reading, (click on link for further comments), disagree with that? |
| 3:11:03 PM | Vice Chairman Cubbage - witness Wolfe | |
| | Note: Sacre, Candace | Proposing zero? |
| 3:11:21 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Examination. What costs being driven by voltage issues today by distributed energy resources? |
| 3:12:49 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Worst case scenario? |
| 3:13:13 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Today, what costs, what problems are incurring, not what other utilities talking to experiencing, what issues having today driving costs from net metering customers? |
| 3:14:02 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Not getting incremental costs from a technical perspective, think those interconnection costs in an interconnection docket? |
| 3:14:34 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Current net metering customers, about 1/5 of current cap of net metering customers? |
| 3:15:04 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | KU little under 20 percent, LG&E little over 20 percent? |
| 3:15:18 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Not see difference your testimony and Seelye testimony, today, are net metering customers creating congestion on distribution system that add to costs, today? |
| 3:15:53 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | With voltage, your understanding that companies' tariffs on file require net metering customers provide electricity on to grid at the voltage that company uses? |
| 3:16:28 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Object to ask Lovekamp provide copy of companies current net metering tariff, proposed or current tariffs in record, net metering service interconnection PSC No. 19 Tariff Sheet 57.1. |
| 3:17:19 PM | Atty Spenard KYSEIA | |
| | Note: Sacre, Candace | Looking at current 57.1, currently on file? |

| | | |
|---|---|---|
| 3:17:41 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Yes, (click on link for further comments). |
| 3:18:34 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | What on the screen same on your screen? |
| 3:18:46 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Net Metering Service Interconnection Guidelines for KU, General - Customer, reading, (click on link for further comments), see that? |
| 3:19:51 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Understanding from your position that expect customer generators supposed to provide voltage companies use? |
| 3:20:31 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Had any instances rogue or customer not keeping system up that you had issues with voltage coming from net metering customer? |
| 3:21:19 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | What saying based off companies' feedback what voltage been on converter settings on inverter changed and that helped issue? |
| 3:22:01 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Similar conversation with Vinsel tune in to these settings as default? |
| 3:22:29 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Copy of supplemental testimony, page 1, line 19, reading, (click on link for further comments), right? |
| 3:23:40 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Aware of applications for CPCN in these cases and Commission approved AMI? |
| 3:23:52 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Bellar supported that business case for that CPCN? |
| 3:24:04 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Remember what cost categories and proposals business case looked like Bellar presented? |
| 3:24:18 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | What was business case? Proposing AMI, benefits exceeded costs, how? |
| 3:24:59 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Help implement conservation voltage program because AMI coupled with volt-var ability to reduce voltages to minimum level? |
| 3:25:17 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Net metering stays current level, companies still implement AMI and volt-var? |
| 3:25:40 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Investments in volt-var at this time not driven by current issues voltage with net metering? |
| 3:26:39 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | What in forecast or business plan drives exponential growth distributed generation, what driving growth where assumes growth of DERs? |
| 3:26:50 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Only get five times more at current level of number net metering load? |
| 3:27:26 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Understand just one percent cap on net metering? |
| 3:27:43 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | One percent cap and obligation ends at one percent cap, what in forecast drives exponential growth distributed generation, what driving exponential growth in business plan where assumes exponential growth of DERs? |

| | | |
|---|---|---|
| 3:28:36 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | NMS 1 customers significantly increased in last two to three years? |
| 3:28:43 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Exactly same time being considered to be changed? |
| 3:28:49 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Have taken last two to three years growth and assumed baseline level of growth DERs out to 2027? |
| 3:29:15 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | That type of document reflected in 2020 business plan? |
| 3:29:35 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Been asked to provide in data request? |
| 3:29:52 PM | POST-HEARING DATA REQUEST | |
| | Note: Sacre, Candace | CHAIRMAN CHANDLER - WITNESS WOLFE |
| | Note: Sacre, Candace | COMPANIES ASSUMED GROWTH RATE IN DERS |
| 3:30:02 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Only forward looking, ignoring imbedded costs, agree companies' current meters imbedded costs? |
| 3:30:19 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Meter reading expense, replacement meters over time, those costs forecast but imbedded class cost of service study for allocating expenses to customers? |
| 3:30:29 PM | Atty Riggs KU/LG&E | |
| | Note: Sacre, Candace | Well beyond scope of testimony. |
| 3:30:36 PM | Chairman Chandler | |
| | Note: Sacre, Candace | How beyond scope of testimony? |
| 3:31:29 PM | Atty Riggs KU/LG&E | |
| | Note: Sacre, Candace | AMI study, COS study, not testified to this. |
| 3:31:49 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Arguing for framework, asking why. (Click on link for further comments.) |
| 3:32:28 PM | Atty Riggs KU/LG&E | |
| | Note: Sacre, Candace | Will testify to framework proposes to the extent he understands other questions, withdraw objection. |
| 3:32:40 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Companies proposal for AMI, make new investment, move away from meters imbedded cost, moving into new meters costs of doing that below avoided costs of old meters? |
| 3:33:38 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Real savings, voltage conservation reduction not necessarily created by AMI but couldn't exist without AMI? |
| 3:34:08 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Voltage monitoring other than at meter? |
| 3:34:20 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Meter reading expense, AMI not meter readers, right? |
| 3:34:41 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Avoiding those costs, replacement of dumb meters, not have to continue replace those with other meters if move on to AMI, remember? |
| 3:35:12 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Can be some consideration of imbedded costs or past costs in determining these types of business plans? |
| 3:35:38 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | What specific about framework distribution system whereas Commission must consider future investments not embedded costs? |

| | | |
|---|---|---|
| 3:37:03 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Distinction, using imbedded as synonym for sunk cost? |
| 3:37:50 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Electric meters an imbedded costs? |
| 3:38:10 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Framework for avoided costs generally? |
| 3:38:21 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Meters not technically distribution capacity costs? |
| 3:38:25 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Distinction between avoided distribution cost and avoided distribution capacity cost? |
| 3:38:55 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Propose what is and isn't capacity related distribution cost or actually avoidable? |
| 3:39:47 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | What can avoid for companies' growth? |
| 3:40:25 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Talking about today, issues congestion/voltage today, pages 3-5, supplemental, growth, reading, (click on link for further comments), rules created no impact distribution system but trying to get ahead of exponential growth, how square those? |
| 3:42:26 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Referring to 15 percent, guidelines single circuit? |
| 3:42:34 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Protect other customers including net metering customers? |
| 3:42:51 PM | Chairman Chandler - witness Wolfe | |
| | Note: Sacre, Candace | Follow on impact? |
| 3:42:59 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Questions? |
| 3:43:52 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | Cross Examination. Said currently with both utilities having 20 percent net metering customers with one percent cap not seeing capacity constraints or congestion issues? |
| 3:44:42 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | Formerly, net metering statutes, petition being relieved when aggregate amount net metering generation one percent single hour peak load annually? |
| 3:45:09 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | Change in law no longer requirement petition be relieved but hard cap of one percent, once reach cap no further obligation offer net metering? |
| 3:45:23 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | Companies intend to offer net metering once one percent cap reached? |
| 3:45:45 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | Not announced decision companies will or won't provide it? |
| 3:45:58 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | Understand interaction with Commission Staff currently not seeing congestion on system or capacity constraints because of net metering customers? |
| 3:48:04 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | Aware of circumstances modeling occurred, scenario played out? |

| | | |
|---|---|---|
| 3:48:54 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | Based on real world, current pattern distribution net metering customers, expect to see congestion/other technical grid issues at 40 60 80 or 100 percent of cap? |
| 3:50:01 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | Seen circumstance 15 percent cap on aggregate generation on circuit most recent annual one-hour peak load seen situation even having clustered net metering customers has caused that problem? |
| 3:50:57 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | Know whether have a one percent cap in net metering obligations? |
| 3:51:25 PM | Atty Fitzgerald Joint Intervenors - witness Wolfe | |
| | Note: Sacre, Candace | Possible to produce those circumstances where engineers identified problems in other utilities in system? |
| 3:52:24 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Questions? |
| 3:52:32 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Witness is excused. |
| 3:52:52 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Recess until 4:05. |
| 3:53:19 PM | Session Paused | |
| 4:09:01 PM | Session Resumed | |
| 4:09:04 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Back on record in Case Nos. 2020-00349 and 2020-00350. |
| 4:09:31 PM | Chairman Chandler | |
| | Note: Sacre, Candace | No objection allow Kurtz call witness. (Click on link for further comments.) |
| 4:09:53 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Witness is sworn. |
| 4:10:00 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | Examination. Name and address? |
| 4:10:23 PM | Atty Kurtz KIUC - witness Baron | |
| | Note: Sacre, Candace | Direct Examination. Provide testimony? |
| 4:10:40 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | Examination. What documents have in front of you? |
| 4:11:35 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | June 30th order? |
| 4:12:02 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Questions? |
| 4:12:16 PM | Atty Spenard KYSEIA | |
| | Note: Sacre, Candace | Point out to Commission Baron not file testimony in supplemental proceedings. (Click on link for further comments.) |
| 4:12:45 PM | Camera Lock Intervenor Activated | |
| 4:14:54 PM | Camera Lock Deactivated | |
| 4:14:55 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Baron did provide testimony at initial part of case, not waiving objection, may assert your objection if goes beyond. |
| 4:15:13 PM | Atty Spenard KYSEIA | |
| | Note: Sacre, Candace | Yes. |
| 4:16:04 PM | Atty Spenard KYSEIA - witness Baron | |
| | Note: Sacre, Candace | Cross Examination. On March 5 2021 KIUC and AG jointly filed direct testimony/exhibits, correct? |
| 4:17:02 PM | Atty Spenard KYSEIA - witness Baron | |
| | Note: Sacre, Candace | Aware June 30 2021 order procedural schedule? |

| | | |
|---|---|---|
| 4:17:18 PM | Atty Spenard KYSEIA - witness Baron | |
| | Note: Sacre, Candace | Refer to activity after June 2021 additional proceedings? |
| 4:17:46 PM | Atty Spenard KYSEIA - witness Baron | |
| | Note: Sacre, Candace | Prepare supplemental rebuttal testimony? |
| 4:18:00 PM | Atty Spenard KYSEIA - witness Baron | |
| | Note: Sacre, Candace | Prepare supplemental rebuttal for additional proceedings? |
| 4:18:07 PM | Atty Spenard KYSEIA - witness Baron | |
| | Note: Sacre, Candace | Update to testimony/exhibits filed March 5 2021? |
| 4:18:19 PM | Atty Spenard KYSEIA - witness Baron | |
| | Note: Sacre, Candace | Respond to request for information by companies, Commission Staff, or intervenors? |
| 4:18:40 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Questions? |
| 4:19:23 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Cross Examination. Economist? |
| 4:19:29 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Masters degree University of Florida 1974? |
| 4:19:40 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Professional experience electrical utility rates rate analysis? |
| 4:20:08 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | How many cases filed testimony? |
| 4:20:16 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Testified in every KU/LG&E since 1981? |
| 4:21:03 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Every rate case? |
| 4:21:10 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Presently represent GA and LA Commissions and industrial customers? |
| 4:21:35 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Who representing in this case, representing AG and KIUC? |
| 4:21:51 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Members of KIUC include Ford and Toyota? |
| 4:22:08 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | During career, marginal or COS? |
| 4:22:44 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Familiar with term marginal cost? |
| 4:22:50 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Change in cost due to change in demand? |
| 4:23:07 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Avoided cost similar concept? |
| 4:23:45 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Familiar with PSC regulations definition of avoided cost, reading (click on link for further comments)? |
| 4:24:17 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Avoided cost incremental energy capacity cost utility not incur if purchased from QF or net metering customer? |
| 4:24:44 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Difference between marginal energy cost and marginal generation capacity cost? |
| 4:26:15 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Imbedded costs not same as avoided costs? |
| 4:26:26 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Imbedded costs relate to capacity costs already incurred by utility? |

| | | |
|---|---|---|
| 4:27:08 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Imbedded costs essentially sunk costs? |
| 4:27:58 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Avoided capacity costs can be higher or lower than imbedded costs? |
| 4:28:06 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Avoided capacity costs depend on changes in capacity-related costs planned or in future? |
| 4:29:28 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Possible utility marginal generation capacity cost be very minimal or small? |
| 4:29:58 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Sufficient capacity possible generation capacity cost zero? |
| 4:31:14 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Utility demands decreasing possible still have capacity to serve existing customers and marginal or avoided capacity costs be zero or very little? |
| 4:31:50 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Same case when analyzing transmission costs, peak demands decreasing marginal transmission costs be zero or near zero? |
| 4:32:50 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Calculating marginal generation capacity costs, necessary consider time frame when utility needs install additional capacity? |
| 4:33:59 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Calculation of avoided generation cost, no capacity need for number of years, necessary discount future capacity costs in determining marginal or avoided capacity costs? |
| 4:35:08 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Understand answer to say if utility not have need for capacity 7-15 years agree not appropriate use undiscounted cost of generating unit to calculate long term marginal or avoided costs? |
| 4:36:45 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Incorporate that into calculation by discounting? |
| 4:36:58 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Based on experience, solar facilities be called on any time to provide capacity to grid? |
| 4:37:56 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Describe solar capacity as intermittent energy? |
| 4:38:04 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Solar facilities not provide firm capacity? |
| 4:38:34 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Should companies plan resources and conduct operations based on principle of lowest reasonable cost? |
| 4:38:48 PM | Atty Riggs KU/LG&E - witness Baron | |
| | Note: Sacre, Candace | Sound economics and appropriate to pay high QF customer or net metering customer generator for capacity at higher cost than purchase from a purchase power agreement? |
| 4:39:40 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Questions? |
| 4:39:47 PM | General Counsel Vinsel PSC - witness Baron | |
| | Note: Sacre, Candace | Cross Examination. Definition avoided costs, lay opinion, familiar with regulation Commission has small power production co-generation? |

| | | |
|---|---|---|
| 4:40:41 PM | General Counsel Vinsel PSC - witness Baron | |
| | Note: Sacre, Candace | Definition provided avoided costs comes directly from regulation, aware, lay opinion, whether regulation based on federal law, PURPA law, and definitions? |
| 4:41:06 PM | General Counsel Vinsel PSC - witness Baron | |
| | Note: Sacre, Candace | Familiar with PURPA definitions of avoided costs? |
| 4:41:34 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Questions? |
| 4:42:04 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | Examination. Riggs asked avoided costs, imbedded costs, do a number of COS across jurisdictions work in? |
| 4:42:32 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | Imbedded cost not new or foreign you go a week without hearing? |
| 4:42:49 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | End of year ending balance capital costs or expenses incurred during that year? |
| 4:43:14 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | When say expenses, imbedded costs, more general term cost or expense? |
| 4:43:40 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | If utility going forward and comes upon a cost avoidable but rather than avoiding cost is incurred, for utility purposes at that point imbedded cost? |
| 4:44:23 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | Imbedded costs effectively costs incurred whether avoidable or not? |
| 4:45:06 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | In test year, if Mill Creek 1 fixed O&M $10 million and stay-open cost $10 million, test year $20 million on that basis as imbedded costs for COS purposes? |
| 4:45:38 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | Not mean Mill Creek 1 retired on December 1 2021, in 2022 companies incur going forward capital and fixes O&M costs? |
| 4:46:14 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | Because imbedded cost one time frame not mean is or is not avoidable? |
| 4:47:12 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | Not do anything costs incurred but avoid cost going forward? |
| 4:47:25 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | Or cost for same action or entity demand going forward? |
| 4:47:47 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | Over simplified conversation, if imbedded costs include costs fixed expenses not avoidable costs technically could be avoidable and include capital costs and operating expenses? |
| 4:48:23 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | Cost avoidable but not get avoided in rate making imbedded cost at that point? |
| 4:48:39 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | Avoided costs incurred not avoided become imbedded costs? |
| 4:48:49 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | Relationship between avoided costs and imbedded costs? |
| 4:49:36 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | Reason ask, imbedded cost accounting cost been incurred? |
| 4:50:12 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | Fact spent certain amount past month not necessarily mean have to spend that amount going forward? |

| | | |
|---|---|---|
| 4:50:36 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | Mortgage, not sell house, have that cost the following month? |
| 4:51:07 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | Avoided cost and marginal cost, change in cost based on change in demand, marginal cost linear, remember that? |
| 4:52:37 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | Not perfectly linear or curve line, may be stair step, may be some change in demand that not change cost and all of sudden may significantly change cost, your experience? |
| 4:53:54 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | Avoided generation capacity, stair step, presents complications, very expensive, long lead times, chunky, not come in one mW increments, nearest 100 mW? |
| 4:55:25 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | Compare avoided costs happen be linear direct correlation short time period and costs more stair step, if change demand by one increment, not change cost any, assume no avoidance along that change in demand or should be acknowledgment about to be in ten or two or 100 mW significant change when move along data set? |
| 4:58:46 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | Riggs asking possible avoided generation capacity value zero or near zero or de minimis, very base level stay-open cost for generator fixed O&M and going-forward capital costs, fair proxy for avoided capacity cost at time utility adequate generating capacity or within reserve margin? |
| 5:01:17 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | Any jurisdictions change generators operate seasonally? |
| 5:02:13 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | Economics effectively doing that avoiding costs otherwise incurred keeping active/operating? |
| 5:02:38 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Questions? |
| 5:02:45 PM | Atty Kurtz KIUC - witness Baron | |
| | Note: Sacre, Candace | Redirect Examination. Fair market value 50 mW solar $30 mWh fixed over 20 years and utility buys it keeps RECs but QF regulation requires utility pay $36 mWh and developer keeps RECs, who is harmed? |
| 5:03:54 PM | Atty Kurtz KIUC - witness Baron | |
| | Note: Sacre, Candace | Who benefit? |
| 5:04:04 PM | Atty Kurtz KIUC - witness Baron | |
| | Note: Sacre, Candace | Owner of power plant? |
| 5:04:09 PM | Atty Kurtz KIUC - witness Baron | |
| | Note: Sacre, Candace | Any way audit power plant owner whether needed money to build plant? |
| 5:04:23 PM | Atty Kurtz KIUC - witness Baron | |
| | Note: Sacre, Candace | Discount rate, consumers required to buy QF plant before needed, what would the appropriate discount rate methodology be? |
| 5:05:23 PM | Atty Kurtz KIUC - witness Baron | |
| | Note: Sacre, Candace | Residential rate payer credit card balance, loan, buy QF power plant before needed, 17, 18, 20 percent, out money, personal cost of capital? |
| 5:06:02 PM | Atty Kurtz KIUC - witness Baron | |
| | Note: Sacre, Candace | Higher discount rate, greater present value discounting, buying before needed discount 18 percent, present value less than discount risk-free Treasury bond rate? |

| | | |
|---|---|---|
| 5:06:53 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Questions? |
| 5:07:02 PM | Atty Spenard KYSEIA - witness Baron | |
| | Note: Sacre, Candace | Recross Examination. Response to Riggs PPA, phrase all else being equal, recall that? |
| 5:07:41 PM | Atty Spenard KYSEIA - witness Baron | |
| | Note: Sacre, Candace | Familiar with Latin phrase ceteris paribus? |
| 5:07:53 PM | Atty Spenard KYSEIA - witness Baron | |
| | Note: Sacre, Candace | Allows us to simplify economics? |
| 5:08:14 PM | Atty Riggs KU/LG&E | |
| | Note: Sacre, Candace | Objection. Define. |
| 5:08:16 PM | Atty Spenard KYSEIA | |
| | Note: Sacre, Candace | Working with witness. |
| 5:08:22 PM | Atty Spenard KYSEIA - witness Baron | |
| | Note: Sacre, Candace | Latin phrase familiar with in economics? |
| 5:09:40 PM | Atty Spenard KYSEIA - witness Baron | |
| | Note: Sacre, Candace | Response to Riggs, when say all else being equal, using from economist standpoint, that simplifying assumption? |
| 5:10:06 PM | Atty Spenard KYSEIA - witness Baron | |
| | Note: Sacre, Candace | Qualifying answer by saying basically putting boundaries around response, all else being equal that's the answer? |
| 5:11:19 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Questions? |
| 5:11:29 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Cross Examination. Familiar with economic externalities? |
| 5:11:37 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | What are they? |
| 5:12:48 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | If real cost, real benefit left out of price, price more or less efficient? |
| 5:13:10 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Idea proper pricing include real cost and real benefits not familiar with? |
| 5:13:36 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Brown Station Solar Plant? |
| 5:13:41 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Familiar IRPs filed concerning future capacity? |
| 5:14:13 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | In your experience, how many years utility related economic work? |
| 5:14:28 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Time at which cost of sulfur dioxide controls considered externality? |
| 5:14:54 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Recall cost of controlling fine particulate externality? |
| 5:15:23 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Familiar concept social discount rates? |
| 5:15:36 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | What understanding? |
| 5:16:26 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Know whether social discount rates higher or lower than private discount rates? |
| 5:16:34 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Capacity value of solar, being able to be called upon, particular energy source? |
| 5:17:06 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Capacity value can be calculated? |

| | | |
|---|---|---|
| 5:17:11 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Is calculated for solar? |
| 5:17:16 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Solar deemed have a capacity value? |
| 5:17:24 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Operate during summer peaks? |
| 5:17:59 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Did you make calculations in this case? |
| 5:18:04 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Company made those calculations? |
| 5:18:13 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Mentioned solar intermittent, what intermittent mean to you? |
| 5:19:22 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Solar resource/wind resource fairly predictable? |
| 5:19:50 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Sinclair testified about chart and how predict may be actually capacity of Brown Unit on particular day? |
| 5:20:13 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Fair say solar high availability rate? |
| 5:20:23 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Intermittent, do you mean variable? |
| 5:20:54 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Purchase power agreement importance of contract, tariffs not contractual relationship between customer and utility approved by Commission services offered under certain terms and customer certain obligations? |
| 5:23:08 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Net metering customer not credited for generation not use? |
| 5:23:34 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Asked by Riggs definition avoided costs, read definition as appears 807 KAR 5:054? |
| 5:24:08 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Reading, (click on link for further comments), aware has any relationship to net metering customer? |
| 5:25:12 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Know whether net metering customer considered qualifying facility? |
| 5:25:30 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Know whether statute used avoided cost in establishing fair, just, reasonable rate for fed-in solar? |
| 5:26:10 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Take issue with statement, in evaluating cost necessary to serve net metering service customers, evaluation deficient if evaluation failed consider known or reasonably expected measurable positive effects or benefits that accrued to companies? |
| 5:26:40 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Agree or disagree with that? |
| 5:27:36 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | May 14 Order, Kentucky Power case, established methodology for considering and evaluating compensatory credit for net metering customers, disagree with methodology adopted in that order by Commission? |
| 5:28:35 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Provide any opinion after May 14 Order on whether net metering tariff fails incorporate both costs avoided components and benefits would be fair, just, and reasonable? |

| | | |
|---|---|---|
| 5:29:00 PM | Asst Atty General Cook | |
| | Note: Sacre, Candace | Object. |
| 5:29:28 PM | Atty Fitzgerald Joint Intervenors - witness Baron | |
| | Note: Sacre, Candace | Enter opinion whether net metering tariff proposed by LG&E comports with methodology in Kentucky Power case or whether net metering tariff not comport with methodology be fair, just, and reasonable? |
| 5:30:06 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Questions? |
| 5:30:20 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | Examination. Avoiding a harm or damage is benefit in conducting benefit in conducting benefit cost analysis, simple question, agree avoidance of cost system benefit? |
| 5:32:25 PM | Chairman Chandler - witness Baron | |
| | Note: Sacre, Candace | Cost to utility avoiding utility cost is benefit to remainder of system? |
| 5:32:54 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Questions? |
| 5:33:07 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Witness is excused. |
| 5:33:51 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Recess until 5:38. |
| 5:34:09 PM | Session Paused | |
| 5:40:37 PM | Session Resumed | |
| 5:40:42 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Back on record in Case Nos. 2020-00349 and 2020-00350, |
| 5:40:51 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Additional witness? |
| 5:40:56 PM | Atty Riggs KU/LG&E | |
| | Note: Sacre, Candace | Beth McFarland. |
| 5:41:07 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Witness is sworn. |
| 5:41:15 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | Examination. Name and address? |
| 5:41:34 PM | Atty Riggs KU/LG&E - witness McFarland | |
| | Note: Sacre, Candace | Direct Examination. Business title? |
| 5:41:44 PM | Atty Riggs KU/LG&E - witness McFarland | |
| | Note: Sacre, Candace | How long with companies? |
| 5:41:52 PM | Atty Riggs KU/LG&E - witness McFarland | |
| | Note: Sacre, Candace | Cause prepared and filed supplemental direct and supplemental rebuttal? |
| 5:42:08 PM | Atty Riggs KU/LG&E - witness McFarland | |
| | Note: Sacre, Candace | Same questions, same answers? |
| 5:42:31 PM | Atty Riggs KU/LG&E - witness McFarland | |
| | Note: Sacre, Candace | Adopt and confirm? |
| 5:42:36 PM | Atty Riggs KU/LG&E - witness McFarland | |
| | Note: Sacre, Candace | What documents you have? |
| 5:42:43 PM | Atty Riggs KU/LG&E - witness McFarland | |
| | Note: Sacre, Candace | Access to screen and computer? |
| 5:42:53 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Questions? |
| 5:43:29 PM | Atty Fitzgerald Joint Intervenors - witness McFarland | |
| | Note: Sacre, Candace | Cross Examination. Rebuttal, have that in front of you? |

| | | |
|---|---|---|
| 5:43:38 PM | Atty Fitzgerald Joint Intervenors - witness McFarland | |
| | Note: Sacre, Candace | Page 4, line 14, definition, referenced current planning horizon, what is that horizon purposes your work with companies? |
| 5:44:14 PM | Atty Fitzgerald Joint Intervenors - witness McFarland | |
| | Note: Sacre, Candace | Rolling five-year plan, update every year? |
| 5:44:25 PM | Atty Fitzgerald Joint Intervenors - witness McFarland | |
| | Note: Sacre, Candace | Page 4, line19, the phrase "imbedded or potentially avoidable transmission costs," see that? |
| 5:44:40 PM | Atty Fitzgerald Joint Intervenors - witness McFarland | |
| | Note: Sacre, Candace | Who holds data what imbedded or potentially avoidable transmission costs would be, in possession of companies? |
| 5:44:54 PM | Atty Fitzgerald Joint Intervenors - witness McFarland | |
| | Note: Sacre, Candace | Incorporated into ongoing planning? |
| 5:45:04 PM | Atty Fitzgerald Joint Intervenors - witness McFarland | |
| | Note: Sacre, Candace | In planning that do, incorporate imbedded or potentially avoidable transmission costs looking forward? |
| 5:45:30 PM | Atty Fitzgerald Joint Intervenors - witness McFarland | |
| | Note: Sacre, Candace | Consider other part of phrase, potentially avoidable transmission costs? |
| 5:45:50 PM | Atty Fitzgerald Joint Intervenors - witness McFarland | |
| | Note: Sacre, Candace | Here when discussing other witnesses idea of no-wires solutions? |
| 5:46:00 PM | Atty Fitzgerald Joint Intervenors - witness McFarland | |
| | Note: Sacre, Candace | Consider in planning no-wires solutions when considering potentially avoidable transmission costs? |
| 5:46:59 PM | Atty Fitzgerald Joint Intervenors - witness McFarland | |
| | Note: Sacre, Candace | Investments companies make in transmission subject to return on equity? |
| 5:47:30 PM | Atty Fitzgerald Joint Intervenors - witness McFarland | |
| | Note: Sacre, Candace | Hypothetical, if companies overbuilt transmission/distribution system, how impact potentially avoidable transmission costs? |
| 5:47:58 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Questions? |
| 5:48:36 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | Examination. Bring up Sinclair supplemental sur rebuttal DSS-3, interconnection queue active projects, capacity runs from 8.5 mW summer capacity to 1200 mW summer capacity? |
| 5:49:31 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | Aware of RFP sell electricity energy companies released in January this year for generation in outer years? |
| 5:49:49 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | Remember occurring in January? |
| 5:49:56 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | Have copy of Schram letter, document familiar with? |
| 5:50:52 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | Letter from Schram, first paragraph, reading, (click on link for further comments), what paragraph says? |
| 5:51:54 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | Look again at DSS-3, companies for reasons FERC made clear, independent transmissoin planner for bulk of transmission planning? |
| 5:52:34 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | Familiar with TRANServ? |
| 5:52:41 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | Relationship, do transmission planning bulk level on behalf of companies? |

| | | |
|---|---|---|
| 5:52:59 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | Serve same functions RTO would except for independent companies? |
| 5:53:18 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | Tell me what TRANServ does for companies on transmission front? |
| 5:53:48 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | Buffer there between competitive generators and companies? |
| 5:54:02 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | Open Access Transmission Interconnection queue? |
| 5:55:01 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | Starting far left, reading, (click on link for further comments), number based on application date, see that? |
| 5:55:10 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | County, state, control area, point of interconnection, request status, available reports, affiliate or not, in-service date, generator, capacity, where studies are, see that? |
| 5:56:10 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | Letter from Schram January 7 2021, beginning of 2019, Washington County and Marion County, see that? |
| 5:56:52 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | Do you see column withdrawn or current? |
| 5:57:01 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | Only one active is Meade County? |
| 5:57:20 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | URL highlighted, 8-10-21, three that have LGIA signed currently suspended, see that? |
| 5:57:41 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | Next page, Caldwell County? |
| 5:57:50 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | Mercer County May of '19, see that? |
| 5:57:58 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | All other ones withdrawn? |
| 5:58:04 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | End of 2019, no more active in 2019 except Hardin, two projects for 2020 Madison County, Mercer County, 2021 single project Caldwell County active, Union County withdrawn? |
| 5:58:46 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | Muhlenberg County active, all ones since Muhlenberg all active? |
| 5:59:00 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | Reasonable believe interconnection requests related to companies RFP January 2021? |
| 5:59:39 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | Ones included through 2019, Sinclair talk previous RFP 2018-2019 led to 100mW group solar project? |
| 5:59:59 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | Correspond to those time frame applied and withdrawn? |
| 6:00:10 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | Expect all move forward, be built? |
| 6:00:49 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | Assuming investors rationale, almost all projects above 80 mW? |
| 6:01:40 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | Only one below 80 mW is a 50 mW at top? |
| 6:02:11 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | A couple, significant number, solar plus battery and five or six just say battery? |

| | | |
|---|---|---|
| 6:02:20 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | More that just say battery? |
| 6:02:31 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | If you were to pay these people $60 $70 $80 per kWh, expect all show up and take benefit kindly? |
| 6:02:49 PM | Chairman Chandler - witness McFarland | |
| | Note: Sacre, Candace | Companies expectation under obligation pay that to procure energy, customers paying $60 $70 $80 per mWh? |
| 6:03:44 PM | POST-HEARING DATA REQUEST | |
| | Note: Sacre, Candace | CHAIRMAN CHANDLER - WITNESS McFARLAND |
| | Note: Sacre, Candace | AUG 17 2021 INTERCONNECTION QUEUE |
| 6:04:04 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Redirect? |
| 6:04:07 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Questions? |
| 6:04:13 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Witness is excused. |
| 6:05:10 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Scheduling discussion. (Click on link for further comments.) |
| 6:06:02 PM | Chairman Chandler | |
| | Note: Sacre, Candace | Recess until 9 am tomorrow. |
| 6:06:11 PM | Session Ended | |

# Exhibit List Report

**2020-00349 and 2020-00350**
**17Aug2021**

**Kentucky Utilities Company (KU) and Louisville Gas and Electric Company (LG&E)**

| Name: | Description: |
|---|---|
| Arbough Rehearing Exhibit 1 | 5-Year Historical Legal Expense by Company |
| Arbough Rehearing Exhibit 2 | Updated Exhibit B-1 (KU) to Affidavit - Tab 59 FR 16(8)(f) - Schedule F-6 - Legal Fees in Forecasted Test Period |
| Arbough Rehearing Exhibit 3 | Updated Exhibit B-1 (LG&E) to Affidavit - Tab 59 FR 16(8)(f) - Schedule F-6 - Legal Fees in Forecasted Test Period |
| PSC Staff Exhibit 1 | Attachment to Response to PSC-7 Question 34 |
| PSC Staff Exhibit 2 | Supplemental Exhibit DSS-2 Page 9 of 16 |
| PSC Staff Exhibit 3 | Minnesota Public Utilities Commission Docket Nos. 3-999/CI-16-521 and E-999/CI-01-1023 Order Establishing Updated TIIR |
| PSC Staff Exhibit 4 | State of Minnesota Technical Interconnection and Interoperabililty Requirements (TIIR) |

Arbough Exhibit ____

ARBOUGH REHEARING EXHIBIT 1

| 5-Year Historic Legal Expense by Company | | | | |
|---|---|---|---|---|
| | | | | |
| | KU | | LG&E (Electric and Gas) | Total |
| | | A | B | A+B |
| | Total Company | Jurisdictional | | |
| 2016 Actual | $2,561,225 | $2,312,095 | $4,846,621 | $7,158,716 |
| 2017 Actual | $2,437,304 | $2,202,640 | $2,494,200 | $4,696,840 |
| 2018 Actual | $3,249,274 | $2,941,633 | $3,457,047 | $6,398,680 |
| 2019 Actual | $3,686,253 | $3,468,285 | $2,561,345 | $6,029,630 |
| 2020 Actual | $5,605,661 | $5,280,533 | $2,900,587 | $8,181,120 |
| Base Period (12 ME 2/28/21) | $5,322,767 | $5,009,788 | $3,020,309 | $8,030,097 |
| Forecast Test Period (12 ME 06/30/22) | $4,234,100 | $3,984,161 | $3,826,975 | $7,811,136 |

**Tab 59 FR 16(8)(f) - Schedule F-6 -**
**Legal Fees in Forecasted Test Period**

| Category | Description | Base Period Actuals (12 ME 2/28/21) Non-Jurisdictionalized | KU Test Year |
|---|---|---|---|
| Litigation | | $488,077 | $ 527,500 |
| Regulatory | | $1,090,090 | 1,154,750 |
| Environmental | | $3,419,003 | 2,012,500 |
| Employment | See subject/matter descriptions below | $103,439 | 171,000 |
| Real Estate | | $76,541 | 84,250 |
| Corporate | | $310,140 | 75,500 |
| Other | | $175,125 | 208,600 |
| Accruals | | $(339,648) | |
| **Total** | | **$5,332,767** | **$ 4,234,100** |

**Details of legal fees for KU**
**Forecasted Test Period**

| | |
|---|---|
| **Litigation Matters** | **$ 527,500** |

| | | |
|---|---|---|
| Alabama Wire Products v. KU | Hardin Circuit Court, Civil Action No. 19-CI-00252<br><br>Plaintiff Alabama Wire Products claimed approximately $40,000 in property damage and up to $250,000 in loss of business as a result of alleged excess voltage delivered to its industrial facility in Elizabethtown. The matter was dismissed for lack of prosecution in April 2021. | |
| Bicknell v KU | Estill Circuit Court, Civil Action No. 19-CI-00204<br><br>KU provides electric service to a rental property located in downtown Irvine. The property was damaged by fire on November 13, 2018. Plaintiff James Bicknell alleges that the fire was caused by KU's service. State Farm Fire and Casualty Company has intervened as plaintiff seeking to recover its subrogation interest in the amount of $61,272.42. The amount of damages claimed by Mr. Bicknell in excess of State Farm's subrogation interest is unknown. | $3,400 (Bicknell)<br><br>$2,589 (State Farm subrogation) |
| Campbell v KU (easement) | Real estate/property dispute. Not in suit. | |

| | | |
|---|---|---|
| Asbestos | Claims/litigation related to alleged asbestos exposure at company facilities | |
| Fire Litigation | Claims/litigation related to fire damage allegedly related to company facilities | |
| Motor Vehicle Accidents | Claims/litigation related to motor vehicle accidents involving company vehicles and drivers. | |
| Premises Litigation | Claims/litigation relating to alleged injuries or damages occurring on company property (excluding alleged asbestos premises litigation) | |
| Dircks v. LKE | Union Circuit Court, Civil Action No. 20-CI-00017<br><br>Plaintiff alleges electrical contact while working as a lineman for Broadband of Indiana at River View Coal on February 8, 2019. Plaintiff claims he sustained severe and permanent bodily injury. River View Coal, Big Rivers Electric Corp., and Kenergy Corp are also named Defendants. KU was dismissed via Agreed Order. | $18,511 |

| | | |
|---|---|---|
| Everman v. Kentucky Utilities | Fayette Circuit Court, Civil Action No. 19-CI-00560<br><br>William Everman was fatally injured when heavy equipment he was operating made contact with a 7200 volt conductor in Lexington, Kentucky on June 22, 2018. Vickie Lynn Everman, on her own behalf and as Administratrix of Mr. Everman's Estate, is claiming damages for loss of consortium in the amount of $10 million, destruction of earning capacity of $5 million, pain & suffering of $5 million, and punitive damages of $90 million – for a total of $110 million in damages. In addition to KU, Ball Realty, LLC, Ball Homes, LLC, and RML Construction, LLP are named defendants. | $127,111 |
| Small Claims | Miscellaneous small claims ($2,500 or under) typically related to allegedly minor property damage from company service | |
| Retail (Billing) | Miscellaneous claims related to billing disputes | |

| | | |
|---|---|---|
| Holland v. KU | Harrison Circuit Court, Civil Action No. 19-CI-00071<br><br>Plaintiff Deanna Holland alleges that her motor vehicle and other personal property sustained property damage after being struck by a falling utility pole on or about April 5, 2017, on KY 1940 in Harrison County. The pole was owned by Bellsouth Telecommunications, LLC d/b/a AT&T Kentucky (AT&T) but KU had equipment on the pole and the pole was subject to a joint use agreement. Plaintiff claims damages in excess of the jurisdictional minimum for circuit court ($5,000) but under the $75,000 minimum amount in controversy for federal court diversity jurisdiction. | $2,634 |

| | | |
|---|---|---|
| Mobley, Frederick | Fayette Circuit Court, Civil Action No. 20-CI-00586<br><br>Plaintiff Frederick Mobley alleges that he was injured after being struck by a falling utility pole in Lexington on March 14, 2019. The pole was owned by Windstream Communications but had KU equipment on it that was subject to a joint use agreement. Windstream Communications is a named defendant and Just Engineering Company, a contractor for KU, is named as a third-party defendant by Windstream. Plaintiff claims damages in excess of $2.5 million. | $23,451 |
| Resthaven Cemetery-Harlan Substation | Harlan Circuit Court, Civil Action No. 09-CI-00102<br><br>A group of plaintiffs d/b/a Resthaven Cemetery Corporation allege that KU distribution facilities are unlawfully trespassing without easement on an approximately 4-acre parcel of unimproved land located in Harlan, Kentucky. The facilities or equivalent replacements have been on the property since the 1960s. | $46 |

| | | |
|---|---|---|
| Revenue Collection-Sundry Receivables | Debt/subrogation collection actions as necessary | |
| Shelby v KU | Bell Circuit Court, Civil Action No. 20-CI-00113<br><br>Plaintiff Charles Shelby alleges negligence against KU and its employee, John Alderson, arising out of a collision between Mr. Shelby (on his bicycle) and Mr. Alderson (in a company-leased vehicle) near downtown Middlesboro on or about April 27, 2018. KU has counterclaimed for its vehicle damage in excess of $2,500. Mr. Shelby's alleged damages are not known at this time, although he alleges in his complaint personal injuries, past and future medical expenses, lost time from work due to permanent impairment, and pain and suffering. | $2,708 |

| | | |
|---|---|---|
| State Farm (Geddes) v KU | Fayette Circuit Court, Civil Action No. 19-CI-04238<br><br>Plaintiff State Farm Fire & Casualty Company filed this action against Kentucky Utilities seeking recovery on its subrogation interest arising from damage to its insured's real property on or about January 30, 2018. Plaintiff alleges damage to property in the amount of $7,513.96 occurred as a result of surges in voltage supplied to the property. | $201 |
| Trent v KU | Fayette Circuit Court, Civil Action No. 19-CI-03198<br><br>Plaintiff Michael Trent alleged personal injuries arising out of a motor vehicle collision with Melody Cason, a KU meter reading employee, in Lexington on or about April 30, 2018. KU and Ms. Cason were the named defendants. Plaintiff alleged that Ms. Cason, while in the course and scope of her job duties, negligently made a left turn onto 4th Street from a parking lot without yielding the right of way to Mr. Trent, resulting in a collision. The matter was settled and was dismissed on July 14, 2021. | $7,294 |
| | **Sum of the above** | **$187,945** |

| | | | |
|---|---|---|---|
| | **Other** | **$300,132[1]** | |
| | **Total** | **$488,077** | |
| **Regulatory Matters** | | | **$ 1,154,750** |
| 2018 KY Rate Case Appeal | Appellate activities associated with customer group appeal of KPSC orders from the 2018 KPSC rate cases | $13,128 | |
| 2021 ECR-related | Contingency for regulatory counsel for development of and advocacy in six-month/two-year KPSC reviews of ECR charges and operation of ECR mechanism | $101,070 | |
| 2021 FAC-related | Contingency for regulatory counsel for development of and advocacy in six-month/two-year KPSC reviews of FAC charges and operation of FAC mechanism | | |
| 2021 Tax Issues | Miscellaneous tax issues and representation before the Kentucky Department of Revenue on state tax issues | | |
| 2021 Administrative Proceeding | Contingency for KPSC administrative proceeding/investigation of regulatory policy and issues | | |
| 2021 Integrated Resource Planning | Regulatory counsel for development of and advocacy for 2021 IRP | $21,149 (2018) | |

[1] Includes KU's portion ($21,433) of the Estate of Venkatv LG&E listed on Exhibit B-2

| | | |
|---|---|---|
| 2021 Tariff Issues | Contingency for miscellaneous tariff filing issues with KPSC | |
| 2021 KU Electric Regulatory Matters Misc. | Research and counsel on various regulatory issues | $47,261 |
| 2021 KU Franchise | Research and counsel on various franchise and regulatory issues | $6,389 |
| 2021 KU Solar Issues | Regulatory counsel for development of and advocacy for solar regulatory contracts and filings | $99,619 |
| 2021 Demand Side Management | Regulatory counsel for development of and advocacy for DSM issues and filings | |
| 2021 KY Miscellaneous Regulatory Asset Issues | Regulatory counsel for development of and advocacy for deferral accounting issues | |
| 2021 Legislative Support | Legal and regulatory counsel for state legislative issues and legislation | $30,291 |
| 2021 Territorial Matters | Research and counsel on various regulatory Kentucky Territorial Boundary Act issues | |

| | | |
|---|---|---|
| Affected Systems | Legal support for issues and questions that arise when projects or service requests on adjacent systems potentially impact the LG&E/KU system | |
| Interconnection | Legal support for questions around Generator Interconnection Process and associated agreements as well as wires-to-wires interconnection agreements | $21,198 (TVA) |
| New Transmission Customers | FERC tariff-related or other questions arising from integration of new transmission customers to the system | |
| Adjacent Systems Issues | Legal support for issues or disputes with adjacent systems (i.e., MISO, PJM, etc.) | |
| Attachment O - Rates Issues | Revisions to Attachment O; questions re: formula interpretation | |
| Bilateral Trading Agmts | Potential isolated questions on contract terms | |
| Cost Based Tariff | Legal support for Order 860 implementation. Other issues on cost based and market based rates at FERC | |
| FERC Customer Dispute/Issues | Issues analysis and handling at beginnings of issues/disputes | |

| | | |
|---|---|---|
| FERC Accounting Advice | Legal support for FERC accounting decisions | |
| ITO issues | Legal support for ITO agreement, questions from ITO re: tariff administration | |
| Load Serving Entity ITO Tariff Issues | Legal support for tariff administration/interpretation questions | |
| OATT amendments | Legal support for enhancements and clarifications to the OATT | |
| Request for Proposals Support | FERC-related questions arising from requests for proposals for company's potential power supply procurement | |
| FERC Special Contracts | CIACs and other non-standard FERC jurisdictional agreements | |
| Customer Litigation | Pre-litigation assessment of customer issues on tariff requirements, provision of transmission service, others | |
| Transmission Matters | General questions regarding FERC rules on transmission tariffs, interconnections, service requirements, etc. | $28,672 |

| | | |
|---|---|---|
| General Advice - Telecom and other areas | Negotiating contracts with pole attachment customers and related work with accompanying requests for PSC approval, resolving disputes related to interpretation or breaches of pole attachment tariff or contracts, reviewing and participating in any relevant rulemaking(s) | $54,277 |
| Joint Planning Agreement | Legal support for development of Joint Planning Agreement with MISO | |
| Municipal Formula Annual Update | Annual update of FERC formula rate of municipal requirements customers filed at FERC | $15,221 |
| OVEC Power Agreement | Disputed contract provisions in OVEC agreement affecting company rights and obligations | |
| Southeast Energy Market | Participation in southeast utilities' filing for FERC approval of enhanced bilateral trading market | $40,890 |
| Utility Legal Entity - Annual Study | Research/input regarding securities law, first mortgage indenture and finance-related aspects to annual merger study. | $8,551 |
| | **Sum of the above** | **$487,716** |
| | **Other** | **$602,374** |
| | **Total** | **$1,090,090** |

| **Environmental Matters** | | | **$** | **2,012,500** |
|---|---|---|---|---|
| Brown Selenium | Administrative case before Kentucky Energy and Environment Cabinet; Case No. DOW-170001.<br><br>The Kentucky Division of Water issued a notice of violation alleging discharges at KU's Brown Plant in excess of water quality standards for selenium and the plant's permit and additionally alleging degradation of Herrington Lake. In a January 30, 2017 agreed order, KU agreed to pay a $25,000 civil penalty and conduct certain environmental assessments, which are currently ongoing. | $218,250 | | |
| CCR Rule Compliance | Advise Company on issues relating to compliance with federal and state CCR regulations | | | |
| Environmental - General Advice | Provide general advice to Company regarding environmental law developments and requirements | $81,464 | | |
| Environmental Legal Challenge | Defend miscellaneous legal challenges to company's operations | | | |
| General Advice - Generation | Provide general advice to Company regarding environmental law developments and requirements | | | |

| | | | |
|---|---|---|---|
| KY Waterways & Sierra Club v. KU (Brown) | U.S. Court of Appeals for the 6th Circuit; Case No. 5:17-cv-292/21-5600<br><br>Kentucky Waterways Alliance and Sierra Club filed a citizen suit in the U.S. District Court for the Western District of Kentucky alleging discharges from the Brown Plant into Herrington Lake in violation of the Clean Water Act and an imminent and substantial endangerment in violation of the Resource Conservation and Recovery Act. On June 16, 2021, Plaintiffs filed a Notice of Appeal in the U.S. Court of Appeals for the 6th Circuit challenging the District Court's May 17, 2021 order dismissing the case in its entirety. | $3,082,058 | |
| | **Sum of the above** | **$3,381,772** | |
| | **Other** | **$37,231[2]** | |
| | **Total** | **$3,419,003** | |
| **Employment Matters** | | | **$ 171,000** |
| Arbitrations | Defense of labor grievance arbitrations arising from the interpretation and application of the collective bargaining agreement | | |
| General OSHA Advice | Legal advice regarding compliance with workplace safety laws and regulations | | |

[2] Refers to KU's portion of the Trimble Impoundment Dewatering matter listed on Exhibit B-2.

| | | | | |
|---|---|---|---|---|
| Workers Comp | Defense of disputed workers compensation claims. Two claims currently pending. | $3,839 | | |
| General Labor and Employment Advice | Legal advice regarding compliance with labor and employment laws and regulations | $26,510 | | |
| McCorkle, Riqui | Jefferson Circuit Court, Civil Action No. 20-CI-001615<br><br>Plaintiff sought damages arising from employee discharge, including past and future lost wages and past and future lost benefits, along with compensatory damages and punitive damages. This matter was recently settled. | $3,854 | | |
| | **Sum of the above** | **$34,203** | | |
| | **Other** | **$69,236** | | |
| | **Total** | **$103,439** | | |
| **Real Estate Matters** | | | **$** | **84,250** |
| Transmission Rights of Way Acquisition | Provide legal assistance with KU's acquisition of property rights necessary for construction, operation, and maintenance of KU's electric transmission lines, with such rights primarily including easements | | | |

| | | | |
|---|---|---|---|
| Encroachments | Provide legal assistance with enforcement of KU's property rights necessary for construction, operation, and maintenance of KU's facilities used in the provision of electric service, with such enforcement including litigation filed by or against KU | | |
| Real Estate Interest Protection | Advice or claims/litigation regarding protection of company's legal right and title to real property | | |
| Interconnections | Legal support for questions around Generator Interconnection Process and associated agreements as well as wires-to-wires interconnection agreements | | |
| Easements | Provide general legal assistance with KU's easements for construction, operation, and maintenance of KU's electric distribution lines | $8,810 | |
| Real Estate General | Provide legal assistance for KU's acquisition, use, and disposition of property owned in fee, as well as KU's activities related to property leases | $67,731 | |
| | **Sum of the above** | **$76,541** | |
| | **Other** | **$-** | |
| | **Total** | **$76,541** | |
| **Corporate Matters** | | | **$ 75,500** |

| | | |
|---|---|---|
| Articles-Bylaws | Planned project to streamline/update corporate articles and bylaws to modernize/remove obsolete provisions | $366 |
| Auditor Letter Work | Replies by primary law firms to financial statement auditor required as part of audits | $1,300 |
| NERC, CIP, IT, Cybersecurity | Research of cyber or IT regulatory issues | |
| General Commercial Advice - Supply Chain | Provide legal assistance for KU's supply chain activities, including the procurement of goods and services for KU's corporate, information-technology, and energy-delivery needs | |
| Data Breach Issues | Preparation for notification and other actions required under state law in the event of a breach of electronic personally identifiable information | |
| Foresight Energy Chapter 11 Bankruptcy- Coal Contracts | For follow-up issues regarding 2020 bankruptcy of large coal supplier. Currently being used for White Stallion/Eagle River bankruptcy | $1,934 |
| General Tax Advice | Occasional tax advice from outside counsel in matters relating to the Kentucky Revenue Cabinet and the Internal Revenue Service | |

| | | | |
|---|---|---|---|
| Hartshorne Coal - Bankruptcy- Coal Contracts | For follow-up issues regarding 2020 bankruptcy of large coal supplier. | $205,191 | |
| Industrial Development Loans | Occasional amendments to documentation regarding loans extended to counties by KU in the 1990s | | |
| Indenture-BONY Mellon | General advice regarding indenture compliance outside of bond deals | | |
| Murray Energy Chapter 11 Bankruptcy – Coal Contracts | For follow-up issues regarding 2020 bankruptcy of large coal supplier. | $19,378 | |
| OVEC Credit Restructuring | Monitoring of OVEC debt and corporate governance matters and follow-up issues regarding 2020 bankruptcy of co-sponsor First Energy Solutions | $4,679 | |
| | **Sum of the above** | **$232,848** | |
| | **Other** | **$77,292** | |
| | **Total** | **$310,140** | |
| **Other Matters** | | | **$ 208,600** |
| Bankruptcy Defense | Defense of preference demands by debtors and those claiming through debtors | | |

| | | |
|---|---|---|
| Customer Issues-Bankruptcy | Compliance with Section 366 and other provisions of the Bankruptcy Code in connection with customers filing for protection under the code | $40,704 |
| General Commercial Advice - Generation | One-off issues arising in negotiation and management of contracts for Commercial Operations, the procurement organization that serves our generation facilities | |
| General Commercial Advice - Project Engineering | One-off issues arising in negotiation and management of contracts for Project Engineering, the procurement organization with responsibility for generation capital projects | |
| Coal Contracts - Force Majeure | For review of force majeure issues due to weather, breakdowns, Covid-19, etc. in coal contracts | |
| Coal Supply Agmts | For review/periodic update of standard form of coal purchase contract | |
| Coal/Fuels Dept Issues | For misc. contract issues in coal, coal transport, pollution reagent, and combustion by-product contracts | |
| Gypsum/Fly Ash-Pollution Control Bond Issues | For review of tax-issues relating to combustion by-product sales contracts | |

| | | |
|---|---|---|
| Refined Coal Project- Trimble Co. | For issues relating to 2021 termination of refined coal facility hosting transaction | |
| Refined Coal Project- Ghent | For issues relating to 2021 termination of refined coal facility hosting transaction | |
| Renewables - Contracts | Negotiation and management of purchase power agreements with developers of renewable generation resources as well as special contracts with retail customers for energy from such resources | |
| Wireless Telecom General | Maintenance of existing and new FCC licenses for wireless telecommunications facilities used in operations | $127,646 |
| Dodd-Frank Act Compliance | For research regarding regulatory or reporting issues re. swaps, derivatives, options or indirect contract review | $852 |
| Finance/Bonds/PCB Misc | For review of regarding issues relating to existing bonds/debt (useful tax lives, trustee changes, muni bond reporting, etc.) | |
| LIBOR Rate Transition | For research regarding 2021-2023 transition from LIBOR to successor index rate(s) in existing contracts or debt series | |
| | **Sum of the above** | **$169,202** |
| | **Other** | **$5,923** |
| | **Total** | **$175,125** |

| | | | | |
|---|---|---|---|---|
| | Accruals | $(339,648) | | |
| **KU Total** | | **$5,322,767** | **$** | **4,234,100** |

**Tab 59 FR 16(8)(f) - Schedule F-6 - Legal Fees in Forecasted Test Period**

| Category | Description | Base Period Actuals (12 ME 2/28/21) Non-Jurisdictionalized | LGE Test Year |
|---|---|---|---|
| Litigation | | $1,341,594 | $ 1,337,500 |
| Regulatory | | $635,165 | 1,049,250 |
| Environmental | | $652,219 | 712,500 |
| Employment | See subject/matter descriptions below | $173,008 | 303,000 |
| Real Estate | | $44,878 | 129,250 |
| Corporate | | $184,683 | 70,500 |
| Other | | $141,076 | 224,975 |
| Accruals | | $(152,314) | |
| **Total** | | **$3,020,309** | **$ 3,826,975** |

**Details of legal fees for LG&E Forecasted Test Period**

| | | |
|---|---|---|
| **Litigation Matters** | **$** | **1,337,500** |

| | | |
|---|---|---|
| Alta Vista House Fire | Jefferson Circuit Court, Civil Action No. 19-CI-004335<br><br>On July 20, 2017 a service line allegedly began leaking natural gas at the connection point between the plastic gas line and the riser at a residential property. The gas ignited, resulting in an explosion and fire damaging the Metropolitan Property & Casualty insured Green home (1010 Alta Vista Rd) and neighboring homes. Metro P&C's subrogation claim is for $1,450.443.14 in damages including dwelling, personal property, additional living expenses, and auto. Elster American Meter Co. is also a party. | $81,993 |
| Bellsouth v. LG&E Asplundh | Jefferson Circuit Court, Civil Action No. 16-CI-002001<br><br>Bellsouth alleges LG&E's contractor Asplundh Tree Service damaged its facilities while trimming trees. The Complaint is for $23,520.62 plus pre and post judgment interest at 12% per annum. | |
| Fire Litigation | Claims/litigation related to fire damage allegedly related to company facilities | |
| Motor Vehicle Accidents | Claims/litigation related to motor vehicle accidents involving company vehicles and drivers | |
| Premises Litigation | Claims/litigation relating to alleged injuries or damages occurring on company property | |

| | | |
|---|---|---|
| Cane Run Particulate Emissions | Jefferson Circuit Court; Civil Action No. 17-CI-003023 | $86,907 |
| | Adjacent property owners Kathy Little, Greg Walker, Debra Walker, and Richard Evans filed a class-action lawsuit in Jefferson Circuit Court alleging property damage claims relating to particulate emissions from LG&E's Cane Run Plant. The Circuit Court's January 8, 2020 order denying class certification was upheld by the Kentucky Court of Appeals and a Petition for Discretionary Review was denied by the Kentucky Supreme Court on April 20, 2021. The case will be remanded to Jefferson Circuit Court for further proceedings on the individual claims of the four plaintiffs. | $173,239 |
| Craig, Joseph v. LG&E | Marion Circuit Court, Civil Action No. 13-CI-00213 | |
| | Property damage/gas easement dispute. Summary Judgment entered for LG&E. | |

| | | |
|---|---|---|
| Estate of Venkat v. LG&E | Jefferson Circuit Court, Civil Action No. 19-CI-003964<br><br>Lalgudi Venkataramanan's estate filed suit against LKE and LG&E Credit Union for unspecified damages relating to the deceased being found unresponsive in the fitness center at the Broadway Office Complex. Plaintiffs are claiming negligence and loss of consortium. They are seeking compensatory and punitive damages. Plaintiffs' estimate damages at $20,130,304 currently, this does not include the punitive damages claim. | $19,104 |
| Ferguson v. LG&E | Jefferson Circuit Court, Civil Action No. 19-CI-005383<br><br>Plaintiff was operating a bicycle on September 16, 2017 and collided with Jacob Lancaster, who was operating a 2013 International Durastar truck for LG&E. Plaintiff alleges negligence and is claiming unspecified damages. Plaintiff's discovery responses have identified $136,888.21 in past medicals, unknown future medicals, and past/future pain and suffering not to exceed $500,000. | $15,386 |

| | | |
|---|---|---|
| Francis v. LG&E | Jefferson Circuit Court, Civil Action No. 19-CI-006493<br><br>Robert Bray was operating a LG&E vehicle when he allegedly caused a motor vehicle collision on or about October 25, 2017. Plaintiff has named Underwriters Insurance also. Damages at this time are unknown. | $75 |
| Galvan v. LG&E | Trimble Circuit Court, Civil Action No. 16-CI-00099<br><br>Galvan claims injuries as a result of being hit by falling refractory dislodged by Thompson Industrial Services employees working above him in a boiler at the Trimble County Generating Station. The Court of Appeals reversed and remanded with instructions to dismiss LG&E. Plaintiff petitioned the KY Supreme Court for discretionary review and LG&E responded. The request is still pending. | $10,412 |
| Small Claims | Miscellaneous small claims ($2,500 or under) typically related to allegedly minor property damage from company service | |
| Retail (Billing) | Miscellaneous claims related to billing disputes | |

| | | |
|---|---|---|
| Hamilton v. LG&E | Jefferson Circuit Court, Civil Action No. 19-CI-4460<br><br>Plaintiff alleges she was walking on the sidewalk near the 300 block of Muhammad Ali Blvd. when she tripped over the leg of a construction sign and fell. Plaintiff claims the construction site was maintained and/or supervised by defendants. She is claiming injuries primarily to her right leg and foot. The Company was dismissed. | $10,526 |
| Jeffrey Sumpter v. LG&E | Jefferson Circuit Court, Civil Action No. 18-CI-007153<br><br>Plaintiff alleges injuries as a result of stepping on severed down guy in his yard while mowing. Plaintiff amended his Complaint to bring in Just Engineering, an LG&E contractor. Plaintiff's demand for past/future lost wages, lost retirement, and medical bills is estimated between $426,141.08 and $526,141.08. | $23,366 |
| Little, Kathy et al. v. LG&E and PPL | See "Cane Run Particulate Emissions" above. | |
| Marathon Insurance Coverage | Legal advice for matter involving insurance carriers AEGIS and AIG for coverage of claims by Marathon regarding incident at Cane Run Switching Substation | $92,285 |

| | | |
|---|---|---|
| Marathon v. LG&E | Jefferson Circuit Court, Civil Action No. 15-CI-006565<br><br>An LG&E static wire fell onto energized conductors in the Cane Run Switching Station which energized the ground grid in proximity to a Marathon jet fuel pipeline. The damage caused the pipeline to rupture and leak. Marathon seeks to recover $5,441,045.61 in compensatory damages and $2,022,676.62 in prejudgment interest. | $674,051 |
| Mercer v. LG&E | Jefferson Circuit Court, Civil Action No. 19-CI-008011<br><br>Plaintiff Kevin Mercer claims he received three electric shocks from a high voltage line that had allegedly become disconnected due to vegetation growth on the line and utility pole. This incident occurred at his home in Louisville on or around 11/21/2019. Damages at this time are unknown. | $5,366 |
| Nehemiah v. LG&E | Jefferson Circuit Court, Civil Action No. 20-CI-001783<br><br>Mr. Nehemiah alleges discriminatory policy and behavior. The Company was dismissed by Opinion and Order Granting Motion to Dismiss. | $3,475 |
| Ramos, Jose | Primary Contact/Fatality on September 16, 2019 at 1300 South Shelby Street, Louisville, KY. Not in suit. | $556 |
| Revenue Collection | Debt/subrogation collection actions as necessary | |

| | | | |
|---|---|---|---|
| State Farm (Lang) v. LG&E | Jefferson Circuit Court, Civil Action No. 21-CI-001521<br><br>Subrogation interest by State Farm Insurance Company regarding an April 30, 2020 fire in Louisville, KY. Insured is Clyde Lang. | $25,179 | |
| USIC v. LG&E | Dispute with underground locator regarding performance. Not in suit. | $2,156 | |
| Webster v. LG&E | Jefferson Circuit Court, Civil Action No. 19-CI-006759<br><br>On or about June 13, 2019 Plaintiff was delivering fly ash premix concrete to a coal-fired power plant at 14660 Dixie Hwy. Plaintiff fell from the loading platform onto the concrete parking floor below due to alleged failure to repair and/or secure the platform. The Company was dismissed by an Order Granting a Joint Motion to Dismiss. | $26,790 | |
| | **Sum of the above** | **$1,250,866** | |
| | **Other** | **$90,728** | |
| | **Total** | **$1,341,594** | |
| **Regulatory Matters** | | | **$ 1,049,250** |
| 2018 KY Rate Case Appeal | Appellate activities associated with customer group appeal of KPSC orders from the 2018 KPSC rate cases | $26,653 | |

| | | |
|---|---|---|
| 2021 ECR-related | Contingency for regulatory counsel for development of and advocacy in six-month/two-year KPSC reviews of ECR charges and operation of ECR mechanism | $68,274 (2020) |
| 2021 FAC-related | Contingency for regulatory counsel for development of and advocacy in six-month/two-year KPSC reviews of FAC charges and operation of FAC mechanism | |
| 2021 Tax Issues | Miscellaneous tax issues and representation before the Kentucky Department of Revenue on state tax issues | |
| 2021 Administrative Proceeding | Contingency for KPSC administrative proceeding/investigation of regulatory policy and issues | |
| 2021 Integrated Resource Planning | Regulatory counsel for development of and advocacy for 2021 IRP | $14,520 (2018 IRP) |
| 2021 Tariff Issues | Contingency for miscellaneous tariff filing issues with KPSC | |
| 2021 Demand Side Management | Regulatory counsel for development of and advocacy for DSM issues and filings | |
| 2021 KY Miscellaneous Regulatory Asset Issues | Regulatory counsel for development of and advocacy for deferral accounting issues | |
| 2021 Legislative Support | Legal and regulatory counsel for state legislative issues and legislation | $25,804 |

| | | |
|---|---|---|
| 2021 LG&E Electric Regulatory Matters Misc. | Research and counsel on various electric regulatory issues | $38,307 |
| 2021 LG&E Gas Regulatory Matters Misc | Research and counsel on various gas regulatory issues | |
| 2021 LG&E Franchise issues | Research and counsel on various franchise and regulatory issues | $1,809 |
| 2021 LG&E Solar Issues | Regulatory counsel for development of and advocacy for solar regulatory contracts and filings | $97,064 |
| 2021 Territorial Matters | Research and counsel on various regulatory Kentucky Territorial Boundary Act issues | |
| Affected Systems | Legal support for issues and questions that arise when projects or service requests on adjacent systems potentially impact the LG&E/KU system | |
| Interconnection | Legal support for questions around Generator Interconnection Process and associated agreements as well as wires-to-wires interconnection agreements | |
| New Transmission Customers | FERC tariff-related or other questions arising from integration of new transmission customers to the system | |

| | |
|---|---|
| Adjacent Systems Issues | Legal support for issues or disputes with adjacent systems (i.e., MISO, PJM, etc.) |
| Attachment O - Rates Issues | Revisions to Attachment O; questions re: formula interpretation |
| Bilateral Trading Agmts | Potential isolated questions on contract terms |
| Cost Based Tariff | Legal support for Order 860 implementation. Other issues on cost based and market based rates at FERC |
| FERC Customer Dispute/Issues | Issues analysis and handling at beginnings of issues/disputes |
| FERC Accounting Advice | Legal support for FERC accounting decisions |
| ITO issues | Legal support for ITO agreement, questions from ITO re: tariff administration |
| Load Serving Entity ITO Tariff Issues | Legal support for tariff administration/interpretation questions |
| OATT amendments | Legal support for enhancements and clarifications to the OATT |
| Request for Proposals Support | FERC-related questions arising from requests for proposals for company's potential power supply procurement |

| | | |
|---|---|---|
| Southeast Regional Transmission Planning Support | Regional planning through SERTP - legal questions specific to LG&E/KU's participation | |
| FERC Special Contracts | CIACs and other non-standard FERC jurisdictional agreements | |
| Customer Litigation | Pre-litigation assessment of customer issues on tariff requirements, provision of transmission service, others | |
| Transmission Matters | General questions regarding FERC rules on transmission tariffs, interconnections, service requirements, etc. | $14,585 |
| FERC Natural Gas Misc. | Monitoring and participating in FERC natural gas matters that impact Company operations | $12,232 |
| Gas Compliance-General | Assistance with ensuring Company operations comply with natural gas regulatory requirements | $4,351 |
| Gas Pipeline Regulatory Compliance | Assistance with ensuring Company operations comply with federal and state safety requirements for pipelines | |
| Gas Supply Contract Matters-Billing | Assist with drafting and modifying gas supply contracts for the LDC business | |

| | | |
|---|---|---|
| General Advice - Telecom and other areas | Negotiating contracts with pole attachment customers and related work with accompanying requests for PSC approval, resolving disputes related to interpretation or breaches of pole attachment tariff or contracts, reviewing and participating in any relevant rulemaking(s) | $23,044 |
| Joint Planning Agreement | Legal support for development of Joint Planning Agreement with MISO | |
| Municipal Formula Annual Update | Annual update of FERC formula rate of municipal requirements customers filed at FERC | |
| Natural Gas Regulatory Matters – FERC | Occasional specialized advice from outside counsel on a variety of federal regulatory matters | |
| Ohio Falls | Required filings for FERC safety and other program documents; participation in efforts to reduce FERC hydro fees | |
| OVEC Power Agreement | Disputed contract provisions in OVEC agreement affecting company rights and obligations | |
| Southeast Energy Market | Participation in southeast utilities' filing for FERC approval of enhanced bilateral trading market | $37,745 |
| Tennessee Gas Pipeline Rates/Regulatory | Assist with evaluating and participating in regulatory filings made by pipeline that impact the Company's business | $4,837 |

| | | | |
|---|---|---|---|
| Texas Gas Pipeline Rates/Regulatory | Assist with evaluating and participating in regulatory filings made by pipeline that impact the Company's business | $1,395 | |
| Utility Legal Entity - Annual Study | Research/input regarding securities law, first mortgage indenture and finance-related aspects to annual merger study. | $7,248 | |
| | **Sum of the above** | **$377,868** | |
| | **Other** | **$257,297** | |
| | **Total** | **$635,165** | |
| **Environmental Matters** | | | **$ 712,500** |
| CCR Rule Compliance | Advise Company on issues relating to compliance with federal and state CCR regulations | | |
| Environmental - General Advice | Provide general advice to Company regarding environmental law developments and requirements | | |
| Environmental Legal Challenge | Defend miscellaneous legal challenges to company's operations | | |
| General Advice - Generation | Provide general advice to Company regarding environmental law developments and requirements | | |
| Mill Creek SO3 Emissions | Defend lawsuit alleging violations of local air quality regulations associated with limited S03 events in the past | $643,486 | |

| | | | | |
|---|---|---|---|---|
| Trimble Impoundment Dewatering | Advise and assist the Company in developing compliant dewatering plans for the main ash pond at Trimble County Generating Stations, in connection with pond closure | $8,733 | | |
| | **Sum of the above** | **$652,219** | | |
| | **Other** | **$-** | | |
| | **Total** | **$652,219** | | |
| **Employment Matters** | | | **$** | **303,000** |
| Andrews, Bryson v. LG&E | U.S. District Court, W.D. Kentucky. Civil Action No. 18-cv-00605<br><br>Plaintiff sought payment of pension benefit allegedly owed, LG&E prevailed and obtained judgment in its favor. | $22,621 | | |
| Arbitrations | Defense of labor grievance arbitrations arising from the interpretation and application of the collective bargaining agreement | | | |
| General OSHA Advice | Legal advice regarding compliance with workplace safety laws and regulations | | | |
| Workers Comp | Defense of disputed workers compensation claims | | | |

| | | |
|---|---|---|
| Estate of Angela Winstead | Jefferson Circuit Court, Civil Action No. 20-CI-005381<br><br>Plaintiff sought compensatory damages arising out of alleged discrimination, harassment and retaliation. The matter has been resolved by settlement. | $335 |
| General Labor and Employment Advice | Legal advice regarding compliance with labor and employment laws and regulations, including but not limited to COVID-19 regulations and protocols, CDC mask guidance, contractor safety program, OSHA guidance on mask usage, drug testing and related issues | $23,826 |
| McCorkle, Riqui | Jefferson Circuit Court, Civil Action No. 20-CI-001615<br><br>Plaintiff sought damages arising from employee discharge, including past and future lost wages and past and future lost benefits, along with compensatory damages and punitive damages. This matter was recently settled. | $3,283 |
| Saulman, Joel v. LG&E | U.S. District Court, W.D. Kentucky, Civil Action No. 18-cv-00750<br><br>Plaintiff sought damages arising from alleged employment discrimination and retaliation. Plaintiff sought recovery of wages, benefits, compensation, and compensatory and punitive damages. The matter has been resolved by settlement. | $44,785 |

| | | |
|---|---|---|
| | **Sum of the above** | **$94,850** |
| | **Other** | **$78,158** |
| | **Total** | **$173,008** |

| **Real Estate Matters** | | | **$** | **129,250** |
|---|---|---|---|---|
| Encroachments | Provide legal assistance with enforcement of LG&E's property rights necessary for construction, operation, and maintenance of LG&E's facilities used in the provision of electric service, with such enforcement including litigation filed by or against LG&E | | | |
| Real Estate Interest Protection | Advice or claims/litigation regarding protection of company's legal right and title to real property | | | |
| Interconnections | Legal support for questions around Generator Interconnection Process and associated agreements as well as wires-to-wires interconnection agreements | $11,415 (TVA) | | |
| Easements | Provide general legal assistance with LG&E's easements for construction, operation, and maintenance of LG&E's electric distribution lines | $2,865 | | |
| Real Estate General | Provide legal assistance for LG&E's acquisition, use, and disposition of property owned in fee, as well as LG&E's activities related to property leases | $7,203 | | |
| | **Sum of the above** | **$21,483** | | |
| | **Other** | **$23,395** | | |

| | | | | |
|---|---|---|---|---|
| | **Total** | **$44,878** | | |
| **Corporate Matters** | | | **$** | **70,500** |
| Articles-Bylaws | Planned project to streamline/update corporate articles and bylaws to modernize/remove obsolete provisions | $240 | | |
| Auditor Letter Work | Replies by primary law firms to financial statement auditor required as part of audits | $1,100 | | |
| NERC, CIP, IT, Cybersecurity | Research of cyber or IT regulatory issues | | | |
| General Commercial Advice - Supply Chain | Provide legal assistance for LG&E's supply chain activities, including the procurement of goods and services for LG&E's corporate, information-technology, and energy-delivery needs | | | |
| Data Breach Issues | Preparation for notification and other actions required under state law in the event of a breach of electronic personally identifiable information | | | |
| Foresight Energy Chapter 11 Bankruptcy- Coal Contracts | For follow-up issues regarding 2020 bankruptcy of large coal supplier. Currently being used for White Stallion/Eagle River bankruptcy | $1,344 | | |
| General Tax Advice | Occasional tax advice from outside counsel in matters relating to the Kentucky Revenue Cabinet and the Internal Revenue Service | | | |

| | | | |
|---|---|---|---|
| Hartshorne Coal - Bankruptcy-Coal Contracts | For follow-up issues regarding 2020 bankruptcy of large coal supplier. | $142,379 | |
| Indenture-BONY Mellon | General advice regarding indenture compliance outside of bond deals | | |
| Murray Energy Chapter 11 Bankruptcy – Coal Contracts | For follow-up issues regarding 2020 bankruptcy of large coal supplier. | $11,567 | |
| OVEC Credit Restructuring | Monitoring of OVEC debt and corporate governance matters and follow-up issues regarding 2020 bankruptcy of co-sponsor First Energy Solutions | $10,918 | |
| | **Sum of the above** | **$167,548** | |
| | **Other** | **$17,135** | |
| | **Total** | **$184,683** | |

| **Other Matters** | | | **$** | **224,975** |
|---|---|---|---|---|
| Bankruptcy Defense | Defense of preference demands by debtors and those claiming through debtors | | | |
| Customer Issues-Bankruptcy | Compliance with Section 366 and other provisions of the Bankruptcy Code in connection with customers filing for protection under the code | $28,641 | | |

| | |
|---|---|
| General Commercial Advice - Generation | One-off issues arising in negotiation and management of contracts for Commercial Operations, the procurement organization that serves our generation facilities |
| General Commercial Advice - Project Engineering | One-off issues arising in negotiation and management of contracts for Project Engineering, the procurement organization with responsibility for generation capital projects |
| Coal Contracts - Force Majeure | For review of force majeure issues due to weather, breakdowns, Covid-19, etc. in coal contracts |
| Coal Supply Agmts | For review/periodic update of standard form of coal purchase contract |
| Coal/Fuels Dept Issues | For misc. contract issues in coal, coal transport, pollution reagent, and combustion by-product contracts |
| Gypsum/Fly Ash-Pollution Control Bond Issues | For review of tax-issues relating to combustion by-product sales contracts |
| Refined Coal Project- Trimble Co. | For issues relating to 2021 termination of refined coal facility hosting transaction |
| Refined Coal Project- Mill Creek | For issues relating to 2021 termination of refined coal facility hosting transaction |

| | | | | |
|---|---|---|---|---|
| Renewables – Contracts | Negotiation and management of purchase power agreements with developers of renewable generation resources as well as special contracts with retail customers for energy from such resources | | | |
| Wireless Telecom General | Maintenance of existing and new FCC licenses for wireless telecommunications facilities used in operations | $109,207 | | |
| Dodd-Frank Act Compliance | For research regarding regulatory or reporting issues re. swaps, derivatives, options or indirect contract review | $852 | | |
| Finance/Bonds Misc | For review of regarding issues relating to existing bonds/debt (useful tax lives, trustee changes, muni bond reporting, etc.) | | | |
| LIBOR Rate Transition | For research regarding 2021-2023 transition from LIBOR to successor index rate(s) in existing contracts or debt series | | | |
| | **Sum of the above** | **$138,700** | | |
| | **Other** | **$2,376** | | |
| | **Total** | **$141,076** | | |
| | Accruals | $(152,314) | | |
| **LGE Total** | | **$3,020,309** | **$** | **3,826,975** |

PSC STAFF EXHIBIT 1

| fcst_year | fcst_month | fcst_day | fcst_hour | Solar: Single Axis Tracking | Solar: Fixed Tilt | Wind | Other Technologies | Solar: Single-Axis Tracking Capacity Factor | Solar: Fixed Tilt Capacity Factor | Wind Capacity Factor |
|---|---|---|---|---|---|---|---|---|---|---|
| 2020 | 1 | 1 | 0 | 0.00 | 0.00 | 10.53 | 80.00 | 0% | 0% | 13% |
| 2020 | 1 | 1 | 1 | 0.00 | 0.00 | 7.73 | 80.00 | 0% | 0% | 10% |
| 2020 | 1 | 1 | 2 | 0.00 | 0.00 | 5.15 | 80.00 | 0% | 0% | 6% |
| 2020 | 1 | 1 | 3 | 0.00 | 0.00 | 2.82 | 80.00 | 0% | 0% | 4% |
| 2020 | 1 | 1 | 4 | 0.00 | 0.00 | 5.15 | 80.00 | 0% | 0% | 6% |
| 2020 | 1 | 1 | 5 | 0.00 | 0.00 | 7.73 | 80.00 | 0% | 0% | 10% |
| 2020 | 1 | 1 | 6 | 0.00 | 0.00 | 13.52 | 80.00 | 0% | 0% | 17% |
| 2020 | 1 | 1 | 7 | 0.00 | 0.00 | 16.69 | 80.00 | 0% | 0% | 21% |
| 2020 | 1 | 1 | 8 | 3.63 | 0.00 | 30.65 | 80.00 | 5% | 0% | 38% |
| 2020 | 1 | 1 | 9 | 40.44 | 7.52 | 41.84 | 80.00 | 51% | 9% | 52% |
| 2020 | 1 | 1 | 10 | 59.43 | 19.57 | 34.35 | 80.00 | 74% | 24% | 43% |
| 2020 | 1 | 1 | 11 | 54.89 | 30.15 | 52.98 | 80.00 | 69% | 38% | 66% |
| 2020 | 1 | 1 | 12 | 49.80 | 36.80 | 41.84 | 80.00 | 62% | 46% | 52% |
| 2020 | 1 | 1 | 13 | 48.57 | 38.55 | 34.35 | 80.00 | 61% | 48% | 43% |
| 2020 | 1 | 1 | 14 | 44.27 | 35.22 | 27.01 | 80.00 | 55% | 44% | 34% |
| 2020 | 1 | 1 | 15 | 26.23 | 17.82 | 13.52 | 80.00 | 33% | 22% | 17% |
| 2020 | 1 | 1 | 16 | 23.27 | 7.46 | 0.00 | 80.00 | 29% | 9% | 0% |
| 2020 | 1 | 1 | 17 | 6.78 | 3.70 | 2.82 | 80.00 | 8% | 5% | 4% |
| 2020 | 1 | 1 | 18 | 0.00 | 0.00 | 2.82 | 80.00 | 0% | 0% | 4% |
| 2020 | 1 | 1 | 19 | 0.00 | 0.00 | 5.15 | 80.00 | 0% | 0% | 6% |

| Other Technologies Capacity Factor |
|---|
| 100% |
| 100% |
| 100% |
| 100% |
| 100% |
| 100% |
| 100% |
| 100% |
| 100% |
| 100% |
| 100% |
| 100% |
| 100% |
| 100% |
| 100% |
| 100% |
| 100% |
| 100% |
| 100% |
| 100% |
| 100% |

PSC Staff Exhibit 2

Table 8: Availability of QF Resources during Peak Hours (% of Nameplate Capacity)

| | Monthly Peak Hour Beginning (EST) | | Solar: Single-Axis Tracking | Solar: Fixed Tilt | Wind | Other Technologies |
|---|---|---|---|---|---|---|
| Jan | 7 | | 0.0% | 0.0% | 35.7% | 100.0% |
| Feb | 7 | | 0.0% | 0.0% | 36.3% | 100.0% |
| Mar | 7 | | 3.6% | 0.2% | 33.8% | 100.0% |
| Apr | 6 | | 0.9% | 0.0% | 18.4% | 100.0% |
| May | 15 | | 72.5% | 57.7% | 39.0% | 100.0% |
| Jun | 15 | | 79.9% | 65.4% | 25.6% | 100.0% |
| Jul | 14 | | 81.4% | 74.1% | 23.4% | 100.0% |
| Aug | 15 | | 74.4% | 59.3% | 23.5% | 100.0% |
| Sep | 15 | | 71.7% | 51.4% | 27.8% | 100.0% |
| Oct | 15 | | 62.2% | 37.5% | 44.8% | 100.0% |
| Nov | 7 | | 0.1% | 0.0% | 11.8% | 100.0% |
| Dec | 7 | | 0.0% | 0.0% | 23.6% | 100.0% |
| **Annual Average** | | | **37.2%** | **28.8%** | **28.7%** | **100.0%** |
| **Summer Average (Jun-Aug)** | | | **78.6%** | **66.3%** | **24.2%** | **100.0%** |

In Table 9, annual avoided costs are computed for each generation technology by multiplying the CT costs in Table 7 by the average annual availability factors in Table 8 (i.e., 37.2% for single-axis tracking solar, 28.8% for fixed tilt solar, and so on).

PSC Staff Exhibit 3

BEFORE THE MINNESOTA PUBLIC UTILITIES COMMISSION

| | |
|---|---|
| Katie J. Sieben | Chair |
| Valerie Means | Commissioner |
| Matthew Schuerger | Commissioner |
| John A. Tuma | Commissioner |

| | |
|---|---|
| In the Matter of Updating the Generic Standards for the Interconnection and Operation of Distributed Generation Facilities Established Under Minn. Stat. § 216B.1611 | ISSUE DATE: January 22, 2020<br><br>DOCKET NO. E-999/CI-16-521<br><br>DOCKET NO. E-999/CI-01-1023 |
| In the Matter of Establishing Generic Standards for Utility Tariffs for Interconnection and Operation of Distributed Generation Facilities under Minnesota Laws 2001, Chapter 212 | ORDER ESTABLISHING UPDATED TECHNICAL INTERCONNECTION AND INTEROPERABILITY REQUIREMENTS |

## PROCEDURAL HISTORY

### I. Adoption of Existing Interconnection Standards

In 2001, the Legislature enacted Minn. Stat. § 216B.1611, requiring the Commission to establish generic standards for interconnection and operation of distributed generation (DG).

Following extensive stakeholder participation, the Commission issued its Order Establishing Standards in Docket No. E-999/CI-01-1023 on September 28, 2004. The September 2004 order included six attachments that formed the generic standards required by Minn. Stat. § 216B.1611, referred to in this order as the 2004 Interconnection Standards.

The 2004 Interconnection Standards contain the following sections:

- Interconnection Process (Attachment 1)
- Technical Requirements (Attachment 2)
- Application (Attachment 3)
- Engineering Data Submittal (Attachment 4)
- Interconnection Agreement (Attachment 5)
- Rates (Attachment 6)

## II. Distributed-Generation Workgroup

On January 24, 2017, after receiving stakeholder input regarding revisions to the 2004 Interconnection Standards, the Commission issued an order establishing the Distributed Generation Workgroup (DG Workgroup) to update the 2004 Interconnection Standards. The January 2017 order initiated a two-phase process to update the 2004 Interconnection Standards:

- The first phase (Phase I) would update Minnesota's DG interconnection process based on the federal Small Generation Interconnection Procedures (SGIP) and Agreement (SGIA). This phase would involve Attachments 1, 3, 4, and 5 of the 2004 Interconnection Standards.

- The second phase (Phase II) would update the Minnesota DG Technical Interconnection and Interoperability Requirements (TIIR) and incorporate newly revised national technical standards. This phase would involve Attachment 2 of the 2004 Interconnection Standards.

On December 15, 2017, the Commission issued a notice seeking comments on the scope and process for updating the TIIR. In subsequent comments, rate-regulated electric utilities[1] jointly submitted an initial draft TIIR to serve as a starting point for discussion. The utilities also proposed that each utility would have a companion Technical Specifications Manual (TSM) containing utility-specific requirements.

Throughout 2018 and 2019, the Technical Subgroup (TSG) of the DG Workgroup met periodically to modify and update the TIIR. The TSG includes representatives of rate-regulated utilities, cooperatives, municipal utilities, and clean-energy advocacy groups. The TSG created a writing subgroup to draft the updates to the TIIR based on the feedback elicited at the TSG meetings.

On August 13, 2018, the Commission issued its order culminating Phase I.[2] In that order, the Commission established the Minnesota Distributed Energy Resources Interconnection Process (MN DIP) and the Minnesota Distributed Energy Resources Interconnection Agreement (MN DIA), and it referred certain issues to the DG Workgroup for further development.

On April 19, 2019, the Commission issued its order approving additional modifications to the MN DIP and MN DIA that resolved the outstanding issues from the August 2018 order. The MN DIP and MN DIA went into effect statewide on June 19, 2019.

## III. Comments on Draft TIIR

On August 23, 2019, the Commission issued a notice requesting comments on the TSG's draft TIIR and associated implementation plan. The draft TIIR was attached to the notice.

---

[1] Minnesota's rate-regulated electric utilities are Dakota Electric Association, Minnesota Power, Otter Tail Power, and Xcel Energy.

[2] Order Establishing Updated Interconnection Process and Standard Interconnection Agreement (August 13, 2018).

On September 24, 2019, the following parties filed comments in response to the notice:

- Dakota Electric Association (DEA)
- Department of Commerce, Division of Energy Resources (the Department)
- Interstate Renewable Energy Council & Fresh Energy (IREC-FE)
- Minnesota Rural Electric Association (MREA)
- Minnesota Power
- Otter Tail Power (Otter Tail)
- Xcel Energy

On October 11, 2019, the following parties submitted reply comments:

- DEA
- The Department
- IREC-FE
- MREA
- Otter Tail
- Xcel Energy

On October 25, 2019, Xcel Energy submitted late-filed comments.

On November 11, 2019, MREA submitted a revised draft of the outline for the utility-specific TSMs.

On November 13, 2019, DEA filed a letter proposing an additional decision option for the Commission's consideration.

On November 14, 2019, the Commission met to consider the matter.

## FINDINGS AND CONCLUSIONS

### I. Summary of Commission Action

The Commission is grateful to the DG Workgroup, and particularly the TSG, for their diligent efforts to update the Minnesota Technical Requirements. In this order, the Commission will take the following actions:

- Approve the draft TIIR with modifications;
- Establish a process for submitting, approving, and updating the rate-regulated utility TSMs;
- Request that the DG Workgroup discuss and propose additional guidance for interim implementation of the TIIR; and
- Recommend additional topics of discussion for the DG Workgroup.

The Commission will set July 1, 2020, as the effective date for the TIIR and TSMs.

## II. Background

### A. Statutory Background

Minn. Stat. § 216B.1611 defines DG as an electric-generating facility with a capacity of ten megawatts (MW) or less, that uses natural gas, renewable, or other "clean fuel," and that interconnects and operates in parallel with a Minnesota utility's distribution grid.[3] The statute requires the Commission to establish generic standards for utility tariffs governing the interconnection of DG, which the Commission fulfilled by adopting the 2004 Interconnection Standards and updating those standards through this proceeding.

Rate-regulated utilities are required to obtain Commission approval of a cogeneration and small power production tariff consistent with the adopted interconnection standards. Cooperatives and municipal utilities need only "adopt a distributed generation tariff that addresses the issues included in the commission's order" adopting the standards.[4]

Commission rules describe the required contents of the cogeneration and small power production tariff, including Schedule E, which must contain "the utility's safety standards, required operating procedures for interconnected operations, and the functions to be performed by any control and protective apparatus."[5] Minn. R. 7835.0300 requires utilities to file this information on an annual basis.

### B. Minnesota Technical Requirements

The Minnesota Technical Requirements applicable to interconnection of DG comprise both the TIIR and TSMs. The purpose of the Minnesota Technical Requirements is to "provide consumers and installers with a clear set of technical requirements and guide the interconnection of DER systems with the local electrical distribution system using a safe, reliable, and cost-effective design."[6]

The TIIR includes the technical requirements that apply across all utilities in Minnesota.[7] Because of the differences among the utilities' distribution systems, the TSMs allow for utility-specific requirements when needed. TSMs also provide further detail in the absence of a common statewide or national industry standard.

The TIIR and TSMs are based on the Institute of Electrical and Electronics Engineers (IEEE) 1547 standard for DG interconnection and other applicable national standards. In April 2018,

---

[3] Minn. Stat. § 216B.1611, subd. 2.

[4] *Id.*, subd. 3.

[5] Minn. R. 7835.0800.

[6] TIIR, at 1.1.

[7] *See* Minn. Stat. § 216B.1611, subd. 3.

IEEE 1547-2018 was published, significantly revising the technical interconnection and interoperability requirements. A key component of Phase II has been aligning the TIIR with IEEE 1547-2018. However, these new standards require equipment that is still in the process of being certified by the relevant authorities. The draft TIIR provides that utilities "cannot require the use of certified equipment that meets the requirements of IEEE 1547-2018 until such time the equipment is readily available."[8] This order addresses interim implementation of the TIIR while this newly certified equipment becomes available.

## III. Utilities' Technical Specification Manuals

### A. Parties' Positions

In its comments, IREC-FE expressed concern that "very significant" technical specifications were being addressed in the TSMs rather than the TIIR, because having different standards for each utility would "complicate the interconnection process" and reduce scrutiny of these requirements.[9] IREC-FE recommended that utilities should file redlined versions of any TSM changes and proposed a process allowing stakeholders to object to TSM provisions. IREC-FE also urged that "TSMs must neither conflict with the TIIR's standards nor establish technical requirements that go beyond those in the TIIR."[10]

The Department interpreted the relevant rules to require the annual filing of the TSM as part of a utility's annual reporting under Minn. R. 7835.0300. The Department argued that the required contents of Schedule E encompasses the TSM.

Utilities generally opposed extensive regulatory review and oversight of TSMs, arguing that a long regulatory approval process would hinder their ability to update TSMs quickly and efficiently to adapt to new technologies. Utilities expressed concern that delaying implementation of TSM changes could hamper their efforts to address safety or reliability issues. Xcel in particular argued that the Commission should not require that TSMs be filed in Schedule E of the utilities' annual tariff filing, and that the TSM should not be part of the utility's tariff. DEA recommended an informational filing whenever a TSM is updated, and Otter Tail recommended that TSM changes occur no more than every six months. Finally, MREA submitted an updated outline of the topics that will be addressed in the TSMs.

### B. Commission Action

The TSMs are an integral part of the Minnesota Technical Requirements and contain significant standards and requirements. The Commission therefore finds that it is necessary for potential interconnection customers to be able to access and voice concerns with a utility's TSM. The Commission also recognizes that TSM updates may impact safety or reliability, and utilities must be able to act quickly to address those issues. Below the Commission adopts a process for updating and publicizing the TSMs that balances stakeholder interests in access and input with the utilities' safety and reliability obligations.

---

[8] TIIR, at 1.6.

[9] IREC-FE comments, at 3.

[10] *Id.* at 5.

The Commission will require each rate-regulated utility to make its draft TSM available to the DG Workgroup no later than April 1, 2020, for review and discussion. Each rate-regulated utility shall file its final TSM no later than May 1, 2020.

After the final TSMs and any subsequent updates are filed, objections may be filed with the Commission within a 30-day period. Any objections should clearly identify the challenged provisions, the basis for the objection, and a preferred alternative approach where possible. If no objections are received, the TSM shall automatically become effective 30 days after filing. If objections are received, the Commission will make a formal determination on the objections before the challenged TSM can become effective. However, if the utility represents that safety or reliability will be directly affected by delayed implementation, then the TSM will immediately become effective while the Commission makes a formal determination on the objections. The absence of objections to a TSM during the initial 30-day objection period does not waive or nullify future objections to any TSM provisions.

The Commission will require rate-regulated utilities to file an informational notice with the webpage link each time their TSM is updated, which will help keep stakeholders informed of any changes to the TSM.

The Commission will require rate-regulated utilities to file their TSMs as part of their annual reporting under Minn. R. 7835.0300. The filing shall include a red-line of any changes, but the TSM is not required to be included in the utility's tariff. This process will promote access to TSMs and ensure compliance with the requirement that a utility's safety standards and interconnection operating procedures be filed on an annual basis.[11] By not requiring the TSMs to be included in the tariffs, utilities will have more flexibility to update and refine the TSMs.

The following principles applicable to TSMs are drawn from Minn. R. 7835.0800:

- The standards and procedures contained in the TSM must not be more restrictive than the standards contained in the TIIR.
- The utility may include suggested types of equipment to perform the specified functions.
- No standard or procedure may be established to discourage cogeneration or small power production.

## IV. Implementation of TIIR

### A. Parties' Positions

IREC-FE expressed concern with some of the draft TIIR's provisions regarding interim implementation until equipment certified under IEEE 1547-2018 becomes available. In particular, IREC-FE argued that the term "readily available" is vague and needs clarification. IREC-FE instead recommended that newly certified equipment be required three months after

[11] *See* Minn. R. 7835.0300, .0800.

the UL 1741 future effective date for incorporating changes related to IEEE 1547-2018. IREC-FE also recommended that the DG Workgroup develop a guidance document to clarify which TIIR sections would become effective immediately, which sections would become effective three months after the effective date for incorporating changes related to IEEE 1547-2018, and which sections would continue the existing requirements until new equipment is available.

Xcel, DEA, and MREA suggested that the DG Workgroup discuss interim implementation, and Xcel noted issues with IREC-FE's recommendations for when newly certified equipment would be required.

### B. Commission Action

The Commission agrees that the DG Workgroup should continue to meet to discuss interim implementation of the TIIR while the equipment-certification process is underway. The Commission will reconvene the DG Workgroup to draft a guidance document to accompany the TIIR that clarifies which provisions are in place in the interim period until newly certified equipment is available. The DG Workgroup should complete its work and finalize the document by the publication date of the TIIR.

The filing of the guidance document will depend upon whether utilities can reach a consensus on the contents of the guidance document. If a consensus is reached, the guidance document shall be filed in Docket No. E-999/CI-16-521 and published by the Executive Secretary along with the TIIR on the Commission's website. If no consensus is reached, each utility shall adopt their preferred version of the guidance document to be included with the utility's TSM.

The Commission also requests input from the TSG as to when IEEE 1547-2018 certified equipment is "readily available." The Commission delegates to the Executive Secretary the authority to issue a notice when the full TIIR goes into effect in consultation with the TSG.

## V. Modifications to Draft TIIR

### A. Parties' Positions

In its comments and late-filed comments, Xcel recommended a number of minor modifications to the TIIR, primarily clarifying edits. No parties objected to Xcel's proposed modifications.

IREC-FE proposed two additional minor edits, and also proposed to modify the definition of "readily available" as it pertained to newly certified equipment, as explained in Section IV.A. above. IREC-FE argued that its proposal would provide interconnection customers with a clear threshold for when newly certified equipment would be required.

### B. Commission Action

The Commission agrees that most of Xcel's and IREC-FE's proposed minor modifications are reasonable edits that improve the clarity and accuracy of the TIIR, and will approve the changes shown below.

However, the Commission declines to adopt the following two changes to the TIIR: 1) the modification to the definition of Minnesota Technical Requirements in Section 3.2, and 2) the

replacement of the term "readily available" in Section 1.6. These modifications concern interim implementation of the TIIR while newly certified equipment becomes available. Interim implementation will instead be addressed by the DG Workgroup as discussed in Section III above.

The Commission also declines to adopt Xcel's proposed modifications to its tariff concerning interim implementation, as these modifications are premature before the DG Workgroup addresses these issues.

The Commission delegates to its Executive Secretary the authority to issue by Notice a clean copy of the statewide TIIR reflecting the modifications approved in this order.

The Commission approves the following modifications to the draft TIIR:

- Section 1.4: Coordination with Area EPS Operator's Specific Technical Standards

  The following is a brief listing of some of the areas which further technical guidance is to be provided within the Area EPS Operator's TSM. [insert footnote:] See Annex C for an anticipated list of additional topics in a TSM.

- Section 2: References

  IEEE Std C62.92.2.-2017, IEEE Guide for the Application of Neutral Grounding in Electric Utility Systems, Part II – Grounding of Synchronous Generator Systems ~~and Part VI – Systems Supplied by Current Regulated Sources~~

  IEEE Std C62.92.6-2017, IEEE Guide for the Application of Neutral Grounding in Electric Utility Systems, Part VI

- Section 3.2: Definition of ESS Control Mode

  The function that manages the real and reactive power flow from or to a ~~DER~~ ESS in response to certain parameters, (such as time, price signals, frequency or external signals, etc.).

- Section 5.4: Title

  Voltage and ~~Reactive~~ Active Power Control

- Section 7.2: Protection Requirements

  All equipment providing relay functions shall meet or exceed ANSI/IEEE Standards for protective relays, or standards applicable for the installation voltage, unless otherwise specified by the Area EPS Operator's TSM. [insert footnote:] Inverters certified to UL 1741 may contain protective functions that do not require equivalent external protective relays to meet IEEE 1547 requirements.

- Section 7.4: Additional Protection

  Medium and large DER installations may require more sensitive and faster protection to minimize potential damage and ensure safety. [insert footnote:] Ride-through capabilities for bulk power system support should be considered before setting protective tripping times that conflict with BPS support.

- Add Annex C: Anticipated TSM Topics

  1. Introduction
  2. Abbreviations and Common Terms
  3. Performance Category Assignment
  4. Reactive Power Capability and Voltage/Power Control Performance
  5. Response to Abnormal Conditions
  6. Protection Requirements
  7. Operations
  8. Power Control Systems
  9. Interoperability
  10. Energy Storage Systems
  11. Metering Requirements
  12. Signage and Labeling
  13. Test and Verifications Requirements
  14. Sample Documents for Simplified Process
  15. Appendix

## VI. Future of DG Workgroup

### A. Parties' Positions

IREC-FE supported continuation of the DG workgroup and recommended a streamlined process for proposing TIIR changes, including a standardized comment form. IREC-FE also recommended a list of topics for future discussion and resolution in the DG Workgroup regarding energy storage systems, voltage regulation settings, and communications operating agreements.

Xcel opposed requiring a form for commenting on the TIIR and encouraged open discussion through the DG Workgroup as a better way to facilitate changes to the TIIR. Xcel maintained that the TIIR already provided for updates to the energy-storage provisions, and specific requirements were not needed in a Commission order.

DEA recommended a change-submittal process for updating the TIIR and a Standing Technical Committee to review proposed changes. DEA also encouraged that any provisions regarding energy storage should avoid hindering the development of emerging technology.

MREA and the Department supported a Standing Technical Committee to address emerging issues and recommend TIIR changes.

### B. Commission Action

The Commission concludes that the DG Workgroup has proven to be an efficient and successful process for updating the 2004 Interconnection Standards, including the TIIR. The Commission believes that the outstanding technical issues should be addressed by the full DG Workgroup in order to allow for the broadest possible participation and input. The DG Workgroup can create subgroups as needed, as it previously has done with the TSG.

The Commission will therefore delegate to its Executive Secretary the authority to establish and maintain an ongoing DG Workgroup to meet annually, or more frequently as needed, to review implementation and technical issues that arise with implementation of the MN DIP, Minnesota DER Interconnection Agreement (MN DIA), TIIR, or emerging DER technology. Updates to the MN DIP, MN DIA, and/or TIIR may be accomplished by Commission order in response to a petition.

The Commission recommends the following items for discussion and eventual resolution through the DG Workgroup:

- Energy storage control modes and harmonization of the language and structure of the energy storage requirements in the operating agreements;
- Determination of explicit treatment of distributed energy resources (DER) using Power Control Systems for maximum capacity and export control in the MN DIP and the TIIR documents;
- Evaluation of Voltage-Reactive Power Regulation in the TIIR;
- Harmonization of the language and structure of voltage regulation considerations in the operating agreements to the extent possible;
- Harmonization of the language and structure of the communications operating agreements so as to not unduly burden DER operators; and
- Plan to reduce and/or track unintended curtailments due to Voltage – Active Power Control prior to implementation.

## ORDER

1. The Commission adopts the State of Minnesota Technical Interconnection and Interoperability Requirements (TIIR) as filed on August 23, 2019, with the modifications contained in Section V.B. above.

2. The TIIR and TSMs shall be effective as of July 1, 2020.

3. The Commission requests input from the Technical Subgroup (TSG) of the Distributed Generation Workgroup (DG Workgroup) as to when IEEE 1547-2018 certified equipment is "readily available." The Commission delegates to the Executive Secretary the authority to issue a notice when the full TIIR goes into effect in consultation with the TSG.

4. The Commission will reconvene the DG Workgroup to draft a guidance document to accompany the TIIR that clarifies which provisions are in place in the interim period until newly certified equipment is available. The DG Workgroup should complete its work and finalize the document by the publication date of the TIIR. The filing of the guidance document will depend upon whether utilities can reach a consensus on the contents of the document. If a consensus is reached, the guidance document shall be filed in Docket No. E-999/CI-16-521 and published by the Executive Secretary along with the TIIR on the Commission's website. If no consensus is reached, each utility shall adopt their preferred version of the guidance document to be included with the utility's Technical Specifications Manual (TSM).

5. Each rate-regulated utility shall make its draft TSM available to the DG Workgroup no later than April 1, 2020, for review and discussion.

6. Each rate-regulated utility shall file its final TSM no later than May 1, 2020.

7. After the final TSMs and any subsequent updates are filed, objections may be filed with the Commission within a 30-day period. Any objections should clearly identify the challenged provisions, the basis for the objection, and a preferred alternative approach where possible. If no objections are received, the TSM shall automatically become effective 30 days after filing. If objections are received, the Commission will make a formal determination on the objections before the challenged TSM can become effective. However, if the utility represents that safety or reliability will be directly affected by delayed implementation, then the TSM will immediately become effective while the Commission makes a formal determination on the objections. The absence of objections to a TSM during the initial 30-day objection period does not waive or nullify future objections to any TSM provisions.

8. Rate-regulated utilities shall file an informational notice with the webpage link each time their TSM is updated.

9. Rate-regulated utilities shall file their TSMs as part of their annual reporting under Minn. R. 7835.0300. The filing shall include a red-line of any changes, but the TSM is not required to be included in the utility's tariff.

10. The Commission finds that it is necessary for potential interconnection customers to be able to access the utility's TSM. These standards and procedures must not be more restrictive than the standards contained in the TIIR. The utility may include suggested types of equipment to perform the specified functions. No standard or procedure may be established to discourage cogeneration or small power production.

11. The Commission recommends the following items for discussion and eventual resolution through the DG Workgroup:

    a. Energy storage control modes and harmonization of the language and structure of the energy storage requirements in the operating agreements;

    b. Determination of explicit treatment of distributed energy resources (DER) using Power Control Systems for maximum capacity and export control in the Minnesota Distributed Energy Resources Interconnection Process (MN DIP) and the TIIR document;

    c. Evaluation of Voltage-Reactive Power Regulation in the TIIR;

    d. Harmonization of the language and structure of voltage regulation considerations in the operating agreements to the extent possible;

    e. Harmonization of the language and structure of the communications operating agreements so as to not unduly burden DER operators; and

    f. Plan to reduce and/or track unintended curtailments due to Voltage – Active Power Control prior to implementation.

12. The Commission delegates to its Executive Secretary the authority to issue by Notice a clean copy of the statewide TIIR reflecting the modifications approved in this order.

13. The Commission delegates to its Executive Secretary the authority to establish and maintain an ongoing DG Workgroup to meet annually, or more frequently as needed, to review implementation and technical issues that arise with implementation of the MN DIP, Minnesota DER Interconnection Agreement (MN DIA), TIIR, or emerging DER technology. Updates to the MN DIP, MN DIA, and/or TIIR may be accomplished by Commission order in response to a petition.

14. This order shall become effective immediately.

BY ORDER OF THE COMMISSION

Ryan Barlow
Acting Executive Secretary

This document can be made available in alternative formats (e.g., large print or audio) by calling 651.296.0406 (voice). Persons with hearing or speech impairment may call using their preferred Telecommunications Relay Service or email consumer.puc@state.mn.us for assistance.

PSC Staff Exhibit 4

# STATE OF MINNESOTA TECHNICAL INTERCONNECTION AND INTEROPERABILTY REQUIREMENTS

TIIR


## Abstract

The technical requirements for interconnection of Distributed Energy Resources to the distribution system to be used in conjunction with electric utilities' Technical Specification Manuals



Approved by Commission's Order dated January 22, 2020


**PSC STAFF EXHIBIT 4**

# Contents

# 1. Overview

## 1.1 General

Distributed Energy Resources (DER) connected to the electric distribution system span a wide range of sizes and electrical characteristics utilizing technology that is constantly evolving. The design of electrical distribution systems varies widely from that which is required to serve the rural customer to that which is needed to serve the large commercial customer.

The electric distribution system is designed to operate in both normal and contingency configurations. Normal system configurations or normal operation exists when all distribution facilities and equipment are available and fully functional and the Area EPS's switches are in their normal state. Contingency system configuration or contingency operation is the condition in which the failure of a single or multiple element(s) affect the normal operation of the Area EPS or when the Area EPS's switch positions are in the abnormal state. Contingency configurations can arise from electric component failures or from planned maintenance.

The scope of this document, referred to as the Technical Interconnection and Interoperability Requirements (TIIR), is to describe common statewide requirements for interconnection of DER systems with the Area EPS. The Area EPS's specific specifications or technology requirements are detailed with the Area EPS Operator's Technical Specification Manual (TSM). Both the TIIR and the TSM documents are based upon the IEEE 1547 standards and other applicable national standards. The intent of these documents is to provide consumers and installers with a clear set of technical requirements and guide the interconnection of DER systems with the local electrical distribution system using a safe, reliable, and cost-effective design.

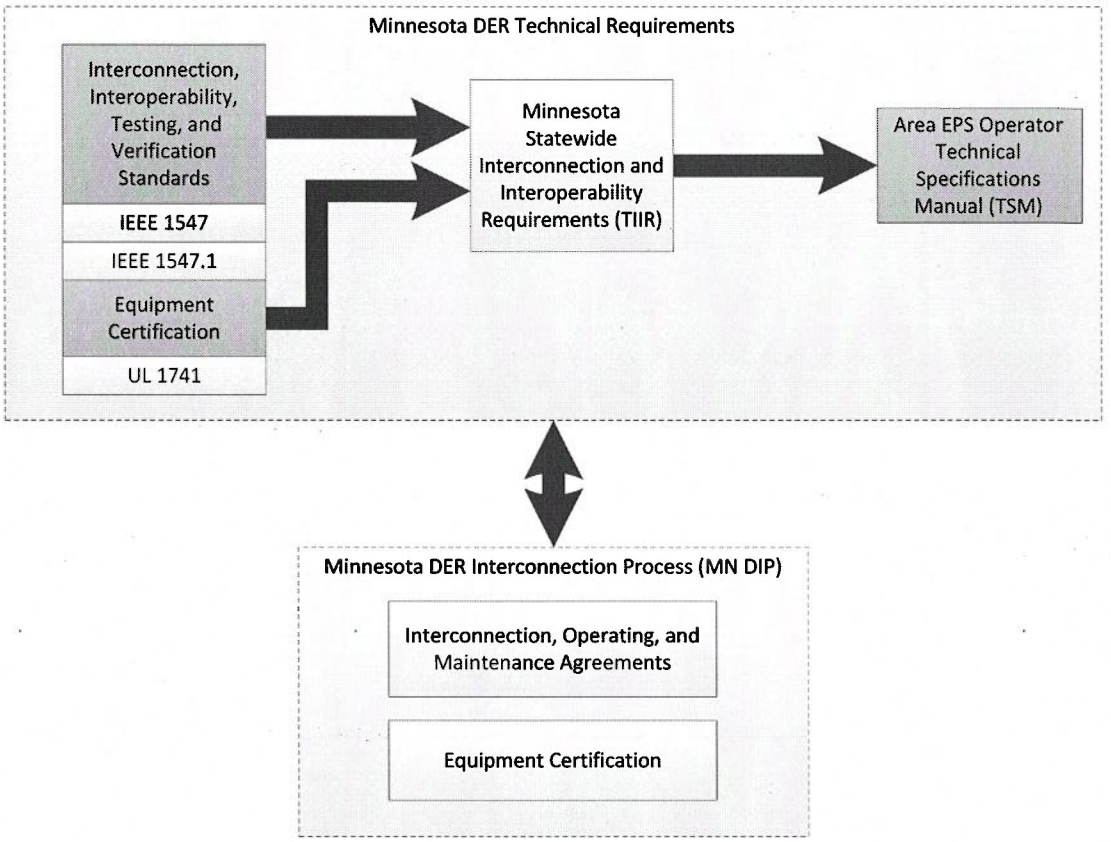
With so many variations in Area EPS designs, it becomes complex to create a single set of interconnection requirements that fits all DER interconnection situations. The Area EPS Operator must maintain a level of engineering judgment in order to interconnect the wide range of technologies over a variety of Area EPS and DER characteristics and designs[1]. The Area EPS Operator shall follow applicable industry standards and good utility practice when applying engineering judgment.

This document sets forth statewide technical requirements for DER interconnecting to an Area EPS in the state of Minnesota. The Minnesota statewide TIIR have been established to align with the Area EPS Operators' duty and obligation to plan and operate a distribution system that economically delivers electric power while focusing on safety, reliability, and quality of service.

[1] Another factor driving the need for engineering judgment is the increasingly varied mixture of legacy DER equipment from different era standards. Currently national standards do not exist to address interconnection engineering considerations that may arise due the mix of current and legacy technology. For example, a portion of the Area EPS with legacy inverters and advanced inverters will respond differently to abnormal conditions when compared to apportion of the Area EPS that contains only advanced inverters. Legacy inverters are grandfathered in under the standards under which they were installed.

The statewide TIIR shall be used in conjunction with individual Area EPS Operator interconnection Technical Specification Manuals (TSM). Where industry standards exist, the TSM shall align with the applicable standards including IEEE 1547. The TSM also lists the Area EPS Operator specific requirements and provides further detail in areas where no common statewide or national industry standards exist[2]. In addition to allowing for differences in distribution electric and information systems design and operation, the Area EPS Operator's TSM allows for expedited adoption of new industry standards and best practices as they become available without creating conditions where the statewide interconnection standards and national standards become out-of-sync. Figure 1 depicts the interaction of key DER industry technical standards, statewide technical standards (TIIR), Area EPS Operator's technical specifications manuals (TSMs), and the Minnesota Distributed Energy Resources Interconnection Process (MN DIP).

*Figure 1. Interaction of DER Standards*




All requirements in the most recent versions of IEEE 1547 and 1547.1 are adopted by the TIIR. IEEE 1547, *IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces*, and IEEE 1547.1, *IEEE Standard Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems*, provides the foundation of interconnection and

[2] For example, industry standards do not define conditions or size thresholds for when metering, interoperability, protection, or other requirements shall be applied. Also, interconnection standards only address the electrical and interoperability interface between the Local EPS and Area EPS.

interoperability technical requirements which applies to all DER interconnections. Other standards, recommended practices, and guide documents may be applicable to individual projects and should be referenced based on the DER technology and configuration being proposed and characteristics of the Area EPS[3] to which it is being interconnected. In general, the content of industry standards is not reproduced here, but instead the additional standards are referenced in Section 3 of this document.

Consistent with IEEE 1547, these requirements apply to the interconnection of all DER units within the Local EPS that parallel with the Area EPS. The requirements in the TIIR shall be applied at the Reference Point of Applicability (RPA)[4], unless otherwise specified by the TIIR or mutually agreed upon. The DER shall not create or contribute to an intentional Area EPS island, unless approved by the Area EPS Operator.

When the need arises, the Area EPS should coordinate with Transmission Providers and Regional Transmission Operators to accommodate requests from these entities which cross the transmission and distribution electric interface while still maintaining the Area EPS Operators' primary responsibility of providing safe, reliable, and quality service for Area EPS retail customers.

Protection systems requirements in the TIIR, are structured to protect the Area EPS, Area EPS customers, and the public. Details of protection systems requirements are specified in the Area EPS Operator's TSM. The protection of the DER and the Local EPS is solely the responsibility of the Interconnection Customer and is not addressed in these technical requirements.

The DER Operator shall be responsible for complying with all applicable local, independent, state and federal codes such as building codes, National Electric Code (NEC), National Electrical Safety Code (NESC) and local municipality noise and emissions standards. As required by Minnesota State law (326B.36 Subd. 5 Duty of Electrical Utility), the Area EPS may require proof of complying with the National Electrical Code before the interconnection is completed, through approval by an electrical inspector recognized by the Minnesota State Board of Electricity. The DER Operator shall maintain the DER facilities using industry standards and best practices in order to reduce the likelihood of an unintended DER operating state causing adverse impacts to customers or the Area EPS.

In the event of an inconsistency between various laws, rules, standards, contracts, or policies over interconnection requirements, the resolution to this inconsistency shall be resolved by assigning an order of precedence from highest to lowest as follows:

1. State of Minnesota statutes
2. Minnesota Public Utilities Commission approved standards, tariffs or orders
3. National Standards, Codes, and Certifications

---

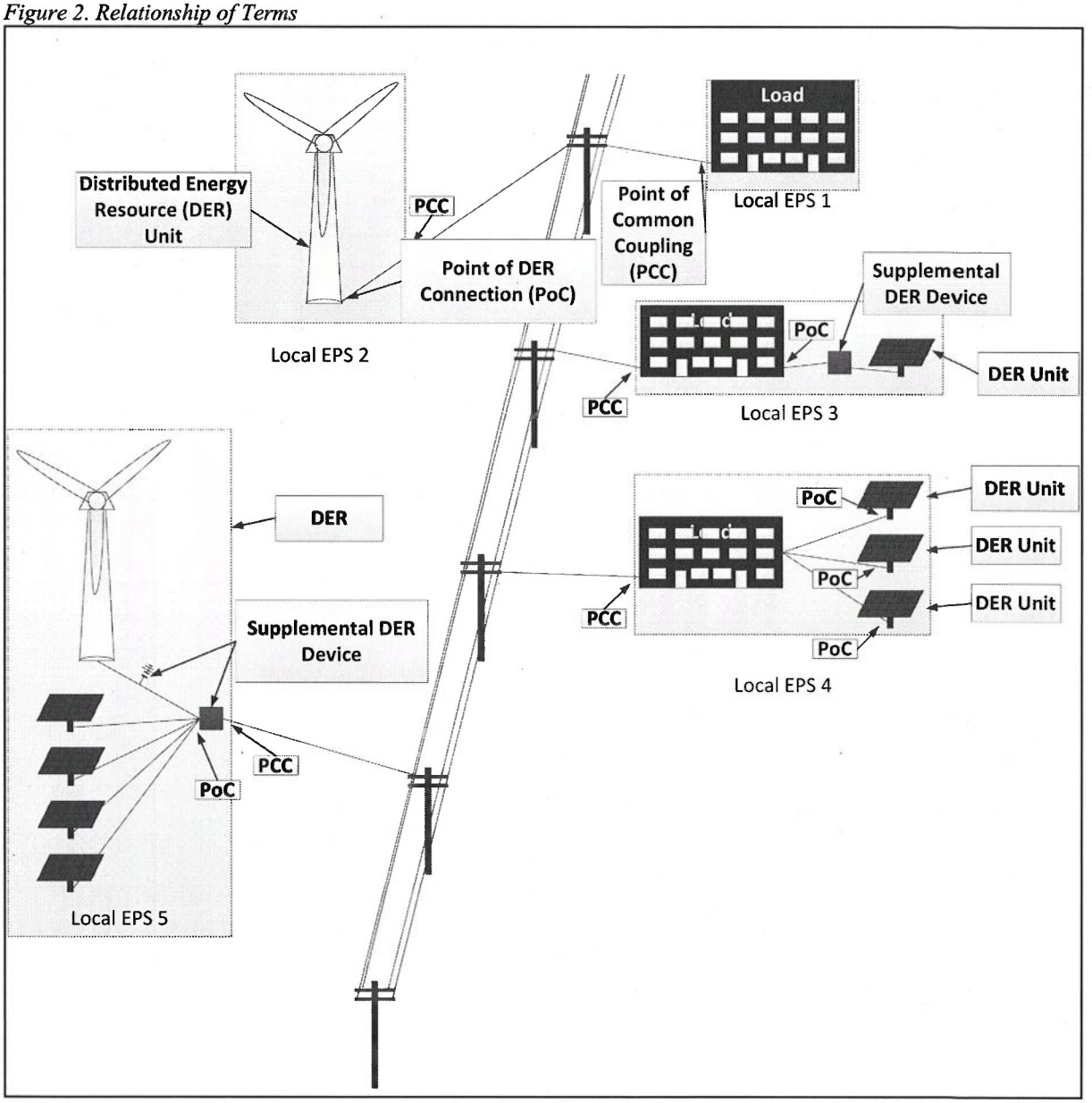
[3] For example, low voltage secondary networks have unique interconnection concerns and the recommended practice in IEEE 1547.6 should be used in conjunction with IEEE 1547 and IEEE 1547.1.

[4] See IEEE 1547 and the TIIR Annex B for further information on the RPA. The RPA is the point at which IEEE 1547 interconnection and interoperability requirements are required to be met.

4. Agreements between the Area EPS Operator and the DER Operator
5. Area EPS Operator published documents

Figure 2 contains a depiction and description of the relationship of some key terms used throughout this document. The usage of these terms as it relates to Figure 2 is consistent with IEEE 1547 definitions. Each of the terms are defined in Section 3-B of this document. Additional discussion of the terms is found in Annex B.

*Figure 2. Relationship of Terms*



## 1.2 Scope

The statewide TIIR applies to all DER technology sized at 10 MW and less in AC nameplate capacity[5] that is interconnected at secondary or primary distribution voltages and is operated in parallel[6] with an Area EPS. The TIIR applies to DER for any duration of parallel operation. Non-exporting DER that operate in parallel with the Area EPS are subject to these technical standards.

## 1.3 Purpose

This TIIR document provides the technical requirements common to all regulated electric utilities in Minnesota for the interconnection and interoperability of DER with associated Area EPS. It provides references and requirements relevant to safety, security, performance, operation, interoperability, testing and verification in harmony with other industry, national and state standards.

## 1.4 Coordination with Area EPS Operator's Specific Technical Standards

Where this TIIR document does not provide technical guidance, the Interconnection Customer needs to review the Area EPS Operator's specific TSM document, the Area EPS Operator's web site or contact the generation interconnection coordinator at the Area EPS Operator. The following is a brief listing of some of the areas which further technical guidance is to be provided within the Area EPS Operator's TSM.[7]

1) Project Coordination Information
2) Protection system requirements for the DER interconnection
3) Operational standards and requirements
4) DER monitoring and communication requirements
5) Metering requirements in support of specific rates and operational needs

The Area EPS Operator's TSM documents are to be designed to provide utility specific details aligned with the TIIR requirements. The Area EPS Operators' TSM document shall be limited to detailing requirements which are in support of the requirements contained within the TIIR and MN DIP. Additional requirements not contemplated by the TIIR may be mutually agreed upon between the Parties.

At the time this document is being written, IEEE 1547.1 is undergoing a revision which is expected to significantly affect requirements surrounding DER testing and verification. The publication of the updated IEEE 1547.1 standard may necessitate updating this document soon thereafter, most notably addressing changes to Section 12.

---

[5] The 10 MW AC nameplate capacity limitation is based on Minn. Stat.§ 216B.1611.

[6] National Electric Code and Area EPS specific requirements apply for standby generators and emergency back-up generators with, a break-before-make type of interconnection.

[7] See Annex C for an anticipated list of additional topics in a TSM.

### 1.5 Convention for Word Usage

Throughout this document, the word *shall* is used to indicate a mandatory requirement. The word *should* is used is used to indicate a recommendation. The word *may* is used to indicate a permissible action. The word *can* is used for statements of capability and possibility.

### 1.6 Transition Period

All requirements of the TIIR are immediately applicable unless requiring equipment that conforms with IEEE 1547-2018 advanced functionalities.

Area EPS Operators cannot require the use of certified equipment that meets the requirements of IEEE 1547-2018 until such time the equipment is readily available. At such time certified equipment first becomes available, the Area EPS Operator and DER Owner may mutually agree to utilize the certified equipment and functionalities in conformance with the requirements of IEEE 1547-2018. At such time when certified equipment is readily available[8], the entire TIIR shall be applicable.

[8] Refer to UL 1741 for timeline of readily available certified equipment that meets the requirements of IEEE 1547-2018.

## 2. References

The standards, codes, certification, guides and recommended practices listed in this section are active as of the publication of this document. These standards, codes, certifications, guides and recommended practices may be superseded, withdrawn, or additional applicable revisions may become available after the publication of this document. Later revisions of the technical references listed below may be available and supersede the versions referenced in this document. At the time an interconnection application is submitted, the Area EPS Operator and the DER Operator shall use the most recent applicable technical reference. Application of industry standards, codes, certifications, guides and recommended practices shall be consistent with the standard governing body's manuals, policies, and procedures.

IEC TR 61000-3-7:2008, Electromagnetic compatibility (EMC) - Part 3-7: Limits - Assessment of emission limits for the connection of fluctuating installations to MV, HV and EHV power systems.

IEC 61000-4-3:2006+A1:2007+A2:2010, Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test.

IEC 61000-4-5:2014+A1:2017, Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques – Surge immunity test.

IEEE Std 1547-2018, IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces

IEEE Std 1547.1, IEEE Standard Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems

IEEE Std 1547.2, Application Guide for IEEE 1547 Standard for Interconnecting Distributed Resources with Electric Power Systems

IEEE Std 1547.3-2007, Guide for Monitoring Information Exchange and Control of DR Interconnected with Electric Power Systems

IEEE Std 1547.4-2011, IEEE Guide for Design, Operation, and Integration of Distributed Resource Island System with Electric Power Systems

IEEE Std 1547.6-2011, IEEE Recommended Practice for Interconnecting Distributed Resources with Electric Power Systems Distribution Secondary Networks

IEEE Std 1547.7-2013, IEEE Guide for Conducting Distribution Impact Studies for Distributed Resource Interconnection

IEEE Std 519-2014, IEEE Recommended Practices and Requirements for Harmonic Control in Electric Power Systems

IEEE Std 1453-2015, IEEE Recommended Practice for the Analysis of Fluctuating Installation on Power Systems

IEEE Std 1453.1-2012 (Adoption of IEC/TR 61000-3-7:2008) - IEEE Guide--Adoption of IEC/TR 61000-3-7:2008, Electromagnetic compatibility (EMC)--Limits--Assessment of emission limits for the connection of fluctuating installations to MV, HV and EHV power systems

IEEE Std C37.90-2005, IEEE Standard for Relay Systems Associated with Electric Power Apparatus

IEEE Std C37.90.1-2012, IEEE Standard Surge Withstand Capability (SEC) Tests for Protective Relays and Relay Systems Associated with Electric Power Apparatus

IEEE Std C37.90.2-2004, IEEE Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers

IEEE C37.95-2014, IEEE Guide for Protective Relaying of Utility-Consumer Interconnections

IEEE Std C50.12-2005, IEEE Standard for Salient-Pole 50 Hz and 60 Hz Synchronous Generators and Generator/Motors for Hydraulic Turbine Applications Rated 5 MVA and Above.

IEEE Std C50.13-2014, IEEE Standard for Cylindrical-Rotor 50 Hz and 60 Hz Synchronous Generators Rated 10 MVA and Above.

IEEE Std C62.41.2-2002, IEEE Recommended Practice on Characterization of Surges in Low Voltage (1000V and Less) AC Power Circuits

IEEE Std C62.42-2016, Guide for the Application of Component Surge-Protective Devices for Use in Low-Voltage [Equal to or Less than 1000 V (ac) Or 1200 V (dc)] Circuits

IEEE Std C62.45-2002, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits.

IEEE Std C62.92.2-2017, IEEE Guide for the Application of Neutral Grounding in Electric Utility Systems, Part II – Grounding of Synchronous Generator Systems

IEEE Std C62.92.6-2017, IEEE Guide for the Application of Neutral Grounding in Electric Utility Systems, Pat VI

IEEE Std 32-1972 (Reaff 1990), IEEE Standard Requirements, Terminology, and Test Procedure for Neutral Grounding Devices

IEEE Std 141-1993, IEEE Recommended Practice for Electric Power Distribution for Industrial Plants – Red Book

IEEE Std 142-2007, IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems – Green Book

IEEE Std 242-2001, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems

IEEE Std 446-1995, Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications

IEEE Std 2030-2011, Guide for Smart Grid Interoperability of Energy Technology and Information Technology Operation with the Electric Power System (EPS), End-Use Applications, and Loads

IEEE Std 2030.5-2013, IEEE Adoption of Smart Energy Profile 2.0 Application Protocol Standard.

IEEE Std 1815-2012, IEEE Standard for Electric Power Systems Communications-Distributed Network Protocol (DNP3)

ANSI C84.1-2016, Electric Power Systems and Equipment – Voltage Ratings (60 Hertz)

UL 1741, Inverters, Converters, and Controllers for use in Independent Power Systems

ANSI C2-2007, National Electrical Safety Code", Published by the Institute of Electrical and Electronics Engineers, Inc.

NFPA 70, National Electrical Code", Published by the National Fire Protection Association

IEC 61850-7-420:2009, Communication networks and systems for power utility automation - Part 7-420: Basic communication structure - Distributed energy resources logical nodes

IEC 62351-12:2016, Power systems management and associated information exchange - Data and communications security - Part 12: Resilience and security recommendations for power systems with distributed energy resources (DER) cyber-physical systems

# 3. Definitions and Acronyms

## 3.1 General

The definitions of terms used in this document are consistent with the IEEE 1547, IEEE 1547.1, and Minnesota DER Interconnection Process definitions, to the extent possible.

The origins of definitions are noted below in Table 1. The associated symbols are shown as a superscript to each term in order to denote the document from which the definition originates. For the purpose of denoting origin, the definition notes are to be considered part of the definition unless otherwise denoted with a separate symbol.

*Table 1. Origin of Defined Terms*

| Document of origin for definition | Symbol |
|---|---|
| IEEE 1547-2018 | x |
| Minnesota Interconnection Process and Agreement (MN DIP/MN DIA) - 2018 | ʌ |
| Minnesota Statewide Interconnection Technical Standards (TIIR) | r |
| Other (additional footnote is shown to denote origin) | ɵ |

## 3.2 Definitions

**Abnormal Operating Performance Category**[X]: The grouping for a set of requirements that specify technical capabilities and settings for a DER under abnormal operating conditions, i.e., outside the *continuous operation* region.

**Area Electric Power System (Area EPS)** [^]: The electric power distribution system connected at the Point of Common Coupling

**Area Electric Power System Operator (Area EPS Operator)** [^]: An entity that owns, controls, or operates the electric power distribution systems that are used for the provision of electric service in Minnesota.

**Area EPS Operator Technical Specification Manual (TSM)**[r]: The Area EPS Operator's technical manual containing interconnection and interoperability requirements specific to the Area EPS. The TSM is considered part of the Minnesota technical requirements framework.

**Affected Systems**[^]: Another Area EPS Operator's System, Transmission Owner's Transmission System, or Transmission System connected generation which may be affected by the proposed interconnection.

**Authority Governing Interconnection Requirements (AGIR)**[X]: A cognizant and responsible entity that defines, codifies, communicates, administers, and enforces the policies and procedures for allowing electrical interconnection of DER to the Area EPS. This may be a regulatory agency, public utility commission, municipality, cooperative board of directors, etc. The degree of AGIR involvement will vary in scope of application and level of enforcement across jurisdictional boundaries. This authority may be delegated by the cognizant and responsible entity to the Area EPS operator or *bulk power system* operator.

NOTE—Decisions made by an authority governing interconnection requirements should consider various stakeholder interests, including but not limited to Load Customers, *Area EPS operators*, *DER operators*, and *bulk power system* operator.

**Bulk Power System (BPS)** [X]: Any electric generation resources, transmission lines, interconnections with neighboring systems, and associated equipment.

NOTE [e 9] – The usage of BPS in this document is intended to be generally aligned with the NERC definition of bulk electric systems, which includes transmission facilities with rated voltages above 100 kV; generating units with individual nameplate ratings above 25 MVA with a common point of connection a voltage at 100 kV or above; and generating plants with total capacity ratings above 75 MVA with a common point of connection at 100 kV and above. The term Transmission Power System is used to describe the remaining transmission facilities that are rated for voltages less than 100 kV.

**Cease to Energize**[X]: Cessation of active power delivery under steady state and transient conditions and limitation of reactive power exchange.

[9] The note associated with BPS is intended to be largely aligned with the NERC definition. This is intended to supplement the definition of IEEE 1547 to reduce confusion since the NERC definition is a subset of the IEEE 1547 definition. A new definition, Transmission Power System is introduced in the section to cover the remaining facilities (i.e. < 100 kV transmission lines).

NOTE 1—This may lead to momentary cessation or trip.

NOTE 2—This does not necessarily imply, nor exclude, disconnection, isolation, or a trip.

NOTE 3—Limited reactive power exchange may continue as specified, e.g., through filter banks.

NOTE 4—Energy storage systems are allowed to continue charging but are allowed to cease from actively charging when the maximum state of charge (maximum stored energy) has been achieved.

**Certified Equipment**[^]**:** UL 1741 listing is a common form of DER inverter certification. See **Error! Reference source not found.** and Attachment 5: Certification of Distributed Energy Resource Equipment of the MN DIP.

**Continuous Operation**[x]**:** Exchange of current between the DER and an EPS within prescribed behavior while connected to the Area EPS and while the applicable voltage and the system frequency is within specified parameters.

**Continuous Operation Region**[x]**:** The performance operating region corresponding to *continuous operation.*

**Customers**[r]**:** Individuals or entities that own a Local EPS that is connected to the Area EPS with the purpose of purchasing electric power service from the Area EPS Operator

**Distributed Energy Resource (DER)** [x]**:** a source of electric power that is not directly connected to a bulk power system. DER includes both generators and energy storage technologies capable of exporting active power to an EPS. An interconnection system or a supplemental DER device that is necessary for compliance with this standard is part of a DER.

NOTE 1—Controllable loads used for demand response are not included in the definition of DER.

NOTE 2[r]—See MN DIP Glossary of Terms or Figure 2 in IEEE 1547-2018.

**Distributed Energy Resource Operator (DER Operator)** [x]**:** The entity responsible for operating and maintaining the distributed energy resource.

**Distribution Energy Resource Unit (DER Unit)** [x]**:** An individual DER device inside a group of DER that collectively forms a system.

**Electric Power System (EPS)** [x]**:** Facilities that deliver electric power to a load.

NOTE [r] —This may include generation units. See MN DIP Glossary of Terms or Figure 2 in IEEE 1547-2018.

**Energize**[x]**:** Active power outflow of the DER to an EPS under any conditions (e.g., steady state and transient).

**Energy Storage System (ESS)**[r] **:** An electric system that stores active power for later injection into the Local EPS or Area EPS.

**ESS Control Mode**[Γ]: The function that manages the real and reactive power flow from or to an ESS in response to certain parameters, (such as time, price signals, frequency or external signals, etc.)

**Enter Service**[X]: Begin operation of the DER with an energized Area EPS.

**Intentional Island**[X]: A planned electrical island that is capable of being energized by one or more Local EPSs. These (1) have DER(s) and load, (2) have the ability to disconnect from and to parallel with the Area EPS, (3) include one or more Local EPS(s), and (4) are intentionally planned.

NOTE—An intentional island may be an *intentional Area EPS island* or an *intentional Local EPS island* (also: "facility island").

**Interconnection**[X]: The result of the process of adding DER to an Area EPS, whether directly or via intermediate Local EPS facilities.

**Interconnection Agreement**[Λ]: The terms and conditions between the Area EPS Operator and Interconnection Customer (Parties). See MN DIP Section 1.1.5 for when the Uniform Statewide Contract or MN DIA applies.

**Interconnection Customer**[Λ]: The person or entity, including the Area EPS Operator, whom will be the owner of the DER that proposes to interconnect a DER(s) with the Area EPS Operator's Distribution System. The Interconnection Customer is responsible for ensuring the DER(s) is designed, operated and maintained in compliance with the Minnesota Technical Requirements.

**Interconnection Facilities** [Λ] – The Area EPS Operator's Interconnection Facilities and the Interconnection Customer's Interconnection Facilities. Collectively, Interconnection Facilities include all facilities and equipment between the DER and the Point of Common Coupling, including any modification, additions or upgrades that are necessary to physically and electrically interconnect the DER to the Area EPS Operator's System. Some examples of Customer Interconnection Facilities include: supplemental DER devices, inverters, and associated wiring and cables up to the Point of DER Connection. Some examples of Area EPS Operator Interconnection Facilities include sole use facilities; such as, line extensions, controls, relays, switches, breakers, transformers and shall not include Distribution Upgrades or Network Upgrades.

**Interconnection System**[X]: The collection of all interconnection and interoperability equipment and functions, taken as a group, used to interconnect a DER to an Area EPS.

**Interface**[X]: An electrical or logical connection from one entity to another that supports one or more energy or data flows implemented with one or more power or data links.

**Interoperability**[X]: The capability of two or more networks, systems, devices, applications, or components to externally exchange and readily use information securely and effectively. (IEEE Std 2030)

**Inverter**[X]: A machine, device, or system that changes direct-current power to alternating-current power.

NOTE[r] - While the classical definition of inverter originating from IEEE 1547 considers power flow in a single direction, the usage of the term in this document indicates potential for bi-directional capabilities. The machine, device, or system can change power from direct-current to alternating-current and the machines, devices, or systems may also have capabilities to change power from alternating-current to direct-current.

**Island[x]:** A condition in which a portion of an Area EPS is energized solely by one or more Local EPS through the associated PCCs while that portion of the Area EPS is electrically separated from the rest of the Area EPS on all phases to which the DER is connected. When an island exists, the DER energizing the island may be said to be "islanding".

**Load[x]:** Devices and processes in a local EPS that use electrical energy for utilization, exclusive of devices or processes that store energy but can return some or all of the energy to the local EPS or Area EPS in the future.

**Local DER Communication Interface[x]:** A local interface capable of communicating to support the information exchange requirements specified in this standard for all applicable functions that are supported in the DER.

**Local Electric Power System (Local EPS) [x]:** An EPS contained entirely within a single premises or group of premises.

**Maintenance Requirements [o]:** The maintenance terms and conditions between the Area EPS Operator and Interconnection Customer (Parties) included in the Operating Agreement as Attachment 5 of the Interconnection Agreement.

**Material Modifications [^]:** A modification to machine data, equipment configuration or to the interconnection site of the DER at any time after receiving notification by the Area EPS Operator of a complete Interconnection Application that has a material impact on the cost, timing, or design of any Interconnection Facilities or Upgrades, or a material impact on the cost, timing or design of any Interconnection Application with a later Queue Position or the safety or reliability of the Area EPS.[10]

[10] A Material Modification shall include, but may not be limited to, a modification from the approved Interconnection Application that: (1) changes the physical location of the point of common coupling; such that it is likely to have an impact on technical review; (2) increases the nameplate rating or output characteristics of the Distributed Energy Resource; (3) changes or replaces generating equipment, such as generator(s), inverter(s), transformers, relaying, controls, etc., and substitutes equipment that is not like-kind substitution in certification, size, ratings, impedances, efficiencies or capabilities of the equipment; (4) changes transformer connection(s) or grounding; and/or (5) changes to a certified inverter with different specifications or different inverter control settings or configuration. A Material Modification shall not include a modification from the approved Interconnection Application that: (1) changes the ownership of a Distributed Energy Resource; (2) changes the address of the Distributed Energy Resource, so long as the physical point of common coupling remains the same; (3) changes or replaces generating equipment such as generator(s), inverter(s), solar panel(s), transformers, relaying, controls, etc. and substitutes equipment that is a like-kind substitution in certification, size, ratings, impedances, efficiencies or capabilities of the equipment; and/or (4) increases the DC/AC ratio but does not increase the maximum AC output capability of the Distributed Energy Resource in a way that is likely to have an impact on technical review.

**Minnesota DER Interconnection Agreement (MN DIA)**[^]: The Minnesota Distributed Energy Resource Interconnection Agreement. See MN DIP Section 1.1.5 for when the Uniform Statewide Contract or MN DIA applies.

**Minnesota DER Interconnection Process (MN DIP)**[^]: The Minnesota Distributed Energy Resource Interconnection Process which is statewide interconnection standards for regulated utilities.

**MN Technical Requirements** [^]: The term including all of the DER technical interconnection requirement documents for the state of Minnesota; including: 1) Attachment 2 Distributed Generation Interconnection Requirements established in the Commission's September 28, 2004 Order in E-999/CI-01-1023) until superseded and upon Commission approval of updated Minnesota DER Technical Interconnection and Interoperability Requirements in E-999/CI-16-521.

**Momentary Cessation**[X]: Temporarily *cease to energize* an EPS, while connected to the Area EPS, in response to a disturbance of the *applicable voltages* or the system frequency, with the capability of immediate Restore Output of operations when the applicable voltages and the system frequency returns to within defined ranges.

**Nameplate Ratings**[X]: nominal voltage (V), current (A), maximum active power (kW), apparent power (kVA), and reactive power (kvar) at which a DER is capable of sustained operation.

NOTE—For Local EPS with multiple DER units, the aggregate DER nameplate rating is equal to the sum of all DERs nameplate rating in the Local EPS, not including aggregate capacity limiting mechanisms such as coincidence factors, plant controller limits, etc., that may be applicable for specific cases.

**Normal Operating Performance Category**[X]: The grouping for a set of requirements that specify technical capabilities and settings for DER under normal operating conditions, i.e., inside the *continuous operation* region.

**Non-export, Non-exporting**[Γ]: When the DER is sized and designed such that the DER output is used for host load only and is designed and operated to prevent the transfer of electrical energy from the DER to an Area EPS or TPS.

**Operating Requirements**[^]: Any operating and technical requirements that may be applicable due to the Transmission Provider's technical requirements or Minnesota Technical Requirements, including those set forth in the MN DIA.

**Parallel Operation**[Γ]: a source operated in parallel with the grid when it is connected to the distribution grid and can supply energy to the customer simultaneously with the Company supply of energy.

**Permissive Operation:** Operating mode where the DER performs ride-through either in *mandatory operation* or in *momentary cessation*, in response to a disturbance of the *applicable voltages* or the system frequency.

**Permissive Operation Region:** The performance operating region corresponding to permissive operation.

**Point of Common Coupling (PCC)**[X]: The point of connection between the Area EPS and the Local EPS.

NOTE 1—See MN DIP Glossary of Terms or Figure 2 in IEEE 1547.

NOTE 2—Equivalent, in most cases, to "service point" as specified in the National Electrical Code™ and the National Electrical Safety Code™.

**Point of Distributed Energy Resources Connection (point of DER connection–PoC)**[X]: The point where a DER unit is electrically connected in a Local EPS and meets the requirements of this standard exclusive of any load present in the respective part of the Local EPS.

NOTE 1—See MN DIP Glossary of Terms or Figure 2 in IEEE 1547.

NOTE 2—For (a) DER unit(s) that are not self-sufficient to meet the requirements without (a) supplemental DER device(s), the point of DER connection is the point where the requirements of this standard are met by DER (b) device(s) in conjunction with (c) supplemental DER device(s) exclusive of any load present in the respective part of the Local EPS.

**Power Control**[r]: System that controls the output (production or discharging) and input (charging) of one or more DER in order to limit output, input, export and/or import.

**Range of Allowable Settings**[X]: The range within which settings may be adjusted to values other than the specified default settings.

**Reference Point of Applicability (RPA)**[X]: The location where the interconnection and interoperability performance requirements specified in this standard apply.

**Regional Transmission Operator (RTO)**[r]: The functional entity that maintains the real-time operating reliability of the bulk electric power within a reliability coordinator area.

NOTE – This definition is based on the IEEE 1547 regional reliability coordinator definition. In Minnesota, i.e. the Midcontinent Independent System Operator (MISO) and Southwest Power Pool (SPP), perform this function based on territory.

**Restore Output**[X]: Return operation of the DER to the state prior to the abnormal excursion of voltage or frequency that resulted in a ride-through operation of the DER.

**Return to Service**[X]: Enter service following recovery from a trip.

**Ride-Through**[X]: Ability to withstand voltage or frequency disturbances inside defined limits and to continue operating as specified.

**Secondary Network**[r]: An AC distribution system where the low-voltage of the distribution transformers are connected to a common network for supplying electricity directly to consumers. There are two types of secondary networks: grid networks and spot networks.

**Supplemental DER Device**[x]**:** Any equipment that is used to obtain compliance with some or all of the interconnection requirements of this standard.

NOTE—Examples include capacitor banks, STATCOMs, harmonic filters that are not part of a DER unit, protection devices, plant controllers, etc.

**Technical Interconnection and Interoperability Requirements (TIIR)**[r]**:** The supplemental set of DER interconnection and interoperability requirements in this document which together with each Area EPS Operator's Technical Specification Manual (TSM) and industry interconnection standards, make up the Minnesota Technical Requirements.

**Technical Specification Manual (TSM)** [r]**:** The Area EPS Operator specific interconnection and interoperability requirements for interconnection of Distributed Energy Resources which together with the Technical Interconnection and Interoperability Requirements (TIIR) and industry interconnection standards, make up the Minnesota Technical Requirements.

**Transmission Power System**[r] **(TPS):** Any transmission or generation facility that is not part of the bulk power system.

NOTE - In general, this is transmission facilities rated at voltages less than 100 kV; transmission generation units with power ratings less 25 MVA; and generation plants with total capacity ratings less than 75 MVA.

**Trip**[x]**:** Inhibition of immediate return to service, which may involve disconnection.

NOTE—Trip executes or is subsequent to cessation of energization.

**Type Test**[x]: a test of one or more devices manufactured to a certain design to demonstrate, or provide information that can be used to verify, that the design meets the requirements specified in this standard.

## 3.3 Acronyms

| | |
|---|---|
| AGIR | Authority Governing Interconnection Requirements |
| BPS | Bulk Power System |
| DER | Distributed Energy Resource |
| EPS | Electric Power System |
| ESS | Energy Storage System |
| MN DIA | Minnesota Distributed Energy Resource Interconnection Agreement |
| MN DIP | Minnesota Distributed Energy Resource Interconnection Process |
| PoC | Point of Distributed Energy Resource Connection |

| | |
|---|---|
| PCC | Point of Common Coupling |
| RPA | Reference Point of Applicability |
| RTO | Regional Transmission Operator |
| TIIR | Technical Interconnection and Interoperability Requirements (this standard document) |
| TPS | Transmission Power System |
| TSM | Technical Specifications Manual (supplemental Area EPS Operator document) |

# 4. Performance Categories

## 4.1 Introduction

The IEEE 1547 standard provides a technology-neutral approach in which performance categories are assigned to specify required capability for reactive power performance, voltage regulation performance, and response to abnormal conditions. Performance categories describe minimum equipment capability and the required ranges of allowable settings. The next two subsections, Performance Category Assignment and Use of Default Parameters, contain the Minnesota specific application requirements based on the available performance categories defined in IEEE 1547 standard.

There are a number of available performance categories defined in IEEE 1547 standard which contemplates current and future system needs at varying levels of DER penetration. Performance requirements associated with performance categories could be driven by Area EPS, TPS or BPS needs. Regional coordination and standardization in selection of abnormal performance categories is necessary. The entity determining the appropriate performance categories is specified by the IEEE 1547 standard. The subsections below contain the specific requirements that have been determined to be appropriate for application in Minnesota.

Category A and B specify reactive power capability and voltage regulation performance requirements. Category B is intended for use where DER penetration is higher and where the DER power output is subject to frequent large variations. Category B encompasses all of Category A capabilities. Category A and B assignment is specified by the Area EPS Operator, Section 4.2.A.

Categories I, II, and III differentiate performance requirements for DER response to abnormal conditions. The Minnesota Public Utilities Commission is delegated authority by the IEEE 1547 standard to provide guidance for assigning abnormal performance categories which is specified in Section 4.2.B. Category III is the highest capability and can inherently meet the ride-through requirements of the lower categories. In contrast, the voltage and frequency trip requirements of higher categories may not be met by lower categories as the range of allowable settings may be mutually exclusive.

I. Category I encompasses minimum BPS essential needs
II. Category II coordinates with North American Electrical Reliability Corporation (NERC) PRC-024-2 with a modification to the voltage ride-through in order to account for characteristics of distribution load devices[11].
III. Category III covers all BPS reliability needs and also introduces ride-through requirements aimed at addressing high DER penetration integration issues such as power quality events and other abnormal system conditions which may arise from DER tripping in the Local EPS.

### 4.2 Performance Category Assignment

Performance Category assignment is specific to the state of Minnesota. Based on IEEE 1547, the Area EPS Operator assigns normal performance categories - Category A and B, as shown in Section 4.2.A. The Minnesota Public Utilities Commission assigns abnormal Categories I, II, and III, as shown in Section 4.2.B. The process of assigning performance categories considers Area EPS needs; as well as TPS and BPS needs on a regional and wider basis.

#### A. Normal – Category A and B

Considering existing[12] and future high penetration DER conditions, and the example decision tree in Annex B of IEEE 1547, the assignment of the category for reactive power capabilities and voltage regulation performance of DER in Minnesota shall be as follows:

*Table 2. Normal Performance Category Assignment*

| Technology | Normal performance category |
|---|---|
| Inverter-based DER | Category B |
| Synchronous machine generation | Category A |

The above assignment of Categories A and B is expected to cover the vast majority of interconnections. Any instances that do not fall within the above assignment shall be:

1) reviewed on a case-by-case basis, with the Area EPS Operator making determination[13] for requiring Category A or B; or
2) performance category assignments specified in the Area EPS Operator's TSM

#### B. Abnormal – Categories I, II, and III

The abnormal performance category assignment should also consider a future level of DER penetration that could impact the TPS or BPS if not properly coordinated. The

[11] Fault Induced Delayed Voltage Recovery is the main load consideration. This situation arises where distribution loads that typically consume reactive power draw increased levels of reactive power due to a low voltage event. The additional reactive power consumption of the distribution loads leads to a slower rebound in voltage returning to nominal levels.

[12] At the time this document is being written, portions of the Area EPS in Minnesota are exhibiting power flow characteristics of a high penetration DER environment. Based on these localized pockets of high penetration at the Area EPS level, a future with high penetration at the Area EPS, TPS, and BPS is considered when assigning performance categories in Minnesota.

[13] The Area EPS Operator should consider Annex B of IEEE 1547 when making these determinations on a case-by-case basis or in TSM requirements.

Area EPS Operators in the state of Minnesota shall constructively work with the Regional Transmission Operator to provide a recommendation whether Category II or Category III is the proper default category assignment for inverter-based DER. The decision shall balance the needs of the Area EPS and Local EPS with TPS and BPS considerations. Until a decision is made by the Regional Transmission Operator within that region, all synchronous machine DER shall be assigned Category I and all inverter-based DER shall be assigned Category II. Any instances that do not fall within the above assignment shall:

1) be reviewed on a case-by-case basis, with the Area EPS Operator making determination[14] for requiring Category I, II or III; or
2) have performance category assignment specified in the Area EPS Operators TSM.

### 4.3 Use of Default Parameters

The DER shall use the IEEE 1547 default parameter settings for all capabilities and performance requirements of the applicable performance category unless otherwise specified by the TIIR or Area EPS Operator's TSM. In order to protect BPS and TPS reliability and to produce a response from DER that can be modeled, deviating from the statewide default parameters for abnormal performance category settings should be a rare occurrence.

### 4.4 Assignment of Alternative Abnormal Operating Performance Category

Normal Operating Performance Category assignments are shown in Section 4.2.A in this document. Abnormal Operating Performance Category assignments may be reviewed on a case-by-case basis, with the Area EPS Operator making determination for requiring Category A or B or listed in the Area EPS Operator's TSM.

Upon mutual agreement, provided no adverse effects are caused to the distribution system, TPS or BPS, exceptions may be made for Categories I, II and III if the DER technology is not able to meet the assignment outline in Section 4.2.B. This should be a rare occurrence. Should the DER technology readily exist to meet the stated assignments in Section 4.2.B, no exception shall be allowed.

## 5. Reactive Power Capability and Voltage/Power Control Performance

### 5.1 Introduction

A widely observed effect of relatively high levels of DER is reverse power flow causing an elevation of voltage near the DER source. The Area EPS Operator is responsible for maintaining voltage within standard ANSI C84.1 Range A for normal operations. Depending on the Area EPS characteristics for the system serving the location of interconnection, an economic solution to mitigate high-voltage caused by DER may be to implement DER active power and reactive power control functions. The implementation of these functions can

[14] The Area EPS Operator should consider Annex B of IEEE 1547 when making these determinations on a case-by-case basis or in TSM requirements.

contribute to an Area EPS Operator's ability to operate the system in a safe and reliable manner as increasing levels of DER are deployed. The use of these functions can allow higher levels of DER deployment in an economic manner. In general, reactive power control functions should be used to control voltage[15] for normal Area EPS conditions, by injecting or absorbing vars. The voltage-active power control function should be used for abnormal Area EPS conditions (for example temporary feeder configuration) which work by reducing active power output in order to reduce the severity or alleviate the high voltage condition.

### 5.2 General

As defined by IEEE 1547, DER reactive power capability, required by the applicable performance category[16], shall be available for use by the Area EPS Operator for the purpose of mitigating impacts of DER on the Area EPS. The real and reactive power capabilities shall be available for implementation to resolve DER grid impacts after the initial installation, even if functions are not initially implemented. The Area EPS Operator shall notify the DER Operator when a change in reactive power control modes is required to address Area EPS operating needs. Any implementation of functions shall adhere to applicable agreements.

The decision to use reactive power control functions can affect transmission power system reactive power flow patterns. TPS and BPS impacts should be considered by the Area EPS Operator when specifying reactive power control strategies in the Area EPS Operator's TSM.

The Area EPS Operator shall specify the control mode and settings for the DER. The DER Operator shall implement the settings in a reasonable timeframe. When a communication channel exists from the Area EPS Operator's communication interface to the Local DER Communication Interface, the Area EPS Operator shall have the right to adjust the settings remotely in conformance with the Interconnection Agreement. If no communication channel exists, the DER Operator shall update settings and implement the changes within the time frame required by the Area EPS Operator once receiving the change request per the Area EPS Operator's established protocol defined in agreements or within the protocol defined in the Area EPS Operator's TSM. The timeframe required for the DER Operator to update settings and implement changes should not be shorter than three (3) Business Days. The type of settings change and the impact to the operation of the Area EPS should be considered in determining appropriate time for implementing settings. Failure to carry out a settings change within the applicable timeframe requested by the Area EPS Operator, may result in temporary disconnection of the DER if the inability to make the adjustment may affect safety, reliability or service quality. Nothing in this section precludes the Area EPS Operator's ability to immediately temporarily disconnect the DER for urgent operational needs at any time.

---

[15] The effectiveness of using reactive power control functions depends on the technical characteristics of the system including the send-out voltage, total line impedance, and X/R ratio.

[16] Categories A and B have different reactive power capability requirements, both require a percentage of the apparent power nameplate rating to be available for reactive power. Category B is capable of injecting or absorbing 44% of apparent power rating when active power output exceeds 20% of DER nameplate rating. Category A is capable of reactive power injection of 44% and absorption of 25% of nameplate apparent power when active power output exceeds 20% of DER nameplate rating. Both categories' reactive power requirements contain a gradient between 5% and 20% active power output levels. See section 5.2 of IEEE 1547 for additional details.

### 5.3 Voltage and Reactive Power Control

As defined by IEEE 1547 Clause 5.3.1, the Area EPS Operator specifies a reactive power control mode. Unless otherwise specified in the Area EPS Operator's TSM or specified in the Interconnection Agreement, the DER shall be installed with constant power factor mode enabled with 0.98 power factor, absorbing reactive power.

### 5.4 Voltage and Active Power Control (volt-watt)

Unless otherwise specified by the Area EPS Operator's TSM or in the Interconnection Agreement, the DER shall operate with the voltage-active power function enabled with the following default settings[17].

*Table 3. Voltage-Active Power Setting for Category A and Category B DER*

| Voltage-Active Power Parameters | Default Setting |
|---|---|
| $V_1$ | 1.06 $V_n$ |
| $P_1$ | $P_{rated}$ |
| $V_2$ | 1.1 $V_n$ |
| $P_2$ (applicable to DER that can only generate active power) | The lesser of 0.2 $P_{rated}$ or $P_{min}$[a] |
| $P'_2$ (applicable to DER that can generate and absorb active power | 0[b] |
| Open Loop Response Times | 10 s[c] |

[a] $P_{min}$ is the minimum active power output in p.u. of the DER rating.

[b] $P'_{rated}$ is the maximum amount of active power that can be absorbed by the DER. ESS operating in the negative real power half plane, through charging, shall follow this curve as long as available energy storage capacity permits this operation.

[c] Any setting for the open loop response time of less than 3 seconds shall be approved by the Area EPS Operator with due consideration of system dynamic oscillatory behavior.

The voltage-active power function may reduce DER energy production during times of abnormally high voltage. The extent of that reduction of production is dependent on the specific setting of the function, as well as actual steady-state voltage observed over time at the DER location. Deviation in the voltage parameters settings from the default, such as setting a voltage parameter to a lower value, may exacerbate the possible energy production reduction.

In the circumstance where a DER Operator's production is being impacted by the Area EPS voltage, the DER Operator should notify the Area EPS Operator of the voltage concern[18]. The Area EPS Operator shall investigate the cause of abnormal voltage. If the abnormal voltage is

[17] The default IEEE 1547 volt-watt default setting will not begin curtailing real power until the voltage is beyond 1.06 per unit voltage, which is the upper end of the range of normal voltages allowed under ANSI C84.1.

[18] For example, DER with the PCC located near the substation with a high source voltage may require upward adjustment of the $V_1$ parameter to avoid significant production impacts.

originating from the Area EPS, the Area EPS Operator may need to modify equipment or settings. The Area EPS Operator may also need to work with other electric services to bring voltage within ANSI C84.1 Range A. If the abnormal voltage is originating from the DER Operator's premise, the DER Operator is responsible for mitigating the root cause.[19]

The default in IEEE 1547 is to disable voltage-active power function. The TIIR requirement may necessitate a settings change from the default settings that DER equipment may contain when shipped from a manufacturer.

# 6. Response to Abnormal Conditions

## 6.1 Introduction

Abnormal conditions can arise on the Area EPS, TPS or BPS, for which the DER shall appropriately respond based on the performance category assigned, required settings, and the requirements in IEEE 1547. The abnormal performance capabilities are intended to support wide area and localized system stability. The Minnesota statewide default parameters for DER response to abnormal conditions shall not materially impact safety, reliability, or the Area EPS Operator's ability to operate the Area EPS.[20]

## 6.2 Voltage Ride-Through and Tripping

The DER shall conform to the ride-through requirements for the applicable Abnormal Operating Performance Category. The IEEE 1547 default parameters shall be implemented by the DER Operator for the applicable performance category, unless otherwise specified by the Area EPS Operator's TSM. The RTO may provide guidance on mandatory ride-through capabilities.

Until the Regional Transmission Operator determines the setting for mandatory tripping, the Table 4 and Table 5 shall be used.

[19] All parties should attempt, with a good-faith effort, to resolve voltage concerns in the process identified in TIIR Section 5.3. Any voltage concern disputes not resolved are to follow the dispute resolution process in MN DIP Section 5.3 and MN DIA Article 10.

[20] The Area EPS Operators of Minnesota strive to be included in any efforts by the appropriate entities' Independent System Operator seeking to impose default parameter values on DER that differ from IEEE 1547. The process of determining new statewide or regional abnormal response parameter defaults that deviate from national standard default values should only be the outcome of a broad consensus process.

*Table 4. DER Response (shall trip) to Abnormal Voltages for DER of Abnormal Operating Performance Category I*

| Shall Trip – Category I | | |
|---|---|---|
| **Shall Trip Function** | **Default Setting[a]** | |
| | **Clearing time (s)** | **Voltage (p.u. of nominal voltage)** |
| UV2 | 0.16 | 0.45 |
| UV1 | 2.0 | 0.7 |
| OV1 | 2.0 | 1.10 |
| OV2 | 0.16 | 1.20 |

*Table 5. DER Response (shall trip) to Abnormal Voltages for DER of Abnormal Operating performance Category II*

| Shall Trip – Category II | | |
|---|---|---|
| **Shall Trip Function** | **Default Setting[a]** | |
| | **Clearing time (s)** | **Voltage (p.u. of nominal voltage)** |
| UV2 | 0.16 | 0.45 |
| UV1 | 10.0 | 0.70 |
| OV1 | 2.0 | 1.10 |
| OV2 | 0.16 | 1.20 |

Notes for Table 4 and 5

[a]The Area EPS Operator may specify other voltages and clearing time trip settings within the range of allowable settings, e.g. to consider Area EPS protection schemes.

### A. Modifications to the Permissive Operating Capability Region

Momentary Cessation may be required for a portion of the Permissive Operating Capability Region. Consult the Area EPS Operator's TSM for further details.

## 6.3 Frequency Ride-Through and Tripping

The DER shall conform to the ride-through requirements for the applicable Abnormal Operating Performance Category. The IEEE 1547 default parameters shall be implemented by the DER Operator for the applicable performance category. The RTO may provide guidance on mandatory ride-through capabilities.

Until the RTO provides guidance the settings for mandatory tripping, Table 6 shall be followed.

*Table 6. DER Response (shall trip) to Abnormal Frequencies for DER of Abnormal Operating Performance Category I, Category II and Category III*

| **Shall Trip Function** | **Default Setting[a]** | |
|---|---|---|
| | **Clearing time (s)** | **Frequency (Hz)** |
| UF2 | 0.16 | 56.5 |
| UF1 | 300.0 | 58.5 |
| OF1 | 300.0 | 61.2 |
| OF2 | 0.16 | 62.0 |

Notes for Table 6

[a]The frequency and clearing time set points shall be field adjustable. The actual applied under-frequency (UF) and over-frequency (OF) trip settings shall be specified by the Area EPS Operator in coordination with the requirements of the regional reliability coordinator. If the Area EPS Operator does not specify any settings, the default settings shall be used.

The DER shall conform to the Rate of Change of Frequency (ROCOF) ride-through requirements for the applicable Abnormal Operating Performance Categories. The IEEE 1547 values shown in Table 7 shall be implemented by the DER Operator for the applicable performance category.

*Table 7. Rate of Change Frequency (ROCOF) Ride-Through Requirements for DER of Abnormal Operating Performance Category I and Category II*

| Category I | Category II |
|---|---|
| 0.5 Hz/s | 2.0 Hz/s |

The DER shall conform to the frequency-droop requirements for the applicable Abnormal Operating Performance Categories. The IEEE 1547 values shown in Table 8 shall be implemented by the DER Operator for the applicable performance category.

*Table 8. Parameters of Frequency-Droop (Frequency-Power) Operation for Abnormal Operating Performance Category I and Category II*

| Parameter | Default Settings[a] | |
|---|---|---|
| | Category I | Category II |
| $k_{OF}$, $k_{UF}$ | 0.05 | 0.05 |
| $T_{response\ (small\ signal)}$ (s) | 5 | 5 |
| $db_{OF}$, $db_{UF}$ (Hz) | 0.036 | 0.036 |

Notes for Table 8

[a]Adjustments shall be permitted in coordination with the Area EPS operator.

## 6.4 Exceptions

Tripping or intentional islanding as an alternative to ride-through is allowed in specific situations (such as when a large load is on premise) which may modify the DER response to abnormal conditions. Refer to IEEE 1547 Section 6.4.2.1 and 6.5.2.1 for additional details.

DER systems designated by authority having jurisdiction as emergency, legally required, or critical operations power systems providing backup power to hospitals, fire stations or other emergency facilities as defined by applicable industry code, shall be exempt from the ride-through requirements of this section.

## 6.5 Dynamic Voltage Support

Dynamic voltage support may be required. Consult the Area EPS Operator's TSM for further details.

# 7. Protection Requirements

## 7.1 Introduction

The DER shall be designed with proper protective devices to respond to faults and abnormal conditions in accordance with applicable standards including IEEE 1547 and parameters defined by this document or the Area EPS Operator's TSM.

## 7.2 Requirements

Details of each Area EPS Operator's protection requirements shall be found in the Area EPS Operator's TSM. As specified by Area EPS Operator's TSM, an AC disconnect furnished by the DER Operator may be required for Area EPS Operator's personnel to safely isolate the DER from the Area EPS. If required, the AC disconnect shall provide a visible air-gap, shall be lockable, and accessible to Area EPS Operator's personnel to safely isolate the DER from the Area EPS.[21]

All equipment providing relay functions shall meet or exceed ANSI/IEEE Standards for protective relays, or standards applicable for the installation voltage, unless otherwise specified by the Area EPS Operator's TSM.[22] Other requirements associated with protection and instrument transformer application may be specified by the Area EPS Operator.

## 7.3 Response to Faults and Open Phase Conditions

The DER shall Cease to Energize and Trip for faults on the Area EPS. The DER shall detect and Cease to Energize and Trip all phases to which the DER is connected for an open phase condition occurring directly at the reference point of applicability. The requirement to Cease to Energize for a single-phase condition shall apply to both three-phase inverters and three-phase installations made up of single-phase inverters. As required by IEEE 1547, the DER shall detect and Cease to Energize and Trip for unintentional islands. When restoring output after Momentary Cessation, the Restore Output settings of the DER shall be coordinated with the Area EPS reclosing timing.

## 7.4 Additional Protection

Additional protection may be required as part of the Area EPS's Interconnection Facilities to limit Area EPS exposure to reliability impacts.[23] Other circumstances, such as low voltage secondary network interconnections, may require additional protection associated with the Area EPS's Interconnection Facilities.

In general, an increased degree of protection is required for increased DER size. Medium and large DER installations may require more sensitive and faster protection to minimize

---

[21] In some cases, the NEC required device for rapid shutdown for inverter-based DER may meet the Area EPS Operator's requirement for an AC disconnect if it provides a visual air-gap.

[22] Inverters certified to UL 1741 may contain protective functions that do not require equivalent external protective relays to meet IEEE 1547 requirements.

[23] For example, additional layers of protection may be required if the Area EPS's Interconnection Facilities lead to significant line exposure.

potential damage and ensure safety.[24] The addition of a new DER in conjunction with the aggregate of the existing DER systems may also affect the ability of existing protection schemes to function, which may require modification to the Area EPS's protection equipment.

# 8. Metering

## 8.1 Introduction

The Area EPS Operator shall specify metering requirements in the Area EPS Operator's TSM. Information about the DER's present and historic operating characteristics may be required by the Area EPS Operator in order to plan and operate the system. In addition, information may be needed to fulfill financial and regulatory obligations associated with DER energy production.

The different types of data may have different requirements in terms of accuracy and granularity, which should be considered by the Area EPS Operator. The information required for a given DER size may change as DER penetration increases on a portion of the Area EPS. Furthermore, each utility uses different metering technology that changes over time, each with its own integration considerations. Defining static metering requirements is a challenge. It is beyond the scope of this document to describe all of the potential different metering configurations or requirements. In general, the Area EPS Operator shall consider the following types of information when developing metering requirements in its TSM:

i. Operational – near-real-time information on the DER operating characteristics can be needed in order to perform certain actions such as reconfiguring a feeder or restoring a feeder after an outage.
ii. Planning – an archive of time-series information over multiple years of DER operation is required for Area EPS, BPS and TPS planning.
iii. Regulatory – The Area EPS Operator may have obligations to track and report on the amount of energy produced from renewable energy DER[25]. Specific incentive programs or tariffs can create additional metering needs.
iv. Billing – the Area EPS Operator is responsible for accounting for energy transactions with the DER Operator and shall have access to revenue grade metering information.

The Area EPS Operator may require separate accounting of generation and load power injection and consumption characteristics in order to meet planning and operating objectives on the Area EPS and TPS. Correlation of time data may be necessary in certain situations[26] and the Area EPS Operator should consider this factor when specifying metering requirements in its TSM. The Area EPS Operator may use other means of collecting the necessary information, besides the meter, if the Area EPS Operator determines the information is adequate for the intended use based on industry standards and best practices.

---

[24] Ride-through capabilities for bulk power system support should be considered before setting protective tripping times that conflict with BPS support.

[25] Renewable energy credits for certain Area EPS Operator tariffs is an example of reasons to track energy production.

[26] For example, where a time of use tariff exists and multiple meters are present, the time intervals of meters need to be time synchronized in order for the Area EPS Operator to properly execute its tariffed obligations. Another example would be a planning need where data has to be synchronized in time.

### 8.2 Requirements

The DER installation shall include metering provisions based on the interconnection characteristics and requirements. Each Area EPS Operator shall specify requirements in their TSM.

# 9. Interoperability

### 9.1 Introduction

The IEEE 1547 standard requires the capability to provide a Local DER Communication Interface, which is the basis for interoperability requirements. The Local DER Communication Interface may be used to exchange standardized information with the Area EPS Operator. The exchange of information allows the Area EPS Operator to perform monitoring and control functions necessary to the safe and reliable operation of the Area EPS.

Per IEEE 1547 Section 10.1, the decision to use the Local DER Communication Interface or to deploy a communications network is determined by the Area EPS Operator. Given existing and future DER integration needs, as well as the differences amongst various Area EPS Operator's systems, no uniform set of standards is defined in this document for requiring use of the Local DER Communication Interface. The factors included in an Area EPS Operator's decision to use the Local DER Communication Interface shall be provided in the Area EPS Operator's TSM.

For DER where a standard Local DER Communication Interface is not used upon initial installation, future Area EPS, TPS, or BPS conditions may arise that trigger a need to begin using the Local DER Communication Interface. The DER Operator shall constructively participate in evaluating feasibility of establishing use of the Local DER Communication Interface if needed due to considerations for integrating DER with an Area EPS. Any modifications to utilize the Local DER Communication Interface for existing interconnected DER systems shall be established by mutual agreement between the Area EPS Operator and the DER Operator.

DER systems designated by authority having jurisdiction as emergency, legally required, or critical operations power systems providing backup power to hospitals, fire stations or other emergency facilities as defined by applicable industry code, may be exempt from the interoperability requirements of this section. Additional details are listed in the Area EPS Operator TSM.[27]

### 9.2 Monitoring, Control and Information Exchange

When information exchange through the Local DER Communication Interface is required by the Area EPS Operator, the IEEE 1547 interoperability parameters shall be available for use. The Area EPS Operator shall have read access to all parameters in the nameplate information and monitoring information. The Area EPS Operator shall have read and write access to all parameters in configuration information and management information. The Area EPS

[27] IEEE 1547 does allow exemption in capabilities that the Area EPS operator may require in certain situation.

Operator may choose to use a subset of the available parameters in order to meet operating objectives of safe, reliable, and quality electric service. Writing of information by the Area EPS Operator through the Local DER Communication Interface, shall follow agreements governing Area EPS Operator control of the DER operating state control modes and parameters.

When the Local DER Communication Interface is required by the Area EPS, the Area EPS shall have access to read and write parameters shown in the sub clauses associated with IEEE 1547, Section 4.6 – *Control capability requirements* – including capability to disable permit to service; capability to limit active power; and execution of mode and parameter changes.

### 9.3 Communications

When communication is required to the DER and/or the applicable meter(s), the DER Operator may be responsible for furnishing the communication channel from the Area EPS Operator's applicable system(s) to the DER and/or the meters. The form of communication (Cellular, Radio, etc.) shall be determined by the Area EPS Operator. Additional details of communication requirements shall be specified in the Area EPS Operator's TSM. Communication performance requirements, such as latency of exchanged information, periodicity, reliability of communication channels, and volumes of data, may be defined by the Area EPS Operator's TSM or in an operating agreement.

### 9.4 Cyber Security

The local physical and network security requirements specified by the Area EPS Operator shall be implemented by the DER Operator. The Area EPS should consider the degree of risk associated with various DER technology and application in determining the cyber security requirements. The Area EPS Operator shall outline cyber security requirement with respect to DER in its TSM.

Communications circuits tied to monitoring and control systems associated with Area Electric Power System (EPS) real-time operations shall meet security and reliability requirements as defined by the Area EPS Operator, industry standards, and appropriate regulating authorities.

#### A. DER Physical and Front Panel Security

The DER Operator shall provide a reasonable level of security for the DER controls and devices from operation by intruders. The Area EPS Operator may specify additional physical security requirements in its TSM.

#### B. DER Network Security

The network security requirements and implementation details may differ among Area EPS Operators and are expected to evolve over time in order to maintain cyber security in an environment of constantly changing cyber threats. The network security requirements for the DER Operator may be described in each Area EPS Operator's TSM.

### C. Local DER Communication Interface Security

When information is exchanged through the Local DER Communication Interface, consideration should be given to protect access to information. Numerous system architecture approaches and technologies exist for securing the interface. The Area EPS Operator may specify security requirements associated with the Local DER Communication Interface. Where practical, test and verification procedures shall be specified for local DER communication interface security.

# 10. Energy Storage

## 10.1 Introduction

An Energy Storage System (ESS) operated in parallel with the Area EPS is a DER subject to the standard applicable reviews and requirements for a DER acting as a generation source (ESS discharging). Additional review is required for unique features of ESS, when compared to other DER, such as the load (ESS charging) aspects and ESS Control Mode(s). The Area EPS Operator should perform the appropriate technical review and study of all aspects of ESS during the appropriate step in the Minnesota Interconnection Process. Power Control characteristics may simplify the review process, since ESS is often inverter-based and ongoing reverse power flow may not be anticipated, but a standard review shall be completed since the potential exists for voltage, thermal, and protection impacts.

Interconnection of ESS in a parallel configuration often requires consideration of compatibility with applicable tariffs. ESS interconnection or operational requirements may result from a customer's choice of DER tariff[28] or load service tariff.

Application of the Minnesota DER TIIR shall not constrain adoption of national standards and best practices as they are developed. The ESS-specific aspects of DER interconnection standards are expected to receive an increased focus from industry standards associations in upcoming years[29], with resulting ESS standards publications at a quicker pace.

The absence of guidance on ESS best practices and standards at a national level makes it likely that this section will require future revision sooner than other sections in the document. The intent of this document is to adopt standards as they become available. The approach taken for ESS in the TIIR is to define functional requirements, leaving implementation, testing, and verification for definition in individual Area EPS Operator's TSM. As was the case with inverter-based DER prior to IEEE 1547 in 2003, the types and use cases associated with ESS will continue to rapidly shift until standards and certifications are developed. Based on these factors, the Area EPS Operator shall specify any additional ESS requirements in the Area EPS Operator's TSM.

---

[28] For example, a tariff rate associated with a Qualifying Facility (QF), as defined in federal law and often relied upon in net metering rate definitions of eligible energy resources, requires all energy exported to the Area EPS to be from a QF. For ESS to be considered a QF, all of the energy charging ESS must originate from a different DER which meets the QF definition.

[29] At the time the TIIR are being written, certifications, national standards, guides, and recommended practices governing the capabilities and performance of ESS are yet to be written or published.

### 10.2 ESS Control Modes

Changes in ESS Control Modes to a mode that was not proposed and reviewed during the interconnection process can result in tariff violations or cause adverse technical impacts to the Area EPS. ESS Control Modes may not necessarily be considered a Material Modification, however the Interconnection Customer shall notify the Area EPS Operator of an unapproved ESS Control Mode prior to the change being implemented. The Area EPS Operator shall discuss with the Interconnection Customer the need, or lack thereof, to review the proposed ESS Control Mode for safety, power quality or reliability reasons.
IEEE 1547 states that a functional software or firmware change may result in another verification process at that time of interconnection and interoperability requirements. The IEEE 1547 standard, and other national standards and certifications, are currently silent on requirements relating to ESS Control Mode definition, implementation (i.e. default responses and ranges of allowable settings), transition between modes, adding new modes after initial interconnection, and all associated testing and verification procedures. Until industry standards and certifications are developed to address these aspects of ESS, a significant gap exists for which a grouping of partial solutions may be required by the Area EPS Operator, including, but not limited to the following requirements:

i. Documenting at the time of application the ESS Control Modes being applied for by the ESS owner. This information may be collected through an Area EPS Operator specific document[30] or the Area EPS Operator's online application portal.
ii. Documenting at the time of application the charge/discharge profile(s) or use case(s) intended to be utilized by the ESS owner. This information may be collected through an Area EPS Operator specific document or the Area EPS Operator's online application portal.
iii. The ESS Control Mode(s) reviewed and approved should be documented in an Operating Agreement. The Operating Agreement should also list the ESS Control Mode(s) that is being utilized. Area EPS Operator shall be notified of changes to ESS Control Mode(s). The changes and notification to the Area EPS Operator shall follow all applicable agreements and requirements as documented in the TSM.
iv. A method of ESS Control Modes security shall be furnished by the DER Operator to assure only ESS Control Modes applied for and reviewed by the Area EPS Operator are used. The security may be in the form of password protection of the functions or other methods specified by the Area EPS Operator's TSM.
v. Operation of the ESS shall be compatible with applicable tariffs[31], as required by the Area EPS Operator standard implementation of the tariffs.
vi. The Area EPS Operator may initiate verification of the ESS operation after the interconnection is complete if information is available indicating the ESS is not functioning as designed or approved.

---

[30] Upon publication of standards and certifications, this type of information will be well-suited to be included in statewide interconnection process documentation. Until that time, it is likely the type of ESS information needed could rapidly shift, depending on customer preferences and available technology. Continual shifts in technology, application of technology, and market place are occurring at a rapid pace at the time the TIIR is being written.
[31] Definitions of non-exporting and inadvertent export in statewide standards clarifies implementation of certain tariffs for ESS.

### 10.3 ESS Load Aspects

The load impacts of ESS shall be considered in scope for the statewide TIIR. The load aspects of ESS are not in scope of the IEEE 1547 standard, but reviewing the load aspects in conjunction with generation aspects is crucial to evaluating impacts to the Area EPS and leads to a more efficient review of the overall system. Impacts from ESS may contribute to requirements and mitigations, including but not limited to: electrical component upgrades; information exchange through use of the Local DER Communication Interface; or protection and control system upgrades.
Any Area EPS Operator's operating characteristics requirements for ESS charging operations shall not be more restrictive than the operating characteristics requirements of other comparable loads, to the extent practical or upon mutual agreement. The maximum charge rate of the ESS shall be included in materials submitted to the Area EPS Operator during the technical review portion of the interconnection process.

Certain grid events[32] may cause a large number of ESS in the affected area to simultaneous respond. Any future changes to wholesale markets allowing ESS to participate could also introduce unintentional wide-area ESS simultaneous response and impacts not accounted for during the interconnection process. Interconnection reviews typically do not contemplate this type of group response. The Area EPS Operator may define in the TSM interconnection technical requirements to address impacts from conditions where multiple unrelated ESS on a portion of the Area EPS are operating in concert.

## 11. Power Control Limiting – Capacity, Export, and Import

### 11.1 Introduction

The DER Operator may choose to limit the AC capacity of a DER system using Power Controls. Power Controls may also be used to limit DER system export levels to the Local EPS and/or the Area EPS. There are many possible reasons for implementing Power Controls, including meeting specific tariff terms or to mitigate the maximum level of power which can flow on the Local or Area EPS.

These capabilities are referred to as Power Control limited capacity, Power Control limited export, and Power Control limited import. These terms are discussed in the following sections and may be generally referred to as Power Control limiting. Power Control limiting may be accomplished using a Power Control limiting system. An alternate option, specifically related to assurance that the DER does not export power (non-export) to the Area EPS, is to implement the limit through relaying or by sizing DER in relationship to the size of the Local EPS load. The use and method for Power Control limiting shall require approval from the Area EPS Operator[33].

---

[32] For example, an extended outage could cause all the impacted ESS charge to largely deplete, which could trigger charging of all the effected ESS when power is restored on the Area EPS. The resulting charging could result in unanticipated overloads on the Area EPS unless the condition has been studied.

[33] MN DIP Section 5.14.3 states "the Interconnection Customer must obtain the Area EPS Operator's agreement that the manner in which the Interconnection Customer proposes to implement such a limit will effectively limit active power output so as to not adversely affect the safety and reliability of the Area EPS Operator's system."

### 11.2 Power Control Limited Capacity

Using Area EPS Operator's approved Power Control methods, the DER Operator may limit the DER AC capacity. The limited DER AC capacity value may be used by the Area EPS Operator when performing impact studies if the means of limiting capacity is determined to be adequate by mutual agreement. Some of the reasons the DER Operator may choose to limit DER AC capacity include, to avoid system upgrades or to size the DER to be compatible with programs or tariffs[34].

For inverter-based DER systems 20 kW or less in Nameplate Rating, the Power Control limited capacity shall be implemented through utilizing the IEEE 1547 configuration settings[35]. For Power Control capacity limiting, active power limits at unity and non-unity power factors may be applied. The DER Operator shall propose the configuration settings to the Area EPS Operator for review and approval.

For rotating machines or inverter-based DER systems larger than 20 kW in Nameplate Rating, the DER Operator shall submit details of the proposed Power Control limiting method for maximum capacity limiting, along with settings, if applicable. The Area EPS Operator shall review and either approve the proposed Power Control method and settings or provide a response as to why the method does not provide adequate control. The DER system should use the IEEE 1547 configuration settings as the preferred means of Power Control limited capacity.

### 11.3 Power Control Limited Export and Power Control Limited Import

Power Control limited export and Power Control limited import can provide means of meeting the requirements of specific Area EPS Operator's tariffs or other technical requirements. The DER Operator shall obtain approval from the Area EPS Operator for any Power Control limiting system which is implemented. Power Control limiting for inverter-based DER systems with a Nameplate Rating of 20kW or less shall use a certified control system tested to UL 1741[36]. For these smaller systems, the DER Owner shall submit proposed settings to the Area EPS Operator for review and approval. For DER systems with a Nameplate Rating larger than 20 kW using a certified control system tested to UL 1741, the DER Operator shall provide test results showing the magnitude and duration of power import or export.

The Power Control limited export and import may be applied using a UL 1741 certified Power Control System to limit import or export. Additionally, Power Control limited export may be applied using the IEEE 1547 *maximum active power* parameter to limit export in the

[34] The applicable programs or tariffs eligibility may be based on a nameplate capacity rather than a configured value. Consult the tariff or program rules of interest to determine if the nameplate capacity governs any aspects of the interconnection.

[35] IEEE 1547 Table 28 Nameplate Information contains the available configuration parameters which may be altered as allowed by Section 10.4.

[36] Testing to the UL Certification Requirement Decision on Power Control Systems may be used in the interim.

management settings[37] in cases where the RPA is at the PCC. The *maximum active power* parameter in the DER management information shall be used as a static limit when employed for limiting export. Similarly, the Power Control System import or export limit shall be a static limit when employed for limiting export or limiting import.
The current approved standards-based approaches for Power Control limiting have a maximum open loop response time limit of 30 seconds for limiting inadvertent active power exchange with the Area EPS. Active power exchange may occur for a period of time within this 30 second limit due to Local EPS conditions such as block load changes. Reactive power exchange between the DER, Local EPS and the Area EPS may occur during normal operations, but level and amount of this exchange shall be in accordance with applicable agreements.

The configuration and settings governing the Power Control limiting functions shall be password protected, accessible only by qualified personnel, or protected by other means which have been approved by the Area EPS Operator.

### 11.4 Other Power Control Methods

While this technical document has attempted to provide guidance and standards for Power Control limiting methods, this is a new and quickly changing area. This technical standard shall not preclude alternate means of Power Control limiting which may be implemented by mutual agreement between the DER Operator and the Area EPS Operator. The DER Operator shall provide details to the Area EPS Operator for any proposed Power Control limiting function. The proposal shall include settings, equipment information, and any other information necessary for the Area EPS Operator to complete a review of the proposal. Non-export limitations based on relaying or load characteristics are examples of potential proposals from a DER Operator. It is recommended that the DER Operator consider using a standards-based Power Control limiting system prior to proposing alternate solutions.

## 12. Enter Service and Synchronization

When entering service, the DER shall not energize the Area EPS until voltage and system frequency are within the ranges specified in Table 9 or established by Area EPS Operator's TSM.

*Table 9 Enter Service Voltage and Frequency Criteria*

| Enter Service Criteria | | Default Settings |
|---|---|---|
| Applicable voltage within range | Minimum value | ≥ 0.917 p.u. |
| | Maximum value | ≤ 1.05 p.u. |
| Frequency within range | Minimum value | ≥ 59.5 Hz |
| | Maximum value | ≤ 60.1 Hz |

[37] IEEE 1547 Section 4.6.2 allows for an active power limit to be set as an export limit when the RPA is the PCC. The parameter is found in Table 40 of IEEE 1547 Section 10.6.12.

The DER shall parallel and synchronize with the Area EPS in accordance to IEEE 1547.

# 13. Intentional Islanding

As an alternative to cease to energize and trip in response to voltage or frequency disturbances or unintentional island detection, a Local EPS island may be formed. When DER meets the criteria of Section 6.4, a Local EPS island may be formed rather than ride-through for voltage or frequency disturbances. If DER does not meet the criteria of section 6.4, the transition to the Local EPS island shall meet the rapid voltage change requirements of IEEE 1547. When paralleling a Local EPS island to the Area EPS, the Enter Service and Synchronization requirements of Section 12 shall be met.

DER systems designated by authority having jurisdiction as emergency, legally required, or critical operations power systems providing backup power to hospitals, fire stations or other emergency facilities as defined by applicable industry code, shall be exempt from this section and may Cease to Energize and Trip or separate from the Area EPS without limitation. Scheduled intentional Local EPS islands are allowed in accordance with IEEE 1547 Section 8.2.2 and applicable agreements.

Intentional Area EPS islands shall only be allowed upon mutual agreement between the Area EPS Operator and DER Operator.

# 14. Test and Verification Requirements

## 14.1 Introduction

Prior to a DER system's initial interconnection or operation in parallel with the Area EPS, the Area EPS Operator may require verification and testing of the DER interconnection. The Area EPS Operator's TSM document is expected to be reviewed to understand the interconnection testing requirements. The testing of the DER shall depend upon the type, size and complexity of the DER system. For DER systems utilizing certified inverters, which meet the IEEE 1547 interconnection requirements, the testing shall be to confirm the proper installation and configuration of the equipment.

Type tests and conformance testing are related to the interconnection requirements and safety aspects. The operational compliance with applicable tariffs, which is often pertinent for storage, is not affirmed through the test and verification requirements outlined in this section.

The process associated with design, approval and execution of test and verification procedures follows:

- The Area EPS Operator shall define the characteristics of tests that are required by applying standards and best practices.
- The RPA shall be specified in the one-line diagram submitted to the Area EPS Operator with the Interconnection Application. The DER Operator shall denote the RPA where

the test and verification feature shall be applied in the written test procedure, if required.

- When required by the Area EPS Operator, the DER Operator shall provide written test procedure to the Area EPS Operator for review.
- The testing and verification procedures shall be reviewed and approved by a Professional Engineer when a Professional Engineer is required for design of the DER as specified by the MN DIP[38].
- The Area EPS Operator shall provide written feedback to the DER Operator, if written test procedures are required, indicating the determination if the test and verification meets applicable requirements. Prior to witness testing, the Area EPS Operator may require the DER Operator to attest the DER system is ready for testing.[39]
- The Area EPS Operator and the DER Operator shall arrange for qualified personnel to perform the test procedures. Each entity shall operate their own equipment.
- The Area EPS Operator may arrange personnel to witness the test procedures being performed by the DER Operator.
- The Area EPS Operator may evaluate the DER as-built installation, including as outlined in IEEE 1547.1, during this site visit to verify that the installation meets interconnection and interoperability requirements.

The applicable DER evaluation, commissioning tests and verifications, shall be performed per IEEE 1547, IEEE 1547.1, and Area EPS Operator's TSM.

### 14.2 Full and Partial Conformance Testing and Verification

All DER used for interconnection with an Area EPS shall be tested to conform to IEEE 1547 interconnection requirements using IEEE 1547.1 conformance test procedures. Additional testing to affirm compliance with applicable tariffs may be outlined by the Area EPS Operator within their TSM. One way a DER shall be considered as conforming to IEEE 1547 is if it has been submitted by a manufacturer, tested and listed by an Occupational Safety and Health Administration (OSHA) Nationally Recognized Testing Laboratory (NRTL) for continuous grid interactive operation in compliance with the applicable codes and standards and is determined to be fully compliant. DER equipment shall be tested to conform to the IEEE 1547 requirements and listed in accordance with an OSHA NRTL.

All inverter-based DER units shall be UL 1741 certified. Certified DER equipment that do not require a supplemental DER device to meet IEEE 1547 requirements at the Reference Point of Applicability and where the impedance between the PCC and POC is less than 0.5% on the DER rated apparent power and voltage base shall be considered fully compliant. Partially compliant DER shall require further evaluation and possible testing. All DER systems shall meet the requirements of IEEE 1547 regardless of whether they are classified as fully or partially compliant.

---

[38] A Minnesota license Professional Engineer signature is required for certified system greater than 250 kW or for non-certified system greater than 50 kW as outlined in MN DIP 1.5.1.4.

[39] MN DIP Attachment C Certificate of Completion, is an example of certifying the DER system is ready for testing.

IEEE 1547 introduces the concepts of Reference Point of Applicability, which is located at either the PoC or the PCC. The IEEE 1547 standard section 4.2 should be referenced to determine the RPA, as the RPA is the point at which testing and verification requirements apply. Annex B in this document describes the relationship of these terms.

Figure 3 details the test and verification required steps when the RPA is at the PoC for a fully compliant DER Unit or DER system as well as a partially compliant composite DER system. Fully compliant DER Unit(s) require *basic* design evaluation and commissioning tests. Partially compliant DER Units(s) require *detailed* design evaluation. For example, a fully compliant DER Unit(s) with the RPA at the PoC is representative of a residential rooftop PV system. The DER Unit would be type tested by a NRTL resulting in a UL 1741 certification. IEEE 1547.1 details the Design Evaluation and Commissioning Test required for each of the combinations of fully and partially compliant DER with the RPA at the PoC and PCC.

*Figure 3 Test and Verification Required Steps for RPA at PoC*

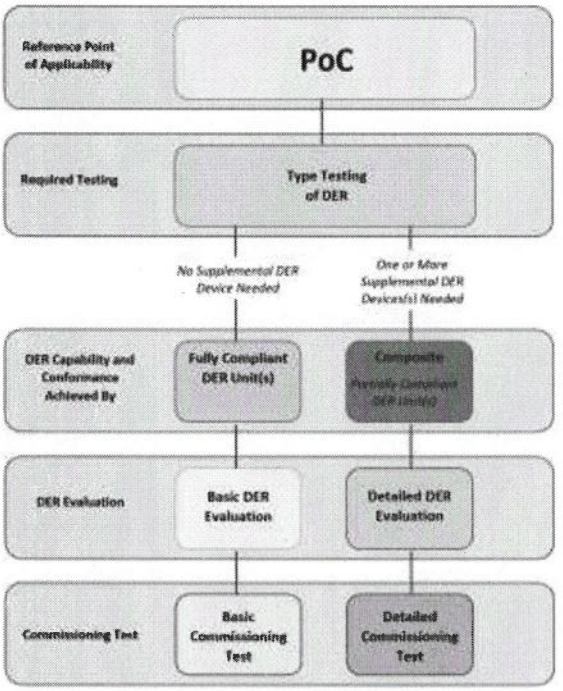
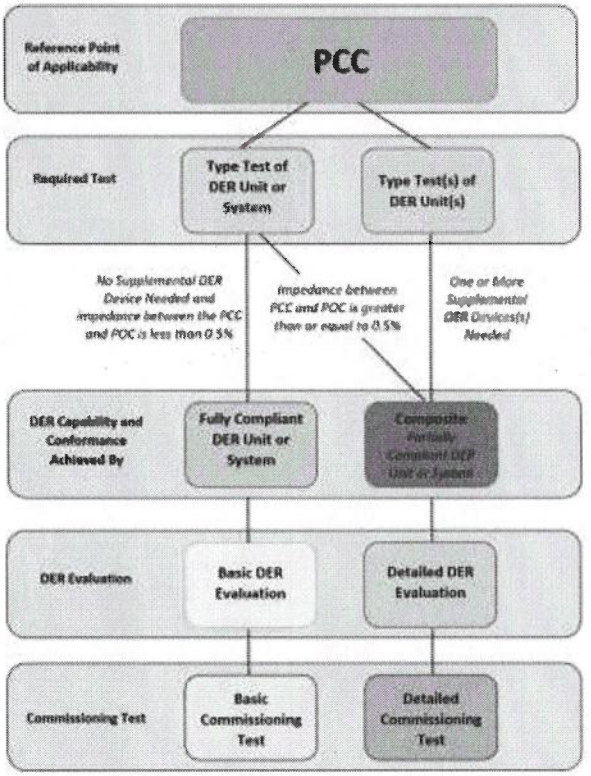



Figure 4 details test and verification requirements when the RPA is at the PCC. Requirements for fully compliant DER Units or systems and partially compliant DER Unit or systems are addressed separately in terms of required testing and evaluation.

*Figure 4 Test and Verification Required Steps for RPA at PCC*




## 14.3 Documentation

Testing and verification documentation requirements shall be specified in the Area EPS Operator's TSM. Fault current characterization information required in IEEE 1547, subclause 11.4, shall be provided to the Area EPS Operator upon request or per the Area EPS Operator's TSM.

## 14.4 Failure Protocol

In the event that a DER fails testing and verification, the DER Operator shall resolve any out-of-compliance items and resubmit or reschedule the appropriate items as defined by the MN DIP and Area EPS Operator's TSM.

## 14.5 Reverification and Periodic Tests

The DER Operator shall notify the Area EPS Operator prior to any of the following events occurring:

- Protection functions are being adjusted after the initial commissioning process.
- Functional software or firmware changes are being made on the DER.
- Any hardware component of the DER is being modified in the field or is being replaced or repaired with parts that are not substitutive components compliant with this standard.
- Protection settings are being changed after factory testing.

Prior to modifications to the DER triggering reverification, the DER Operator shall notify the Area EPS Operator's interconnection coordinator, as identified on the Area EPS Operator's website. Any of the above events may be cause for requiring reverification of the interconnection and interoperability requirements, per IEEE 1547 clause 11.2.6.

The Area EPS Operator may specify the frequency or time intervals for periodic testing consistent with Area EPS Operator's policies or manufacturer requirements.

### 14.6 Simplified Process Testing Procedure

The general process for field inspection and testing of an inverter-based DER that is less than 20 kW in size and approved through the Simplified Process, is outlined below. Specifics of the testing procedure and the responsibilities of the installer shall be identified in the Area EPS Operator's TSM.

General Process for Simplified Testing Procedures

- Verify installation matches design evaluation
  - Verify inverter model matches application
  - Verify certified inverter
  - Verify correct labeling / signage
  - Verify installation matches application one-line (i.e. connections, location of protection, disconnect switch, metering etc.)
  - Verify electrical inspection sticker
  - Verification of operational and protection settings

- Field Testing
  - On-off test
  - Open phase testing (if applicable for multiphase systems)

## 15. Operating and Maintenance Requirements

Operating and Maintenance Requirements may be required by the Area EPS Operator and are documented in Attachment 5 of the Interconnection Agreement.[40] The Operating and Maintenance Requirements are created for the benefit of both the DER Operator and the Area EPS Operator and shall be agreed to between the parties.

Operating and Maintenance Requirements may be reviewed and updated periodically to allow the operation of the DER to change to meet the needs of the DER Operator and the Area EPS Operator. There may also be changes required by external issues, such as changes in FERC and RTO recommendations or policies, which may require the updates to the Operating and Maintenance Requirements. Any updates to the Operating and Maintenance Requirements shall be agreed to between parties. In cases where mutual agreement cannot be achieved, see MN DIP section 5.3 and MN DIA Article 10.

[40] The Interconnection Agreement requirements are defined in the statewide Minnesota DER Interconnection Agreement (MN-DIA).

The following is a list of typical items that may be included as Operating Requirements. The items included as Operating Requirements shall not be limited to the items shown on this list:

i. Operational requirements, settings, and limits for DER when the Area EPS is in a normal condition
ii. Operational requirements, settings, and limits when the Area EPS is in an abnormal condition due to maintenance, contingencies, or other system issues
iii. Permitted and disallowed ESS Control Modes
iv. BPS or TPS limitations and arrangements that could impact DER operation
v. DER restoration of output or return to service settings and limitations
vi. Response to control or communication failures
vii. Performance category assignments (normal and abnormal)
viii. Dispatch characteristics of DER
ix. Notification process between DER Operator and Area EPS Operator
x. Right of Access

The following is a list of typical items that may be included as Maintenance Requirements. The items included as Maintenance Requirements shall not be limited to the items included in this list:

i. Routine maintenance requirements and definition of responsibilities
ii. Material modification of the DER that may impact the Area EPS

# Annex A – Link to webpage containing Area EPS Operator Technical Specifications Manual (TSM)

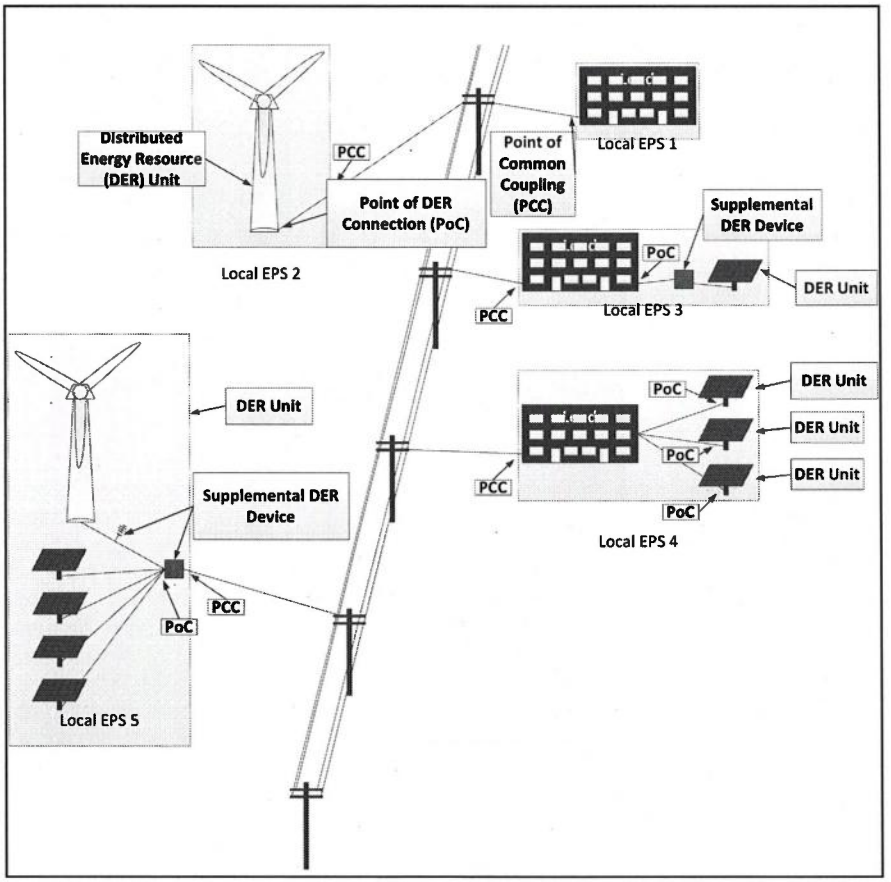
Below is the website address associated with an Area EPS Operator webpage containing the Operator's TSM:

| Company | Website Address |
|---|---|
| Dakota Electric Association | |
| Minnesota Power | |
| Otter Tail Power | |
| Xcel Energy – Northern States Power Minnesota | |

# Annex B – Clarification on Reference Point of Applicability, Point of Common Coupling, Point of DER Connection, and Supplemental DER Devices

The reference point of applicability (RPA) is the location where the requirements in IEEE 1547 and IEEE 1547.1 apply. The TIIR adopts the RPA as the location to apply technical requirements. The RPA is usually at the PCC or PoC. A location between the PoC and PCC can be mutually agreed upon as a substitute for when the location is determined to be at the PoC. The influence of load on the overall Local EPS operating characteristics is a driver behind the need for the RPA to be at the DER PoC. For example, meeting the reactive power requirement for DER may not be feasible if the DER is relatively small compared to a reactive power load in the same Local EPS. Similarly, ground referencing of the Local EPS also affects the ability of a DER to meet certain protection requirements. For example, detection of a loss-of-phase is not possible without zero-sequence continuity[41] between the Area EPS and Local EPS.

Decision trees for determining RPA are described in IEEE 1547, Section 4.2.




[41] For example, a transformer delta winding breaks zero-sequence continuity.

# Annex C – Anticipated list of topics in a TSM

| | |
|---|---|
| 1 | Introduction |
| 2 | Abbreviations and Common Terms |
| 3 | Performance Category Assignment |
| 4 | Reactive Power Capability and Voltage/Power Control Performance |
| 5 | Response to Abnormal Conditions |
| 6 | Protection Requirements |
| 7 | Operations |
| 8 | Power Control Systems |
| 9 | Interoperability |
| 10 | Energy Storage Systems |
| 11 | Metering Requirements |
| 12 | Signage and Labeling |
| 13 | Test and Verification Requirements |
| 14 | Sample Documents for Simplified Process |
| 15 | Appendix |

## *Annex D – Interim Implementation Guidance*

*TBD*

*Honorable Allyson K Sturgeon
Managing Senior Counsel - Regulatory &
LG&E and KU Energy LLC
220 West Main Street
Louisville, KENTUCKY 40202

*Emily W Medlyn
General Attorney
U.S. Army Legal Services Agency Regul
9275 Gunston Road
Fort Belvoir, VIRGINIA 22060

*John Horne
Office of the Attorney General Office of Rate
700 Capitol Avenue
Suite 20
Frankfort, KENTUCKY 40601-8204

*Angela M Goad
Assistant Attorney General
Office of the Attorney General Office of Rate
700 Capitol Avenue
Suite 20
Frankfort, KENTUCKY 40601-8204

*Thomas J FitzGerald
Counsel & Director
Kentucky Resources Council, Inc.
Post Office Box 1070
Frankfort, KENTUCKY 40602

*Honorable Kurt J Boehm
Attorney at Law
Boehm, Kurtz & Lowry
36 East Seventh Street
Suite 1510
Cincinnati, OHIO 45202

*Barry Alan Naum
Spilman Thomas & Battle, PLLC
1100 Brent Creek Blvd., Suite 101
Mechanicsburg, PENNSYLVANIA 17050

*G. Houston Parrish
Labor Law Attorney
Office of the Staff Judge Advocate, B
50 3rd Avenue
Fort Knox, KENTUCKY 40121

*Honorable Kendrick R Riggs
Attorney at Law
Stoll Keenon Ogden, PLLC
2000 PNC Plaza
500 W Jefferson Street
Louisville, KENTUCKY 40202-2828

*Clay A. Barkley
Strobo Barkley PLLC
239 South 5th Street
Ste 917
Louisville, KENTUCKY 40202

*Jeff Derouen
200 S. 5th St. Suite 200 N
Louisville, KENTUCKY 40202

*Larry Cook
Assistant Attorney General
Office of the Attorney General Office of Rate
700 Capitol Avenue
Suite 20
Frankfort, KENTUCKY 40601-8204

*Carrie H Grundmann
Spilman Thomas & Battle, PLLC
110 Oakwood Drive, Suite 500
Winston-Salem, NORTH CAROLINA 27103

*James W Gardner
Sturgill, Turner, Barker & Moloney, PLLC
333 West Vine Street
Suite 1400
Lexington, KENTUCKY 40507

*Lauren Givhan
200 S. 5th St. Suite 200 N
Louisville, KENTUCKY 40202

*Don C A Parker
Spilman Thomas & Battle, PLLC
1100 Brent Creek Blvd., Suite 101
Mechanicsburg, PENNSYLVANIA 17050

*Jody M Kyler Cohn
Boehm, Kurtz & Lowry
36 East Seventh Street
Suite 1510
Cincinnati, OHIO 45202

*Matt Partymiller
President
Kentucky Solar Industries Association
1038 Brentwood Court
Suite B
Lexington, KENTUCKY 40511

*Honorable David Edward Spenard
Strobo Barkley PLLC
239 South 5th Street
Ste 917
Louisville, KENTUCKY 40202

*Joe F. Childers
Childers & Baxter PLLC
300 Lexington Building, 201 West Sho
Lexington, KENTUCKY 40507

*Matthew Miller
Sierra Club
50 F Street, NW, Eighth Floor
Washington, DISTRICT OF COLUMBIA 20001

*J. Michael West
Office of the Attorney General Office of Rate
700 Capitol Avenue
Suite 20
Frankfort, KENTUCKY 40601-8204

*Louisville Gas and Electric Company
220 W. Main Street
P. O. Box 32010
Louisville, KY 40232-2010

*Honorable Michael L Kurtz
Attorney at Law
Boehm, Kurtz & Lowry
36 East Seventh Street
Suite 1510
Cincinnati, OHIO 45202

*M. Todd Osterloh
Sturgill, Turner, Barker & Moloney, PLLC
333 West Vine Street
Suite 1400
Lexington, KENTUCKY 40507

*Rick LoveKamp
Kentucky Utilities Company
220 W. Main Street
P. O. Box 32010
Louisville, KY 40202

*Honorable Robert C Moore
Attorney At Law
Stites & Harbison
421 West Main Street
P. O. Box 634
Frankfort, KENTUCKY 40602-0634

*Robert Conroy
Vice President, State Regulation and Rates
LG&E and KU Energy LLC
220 West Main Street
Louisville, KENTUCKY 40202

*Randal A. Strobo
Strobo Barkley PLLC
239 South 5th Street
Ste 917
Louisville, KENTUCKY 40202

*Sara Judd
Senior Corporate Attorney
LG&E and KU Energy LLC
220 West Main Street
Louisville, KENTUCKY 40202