

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of:	J. Carl Cooper	Attorney Docket No. 58936-0002IP3
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Title:	POWER SOURCE LOAD CONTROL	

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**PETITION FOR *INTER PARTES* REVIEW OF UNITED STATES PATENT
NO. 11,967,857 PURSUANT TO 35 U.S.C. §§ 311–319, 37 C.F.R. § 42**

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EXHIBITS

EX1001	U.S. Patent No. 11,967,857 to Cooper (“the ’857 Patent”)
EX1002	Excerpts from the Prosecution History of the ’857 Patent
EX1003	Declaration and Curriculum Vitae of Dr. Steven Leeb
EX1004	Complaint, <i>PSLC LLC v. Generac Power Systems, Inc.</i> , 2:24-cv-01270-SCD filed October 7, 2024
EX1005	U.S. Patent Appl. No. 2006/0208574 (“Lasseter”)
EX1006	Rashad M. Kamel & B. Kermanshahi, <i>Enhancement of Micro-Grid Dynamic Performance Subsequent to Islanding Process Using Storage Batteries</i> , 34 IRAN. J. SCI. TECH. 605 (Dec. 2010)
EX1007	Alexander Kusko & Marc T. Thompson, POWER QUALITY IN ELECTRICAL SYSTEMS (2007)
EX1008	U.S. Patent No. 8,410,633 (“Batzler”)
EX1009	U.S. Patent No. 7,149,605 (“Chassin”)
EX1010	Declaration and Curriculum Vitae of June Ann Munford
EX1011	J.A. Peças Lopes et al., <i>Defining Control Strategies for MicroGrids Islanded Operation</i> , 21 IEEE TRANSACTIONS POWER SYSTEMS 916 (May 2006)
EX1012	A.G. Madureira & J.A. Peças Lopes, <i>Coordinated Voltage Support in Distribution Networks with Distributed Generation and Microgrids</i> , 3 IET RENEWABLE POWER GENERATION 439 (2009)
EX1013	Netra Gyawali & Yasuharu Ohsawa, <i>Improved Power Sharing Scheme for a Microgrid with Multiple Distributed Generators</i> , 128 IEEE TRANSACTIONS ON ELECS., INFO. & SYSTEMS 1635 (2008)

EX1014	Rashad M. Kamel, Aymen Chaouachi & Ken Nagasaka, <i>Effect of Wind Generation System Rating on Transient Dynamic Performance of the Micro-Grid During Islanding Mode</i> , 1 LOW CARBON ECON. 29 (2010)
EX1015	Robert Lasseter, <i>Providing Premium Power Through Distributed Resources</i> , PROCS. 33RD HAWAII INT’L CONF. SYS. SCIS. (2000)
EX1016	R. H. Lasseter, <i>Smart Distribution: Coupled Microgrids</i> , 99 PROCS. IEEE 1074 (June 2011)
EX1017	Nosh K. Medora et al., <i>Impact of Line Voltage Sag on Switch Mode Power Supply Operation</i> , 2008 3RD IEEE CONFERENCE ON INDUSTRIAL ELECTRONICS AND APPLICATIONS (July 2008)
EX1018	Reserved
EX1019	R.P. Rodrigues & P.M. Silveira, <i>A Survey of Techniques Applied to Non-stationary Waveforms in Electrical Power Systems</i> , IEEE PROCEEDINGS OF THE 14TH INTERNATIONAL CONFERENCE ON HARMONICS AND QUALITY OF POWER (Jan. 2010)
EX1020	U.S. Patent Appl. No. 2004/0051387
EX1021	U.S. Patent Publ. No. 2010/0019574 (“Baldassarre”)
EX1022	Paul Sherz, PRACTICAL ELECTRONICS FOR INVENTORS (2000)
EX1023	U.S. Patent Publ. No. 2007/0222294 (“Tsukida”)
EX1024	U.S. Patent No. 8,204,632
EX1025	U.S. Patent No. 7,356,422
EX1026	U.S. Patent No. 7,274,975 (“Miller”)
EX1027	U.S. Patent No. 6,314,378
EX1028	Robert Lasseter et al., <i>White Paper on Integration of Distributed Energy Resources</i> , CONSORTIUM FOR ELECTRIC RELIABILITY

TECHNOLOGY SOLUTIONS (Apr. 2002)

EX1029 Robert Lasseter & Pablo Piagi, *Microgrid: A Conceptual Solution*, PESCE' AACHEN, GERMANY (June 25, 2004)

EX1030 STANDARD FOR EMERGENCY AND STANDBY POWER SYSTEMS, NFPA® 110 (2010 ed.)

CONVENTIONS OF THE PETITION

- All emphases are added unless noted otherwise;
- Bold-italic emphases correlate to claim language;
- Quotations are generally from exhibits, not claim language; and
- The phrase “*supra*” and equivalent phrases incorporate fully the analysis of the cross-cited portion of the Petition.

Generac Power Systems, Inc. petitions for IPR of the '857 patent based on the grounds in this Petition.

I. REQUIREMENTS FOR IPR

A. Standing

Petitioner certifies the '857 patent is available for IPR, and Petitioner is not barred or estopped.

B. Challenge and Relief Requested

Generac requests IPR of the Challenged Claims on the below grounds. Dr. Leeb provides supporting testimony. EX1003, ¶¶1-378.

Ground	Claim(s)	§103 Basis
1A	45-47, 49-54, 58-60, and 66-69	Lasseter-Lopes
1B	48, 56-57, and 71	Lasseter-Lopes-Baldassarre
1C	69-70	Lasseter-Lopes-Tsukida
1D	55	Lasseter-Lopes-Baldassarre-Tsukida

The references predate May 26, 2011, qualifying as prior art. Petitioner reserves the right to challenge the patent's priority.

Reference	Date	Pre-AIA Section
Lasseter (EX1005)	9/21/2006 (published)	102(a)/(b)/(e)(1)
Lopes	5/31/2006	102(a)/(b)

Reference	Date	Pre-AIA Section
(EX1011)	(published)	
Baldassarre (EX1021)	1/28/2010 (published)	102(a)/(b)/(e)(1)
Tsukida (EX1023)	9/27/2007 (published)	102(a)/(b)/(e)(1)

Lopes was published May 2006 and cataloged in Penn State University Library's subject-matter searchable public catalog so POSITA could have found Lopes in 2006. EX1011, 1; EX1010, ¶¶19-22. POSITA contemporaneously found Lopes. *See* EX1012, 2, 4 (“©...2009”), EX1013, 1-2 (“©2008”), EX1014, 1-2 (“©2010”), each citing EX1011.

C. Claim Construction

Unless stated otherwise or expressly defined, plain meaning is applied. However, the Challenged Claims are obvious under any reasonable *Phillips* interpretation. Petitioner reserves the right to address any subsequent issues of claim interpretation arising in any proceeding.

“Overload” is expressly defined as “a load that if not disconnected or otherwise prevented will either cause a departure from specifications for the power output from the power source, for example such as a deviation of AC power voltage or frequency for longer than a specified time period, a loss of power such as from a tripped circuit breaker, or damage such as overheating or exceeding mechanical

stress limits.” EX1001, 7:55-62.

“Parameter” is expressly defined as “a quantity of one or more property or attribute (e.g. of a device, physical property, substance or environment) which is treated as a constant.” EX1001, 10:11-20. “A parameter may at times change or be adjusted.” *Id.* “Examples...[include] horsepower, mechanical load, temperature, pressure (including altitude), humidity, power, wattage, voltage, current.” *Id.*

“Know” and “known” are expressly defined as “to have been previously stored in a memory and available e.g. having been previously manufactured with, programmed with or measured.” EX1001, 26:18-21.

D. Level of Ordinary Skill in the Art

POSITA of the ’857 Patent’s subject matter as of May 26, 2011, would have had at least a Bachelor’s degree in Electrical or Mechanical Engineering, or equivalent, and at least two-years’ experience in power electronics, power generation, or backup power generation engineering. Additional graduate education could substitute for work experience. EX1003, ¶¶24-28.

II. THE ’857 PATENT

A. Brief Description

The ’857 Patent discloses controlling backup power sources. EX1001, Abstract. Specifically, it concerns controlling a backup power source’s AC-power frequency “in response to the loading on the power source.” *Id.*

Given a power source’s loading, the system “can determine the amount of

remaining power available from the power source.” *Id.* If inadequate power remains—*i.e.*, if the power source is (or is about to be) overloaded—the system can alter its frequency. *Id.*

B. Prosecution History

The Examiner allowed the ’857 Patent because he believed the prior art did not teach:

the power source operating in such a manner so as to control the frequency of the output AC power to have a first frequency when the power source is not overloaded and a second frequency when the power source is overloaded or near to being overloaded *in addition to a processor circuit operating in response to the occurrence of the second frequency to control the amount of AC output power consumed by at least one load.*

EX1002, 40-41. But this Petition shows such processor circuits were part of the prior art. The Challenged Claims are obvious—this would have been apparent if the Examiner had the prior art presented below. EX1003, ¶¶40-49.

III. THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. [GROUND 1A] – Claims 45-47, 49-54, 58-60, And 66-69 Are Obvious Over Lasseter-Lopes

1. Lasseter (EX1005)

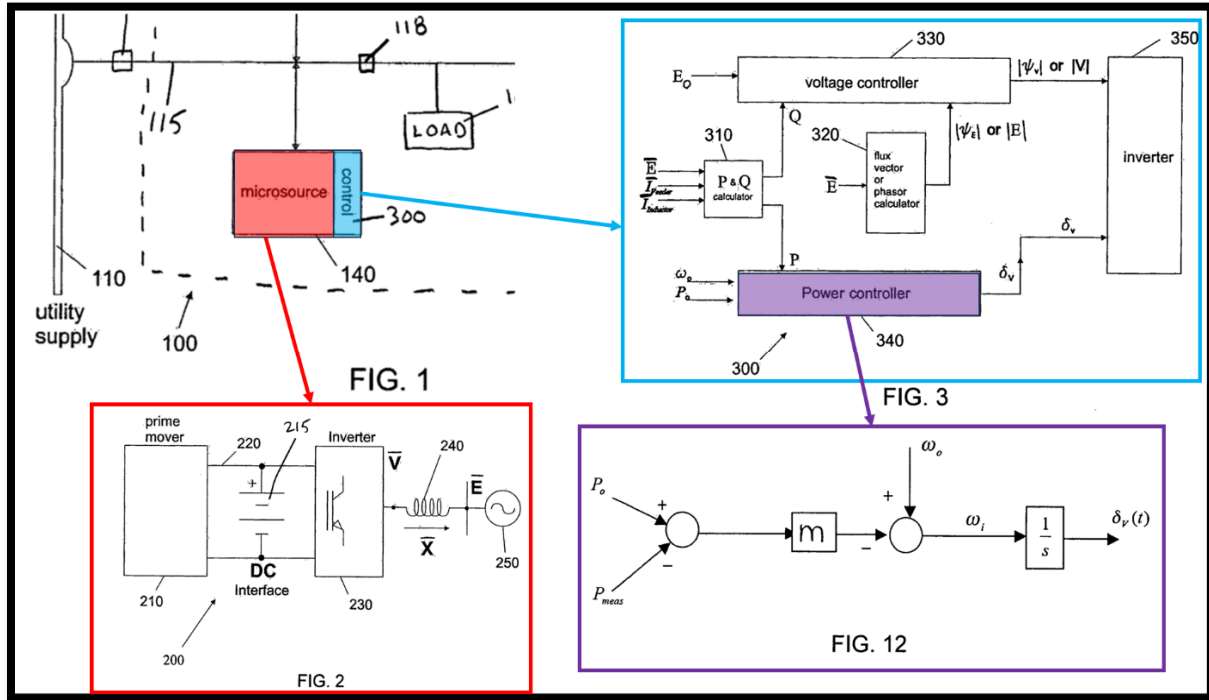
Lasseter concerns “distributed energy resource system[s].” EX1005, Abstract. “[D]istributed energy resources (DER)” are “independent power generation and storage systems which may be owned by, and located near, consumers of electrical power.” *Id.*, ¶[0006]. DERs “provide more reliable power...as a backup to the

primary electrical supply.” *Id.*, ¶[0007]. DER power sources are called “microsources.” *Id.*, ¶[0009].

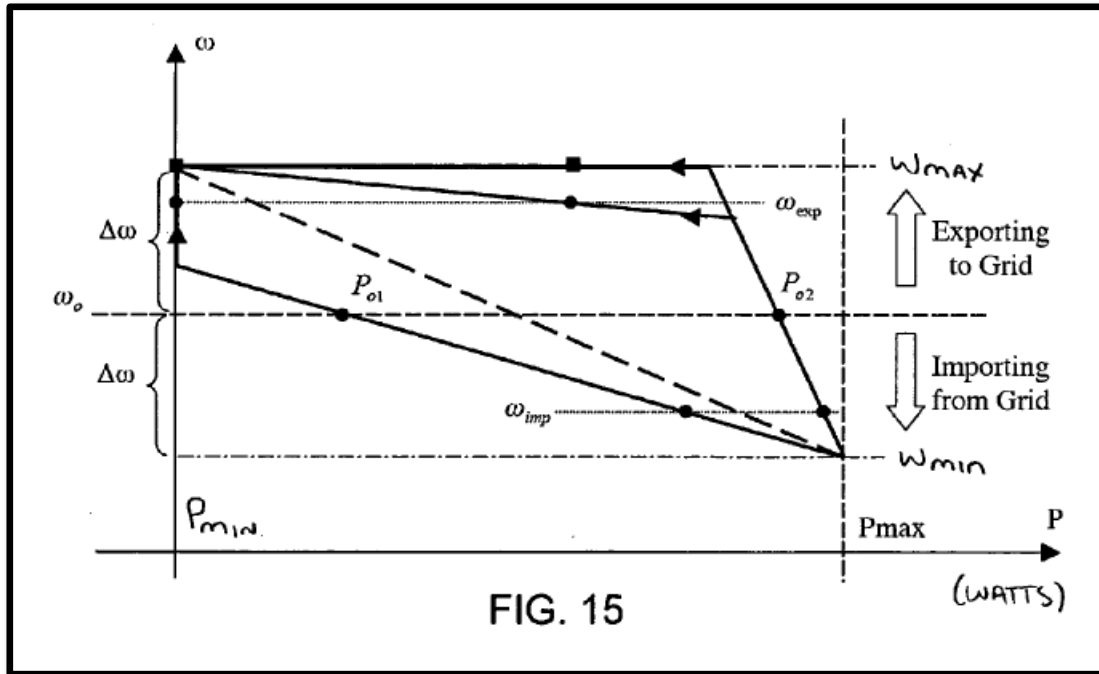
Lasseter discloses “controlling...instantaneous frequency and power from one or more microsources in ways that tend to ensure that the microsources stay within their normal operating ranges and otherwise operate effectively.” *Id.*, ¶¶[0058], [0106]-[0142], [0158]-[0171]; FIGS. 14-18, 25-29. These frequency-changing control schemes focus on “respon[ding] to events such as islanding or new loads.” *Id.* When loads demand additional power, microsource have “controllers that reduce the operating frequency of” microsources “to increase...unit output power.” *Id.*, Abstract, ¶[0110].

Lasseter’s “feeder lines **115**...interconnect microsource systems...and one or more loads.” *Id.*, ¶[0063], FIG. 1. “[F]eeder line 115, the interconnected microsource systems...and the one or more loads **160** can form a microgrid **117**.” *Id.* “FIG. 2 is a diagram of an exemplary microsource **200** that can be used in a [DER] such as that of FIG. 1” *Id.*, ¶[0070]. “FIG. 3 is a diagram of a controller **300** that can be used with a microsource such as that of FIG. 2...to control an inverter that regulates power flow from the microsource in a distributed energy resource system such as that of FIG. 1.” *Id.*, ¶[0074]. Controller **300** includes voltage controller **330** and power controller **340**. Voltage controller **330** controls “the magnitude of the inverter output voltage $|V|$,” as discussed for FIG. 5. *Id.*, ¶¶[0074]-[0076], [0086]-[0090]. Power

controller **340** “control[s] the instantaneous operating frequency ω_i of the inverter [350] by changing the operating phase angle of the inverter $\delta_v(t)$.” *Id.*, ¶¶[0074]-[0076], [0107]. FIG. 12 depicts power controller **340**. *Id.*, ¶¶[0105]-[0107].



FIGS. 14-17 depict varying “unit power control” schemes power controllers implement to control microsources’ frequency-power output. *Id.*, ¶¶[0105], ¶¶[0110]-[0141]. FIG. 15 depicts an example “relationship between steady state unit power vs. frequency (P - ω)...for two exemplary microsources.” *Id.*, ¶[0122]. The power-frequency slopes depend on “power set point, P_0 and the maximum power output, P_{max} , of [a] microsource.” *Id.*, ¶¶[0122]-[0132].



Power controller operates so “operating characteristics for all the units converge at the point of maximum power and minimum frequency,” allowing “the power to increase more in the units that are less loaded (unit1) and increase less in the units that are more loaded (unit2).” EX1005, ¶¶[0117]-[0118]. Unlike natural frequency droop (e.g., EX1001, 6:28-43), Lasseter expressly controls frequency. EX1005, ¶[0012]; ¶¶[0015]-[0018], ¶¶[0057]-[0058].

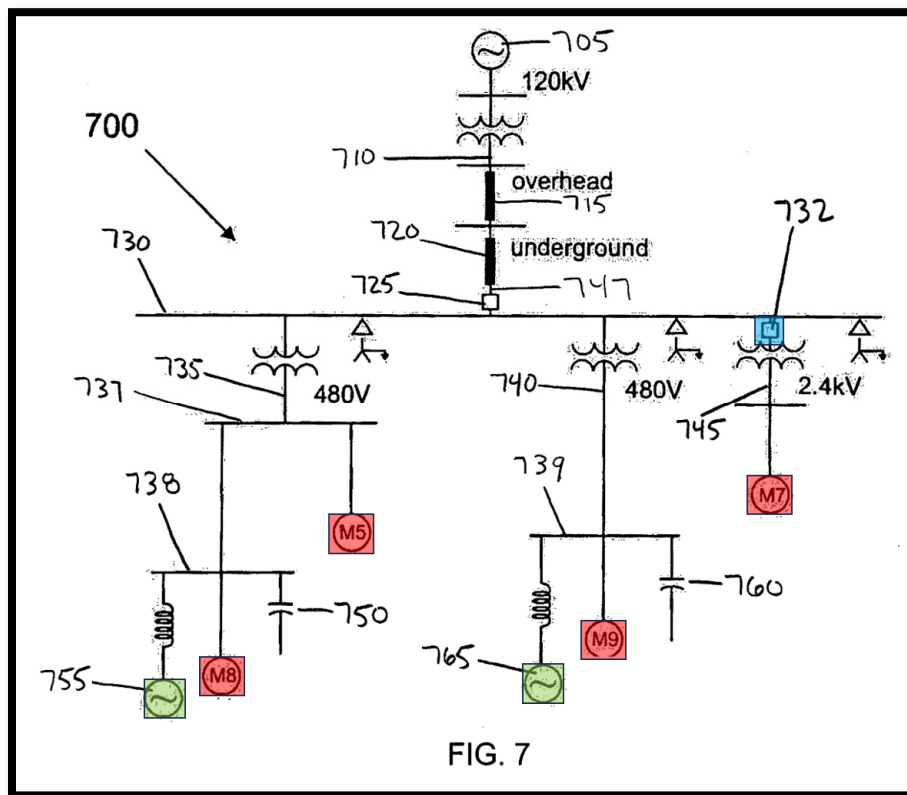
Lasseter’s disclosure focuses on situations where microsources can supply connected loads in steady state, “assuming enough generation” to supply loads or total load is “smaller than sum of all generation.” *Id.*, ¶[0137], ¶[0141]. The lines in FIGS. 14-17 representing the power-frequency relationship end at minimum power, P_{min} , and maximum power, P_{max} . EX1003, ¶58. But “the minimum limit on frequency

can be exceeded...if the limit on maximum power is also exceeded, *i.e.* there are more loads than generation.” EX1005, ¶[0130]. This remains true for all unit-power schemes of FIGS. 14 and 17. *Id.*, ¶[0119], ¶[0141]. Lasseter’s FIGS. 25(a)-25(b), implementing the power-frequency relationship of FIG. 17, also show power exceeding $P_{\max}$. *Id.*, FIGS. 25(a)-25(b) (power and frequency spike from D-E); EX1003, ¶58. $P_{\max}$ is a maximum rated power of the microsource, or at least it would have been obvious to set $P_{\max}$ as such—Lasseter teaches controlling power output between $P_{\min}$ and $P_{\max}$. EX1003, ¶58. Lasseter’s prior filing confirms, calling $P_{\max}$ “the maximum rated power of the machine.” EX1020, ¶[0112] (incorporated by reference into EX1005). Exceeding $P_{\max}$ is an “overload,” per the ’857 patent, because a load greater than $P_{\max}$ represents “a load” on the microsource “caus[ing] a departure from specifications for the power output from the source” in both the rated power specification ($P_{\min}$ - $P_{\max}$) and below Lasseter’s minimum-frequency specification. EX1003, ¶58. POSITA would have understood operating a microsource beyond its maximum rated power for long enough, if not stopped by a tripping a circuit breaker, causes damage to the microsource. EX1003, ¶58. Power is a function of voltage, current, and frequency. *Id.* (citing EX1022, 64).

$$P_{\text{ave}} = \text{Re}(VI^*) = |VI^*| \cos \phi$$

Lasseter, in certain embodiments, preemptively “disconnects” loads when it

expects “the combined power capacity of the microsources...is not adequate to supply the total load from loads.” EX1005, ¶[0099]. In one such embodiment, “the combined power capacity of the **microsources 755** and **765** is adequate to supply the combined load from **loads M5, M8, and M9**” but not **M7**. *Id.* When the power system disconnects from the grid (during islanding), “**switch 732** can...open[] to disconnect...**load M7**.” *Id.*, FIG. 7.



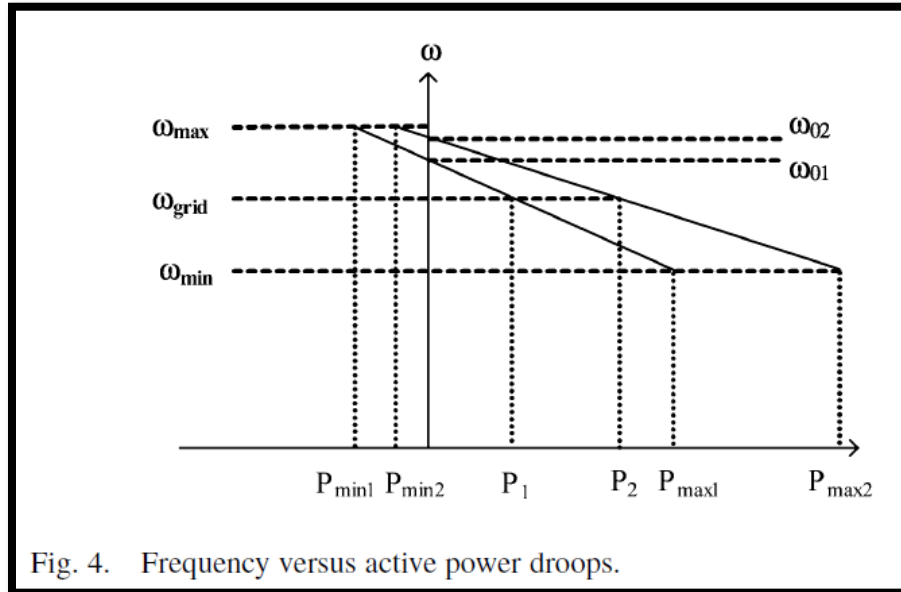
Thus, Lasseter acknowledges needing additional control strategies when load exceeds supply.

2. Lopes (EX1011)

Lopes concerns control strategies for islanded-DER operation with

microsources like Lasseter's. EX1011, 1. Lopes "further developed" a "control scheme based on droop concepts to operate in terms of feeding a standalone ac system," a controlled-droop system similar to Lasseter. *Id.*, 8 (citing EX1015, an earlier Lasseter paper); EX1015 at 3, Fig 1, 6-7, FIGS. 8, 11-11-14. Like Lasseter, Lopes' inverters actively "control[] voltage and frequency on the ac system...through droops." EX1011, 3-4.

According to Lopes, DERs disconnecting from the grid "must have the ability to operate stably and autonomously." EX1011, 1. Like Lasseter, as shown in Lopes' Figure 4, Lopes' microsources increase power generation by changing output frequency up to max-power outputs:



But when loads exceed generation, Lopes explains there can be an "overload." *Id.*, 4. "[H]igh imbalance between local load and generation may lead to large frequency

deviations and transient overload of” inverters. *Id.*, 4. To address overloads, Lopes uses “load shedding strategies...to avoid large frequency and voltage excursions.” *Id.*, 2. “The amount of load to be shed is defined based on the amplitude of frequency deviation.” *Id.*, 5. Thus, Lopes advocates allowing “a temporary disconnection of less important loads.” *Id.*, 6.

3. The Combination, Reasons to Combine, & Expectation of Success

Because POSITA would have recognized the benefit of combining Lasseter and Lopes—doing so would have been obvious. EX1003, ¶¶69-83, ¶211, ¶288. Indeed, according to the inventor (who prosecuted the ’857 Patent), “such combinations of” power sources controlling AC frequency with load shedding systems “are readily apparent to the person of ordinary skill.” EX1002, 3; EX1016, 3, 5. Moreover, Lopes cites several microgrid-related-Lasseter papers. EX1015, EX1028, EX1029. As discussed, *supra* §III.A.1, Lasseter discloses methods of controlling power source frequency to alter output power in response to changing loads. While Lasseter addresses instances where microsources can fully supply steady-state power demanded by the connected loads, Lasseter acknowledges “the combined power capacity of the microsources...is not” always “adequate to supply the total load.” *Id.*, ¶[0099]. Thus, Lasseter discloses a situation it does not explain how to address—where combined generation capacity is insufficient to supply the potential total load. For the below reasons, it would have been obvious to supply

generation capacity needed for expected steady-state operation of the connected loads and employ a responsive (rather than preemptive) load-shedding strategy, such as Lopes', in Lasseter's system to temporarily disconnect less important (e.g., non-critical) loads when necessary. EX1003, ¶¶71-72. Load shedding in response to frequency deviation was a well-known technique at the time. *Id.* (citing EX1006, 7; EX1023, ¶¶[0002]-[0004]); EX1009, 8:63-9:41; EX1023, Abstract. POSITA would have further found it obvious to set the load-shedding threshold at or below Lasseter's minimum frequency, potentially allowing frequency deviation to the lower specified threshold as loading demands. EX1003, ¶¶71-72 (discussing how thresholds below minimum frequency/maximum power were common, citing EX1006, 7 and EX1005, FIG. 25(a); EX1023, ¶[0004]). POSITA would have been motivated to combine Lasseter with Lopes' frequency-deviation-load-shedding strategy for multiple reasons.

First, because Lasseter does not detail what to do when its microsources' generation capacity is inadequate to supply the total potential load, POSITA would have looked to Lopes and its responsive frequency-based load-shedding scheme for solutions. EX1003, ¶73. POSITA would have been motivated to apply responsive load shedding, as in Lopes, instead of providing excess generation capacity, which, as explained below, has drawbacks. Lopes explains, "[t]he key issue for successful MG islanded operation is the management of load shedding." EX1011, 7-8. POSITA

would have further set the load-shedding threshold at or below Lasseter's minimum frequency to prevent overload or significant overload—including excursions beyond Lasseter's specified $P_{\max}$ —when the total load exceeds the available generation capacity. *Id.*; EX1003, ¶54-73. POSITA would have understood thresholds below Lasseter's minimum frequency would beneficially allow the system to operate through less significant excursions beyond $P_{\max}$, ensuring loads are not unnecessarily shed for manageable excursions (e.g., where the overload condition is not sustained). EX1003, ¶74 (discussing a less significant excursion in EX1005, FIG. 25(a) and collecting cites). Applying load shedding to Lasseter based on (or below) its minimum frequency would simply combine “familiar elements according to known methods,” *i.e.*, applying load shedding for its intended purpose of responsively eliminating loads to ensure sufficient generation capacity, to “yield predictable results,” *i.e.*, a variable total load appropriate for the available generation capacity. *KSR Intern. Co. v. Teleflex Inc.*, 550 U.S. 398, 401 (2007); EX1003, ¶75.

Second, employing responsive load-shedding activated at or below Lasseter's minimum frequency could avoid inefficiencies from excess generation capacities. Without responsive load shedding, systems must maintain more generative capacity than max-potential load. EX1003, ¶76. This is inefficient—typical loads do not constantly demand maximum power, resulting in unnecessary cost from unused generative capacity. EX1003, ¶76. Indeed, there are cost, size, fuel consumption,

and system complexity implications to having excess generative capacity in backup power sources. EX1003, ¶76. In view of Lopes' express example of power-management load shedding, POSITA would have found it obvious to ensure generative capacity was sufficient for typical operation, deploying Lopes' load-shedding strategies when Lasseter reached or exceeded its minimum frequency and maximum-power output. EX1003, ¶76. Doing so would avoid excess-generative-capacity inefficiencies while always providing adequate power to the connected loads during typical operation. EX1003, ¶76.

Third, Lasseter teaches one could alternatively impose an express power-output limit, but this could result in providing less power than the loads demanded. EX1003, ¶77. While certain Lasseter embodiments “actively enforce[]” limits on power output, Lasseter describes this as a “disadvantage” compared to situations with “enough generation” to power the loads. EX1005, ¶[0137]. Supplying less than demanded power is undesirable, especially for critical loads (*e.g.*, life support). EX1003, ¶77. In contrast, shedding and reconnecting “less important” loads—only as needed—ensures critical loads can continue to receive power. EX1003, ¶77; EX1011, 4.

Fourth, POSITA would have been motivated to employ load shedding in systems where only some loads are truly critical. EX1003, ¶78. Hospitals provide a paradigmatic example: “interruption of power...can have life-threatening

consequences.” EX1005, ¶[0007]. Under normal operation, DERs supply both critical loads (e.g., life-support machines) and non-critical loads (e.g., air conditioning). *Id.*, ¶[0099]; EX1003, ¶78. Lasseter discloses systems that preemptively disconnects non-critical loads (M7) (like air conditioning) in favor of critical loads (M5, M8, M9), EX1005, ¶[0099], such as life support. But because loads vary over time, there may be periods when both critical and non-critical loads can be adequately powered. *Id.*, ¶[0104]; EX1003, ¶78. In such circumstances—where non-critical loads can sometimes remain online without jeopardizing critical ones—POSITA would have been motivated to delay Lasseter’s shedding of “less important loads” until necessary (and only do so “temporar[ily]”) to preserve adequate power for critical applications, as Lopes teaches. EX1011, 4; EX1003, ¶78.

Fifth, POSITA would have been motivated to combine Lasseter and Lopes to avoid drawbacks associated with Lasseter’s preemptive load disconnection. EX1003, ¶79; EX1005, ¶[0099]. Though this prevents loads from exceeding generation high-power demand moments, it prevents power sources from powering said loads in low-power demand moments. EX1003, ¶79. Even if a power source cannot supply the maximum-possible load, it may be able to power all loads in low-power demand moments. EX1003, ¶79; EX1001, 7:5-22. Doing so avoids costs associated with disconnecting lower-priority loads, like sensitive electronics that have restart times or manufacturing processes where interruption results in “wasted

material in process that must be scrapped.” EX1005, ¶[0099]. Disconnecting low-priority loads has drawbacks which need not be borne in all instances when systems employ Lopes’ load-shedding strategy rather than always preemptively disconnecting loads as Lasseter discloses. EX1003, ¶79.

Sixth, shedding loads only when necessary (as in Lopes) helps power sources operate near maximum-output (and most efficient), motivating POSITA. EX1003, ¶80. “Microsources are expected to operate most of their time with power outputs near maximum because of the better efficiencies enjoyed at this higher operating points.” EX1005, ¶[0132]; EX1001, 3:21-36, 4:7-53. Preemptive load-shedding may result in shedding loads the microsource could have otherwise powered and have operated nearer to its maximum (more efficient) power output. EX1003, ¶80. Employing Lopes’ load shedding based on the frequency droop indicative of loading would result in a more efficient use of power resources. EX1003, ¶80.

POSITA would have reasonably expected success in the combination. EX1003, ¶81. It implements “well-known” benefits of load-shedding in response to decreased frequency for Lasseter’s microsource systems, which already decrease frequency as a function of increased loading. EX1005, Abstract; EX1003, ¶81 (quoting EX1006, 611). This implementation achieves predictable improvements (i.e., ensuring only loads that can be adequately powered are connected to Lasseter’s microsources) without impacting the operating principle of Lasseter’s microsource

power-control systems. EX1003, ¶81.

Rather than impact it, this combination is a commonsense improvement to the operating principle of Lasseter's microsources when outputting max-power. Further loading will not receive the demanded power. EX1003, ¶82. Lasseter already prescribes a minimum frequency for the max-power; Lopes supplies the obvious next step—shed loads at or below that frequency rather than persist with inadequate power delivery. EX1003, ¶82.

Combining Lasseter with Lopes would have been nothing more than integrating Lasseter's teachings with Lopes' "well-known" load-shedding techniques, both relating to DERs. EX1003, ¶¶82-83 (quoting EX1006, 611). The fundamental aspects of Lasseter's frequency manipulating power sources, bolstered by the beneficial aspects of Lopes' load-shedding scheme, result in a reasonable expectation of success. *Id.*

4. Claim Element Analysis

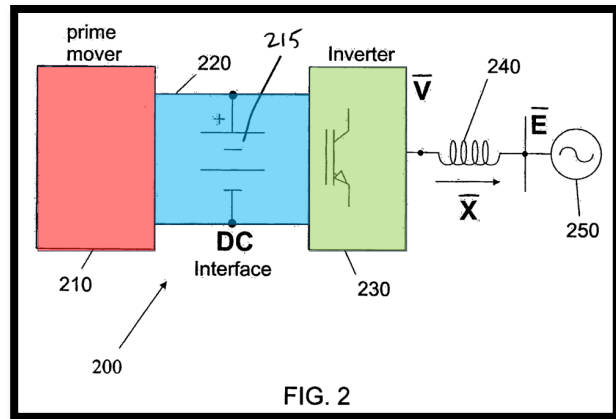
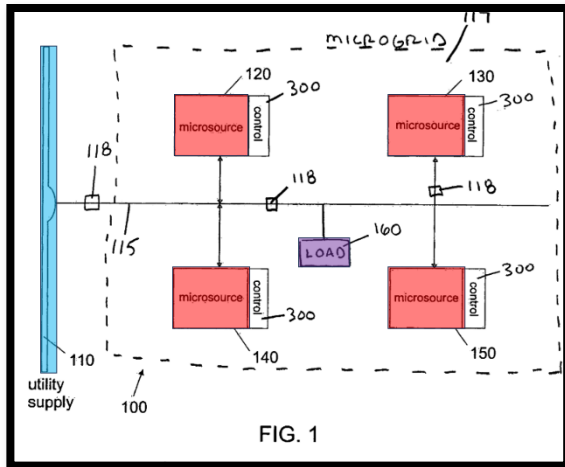
[45.pre] A power system which provides AC power to one or more loads, the AC power frequency being changeably controlled to assist managing the loading of the power system at least when not sending power to a grid, the power system comprising:

If limiting, Lasseter's "distributed energy resource system" (DER) provides the claimed ***power system***. EX1005, Abstract, ¶[0063], FIG. 1; EX1003, ¶289, ¶¶289-316. DERs comprise at least one "microsource" power source, and output ***AC power***'s "AC voltage or current at the required frequency." EX1005, ¶¶[0008]-

[0011]; EX1003, ¶289. Frequency is *changeably controlled*—Lasseter discloses “control schemes for controlling the instantaneous frequency...from one or more microsources.” *Id.*, ¶[0058]. This control *assists in managing the DER’s loading*, for frequency is controlled “in response to events such as islanding or new loads.” *Id.*; EX1003, ¶289. The loads include “*one or more loads 160*.” EX1005, ¶[0063]. Because Lasseter can operate disconnected from the utility supply **110 (a grid)** in island mode, it can provide changeably controlled AC power to the loads *when not sending power to* the supply *grid*. EX1005, ¶[0011], ¶[0063]-[0068], FIGS. 1-4, 8(a)-8(b), 11(a)-11(b).

[45.a.1] a non-utility type power source comprising one or more inverter which receives power from one or more of: i) a rechargeable power storage system; ii) a vehicle battery; iii) a solar PV system; iv) another green renewable power system; v) an internal combustion power generator;

Lasseter’s microsources are *non-utility type power source comprising one or more inverter*—Figure 1’s DER distinguishes **microsources 120-50** from “**utility supply**” **110**. *Id.*, FIG. 7. “[M]icrosource 200...can be used in a [DER]...of FIG. 1,” which “may include” an “**inverter 230**”/ “inverter 350.” *Id.*, ¶[0070], ¶[0074], FIGS. 1-3; EX1003, ¶290, 290-93.



Inverter 230/350 is connected to *DC interface 220* and can receive power from “*power storage 215...a battery.*” EX1005, ¶¶[0070]-[0071], FIG. 2. POSITA would have understood or found it obvious (e.g., in view of Lopes’ rechargeable storage devices, EX1011, 5) that Lasseter’s *batteries* are a *rechargeable power storage system*, given the *battery’s* position between the *prime mover* and *inverter* suggests the *prime mover’s* power supplies the *battery*. *Id.*; EX1003, ¶291. *Inverter 230 receives power* flowing through the *battery 215*. EX1005, ¶¶[0070]-[0074]; EX1003, ¶291.

Inverter 230/350 can also receive power from “*prime mover 210,*” which can include “*PV*” (*solar PV system*). EX1005, ¶[00690], ¶[0064], ¶[0070], FIG. 2; EX1003, ¶292. Other *green renewable power system* would include Lasseter’s “*fuel cell...or wind turbine.*” EX1005, ¶[0070]; EX1003, ¶[0070].

Finally, Lasseter’s “microsource control methods...can be used to control *inverter* interfaces found in...*internal combustion engines*” EX1005, ¶[0069];

EX1003, ¶293. Lasseter also provides a “microturbine” (another type of *internal combustion power generator*) as an example microsource. EX1005, ¶[0064].

[45.a.2] the power source providing single or multiple phase output AC power to one or more loads which may include the power grid, the output AC power having one or more controlled parameter, including the AC frequency which frequency is controlled by the power source in response to the power grid frequency or another device frequency if synchronization thereto is desired, or if synchronization is not desired the one or more controlled parameter including the AC frequency may be controlled in response to the loading of the power source;

Microsource inverter **230/350** *provides single or multiple phase output A.C. power* to “*one or more loads 160.*” EX1005, ¶[0063]. “[I]nverter **230** controls [the] phase of its output voltage,” so inverter **230/350** inverts the DC power from interface **220** to AC power in at least single or multiple phases. *Id.*, ¶¶[0073]-[0074], FIGS. 1-3, EX1003, ¶294, ¶¶294-300. Because Lasseter discloses situations where microsources are “exporting power to the grid,” the loads *may include the power grid*. EX1005, ¶[0111]; ¶[0115], ¶[0116], ¶[0124].

Lasseter’s microsources’ *output AC power has one or more controlled parameter, including AC frequency*. Lasseter discloses “control schemes for controlling the instantaneous frequency...from one or more microsources.” *Id.*, ¶[0058]. Frequency is a “parameter” within the language of ’857 patent, because it is “a quantity of...[an] attribute” of the microsources, i.e., the maximum rated power, “which is treated as constant” throughout Lasseter (although it “may at times change”). EX1003, ¶295.

When Lasseter's microsources are in "grid mode," they are *synchronized* to the frequency of the DER and "operate at the same nominal frequency," which is "system frequency, ω_o ." EX1005, ¶[0111], ¶[0113], ¶[0139], FIGS. 14-17, 27; EX1003, ¶296. Power is maintained because each microsource "holds its injection to a set point P_0 ." EX1005, ¶[0109], ¶[0111]; EX1003, ¶296. Consistently, FIGS. 27 and 25(b) depict "microsources...of unit power control" when "grid connected" (i.e., when *synchronization is desired*) at "**steady state A**" controlling their frequency *in response to the power grid frequency* to be the **60 Hz grid frequency** – a common utility grid frequency. EX1005, ¶[0161]; EX1003, ¶296.

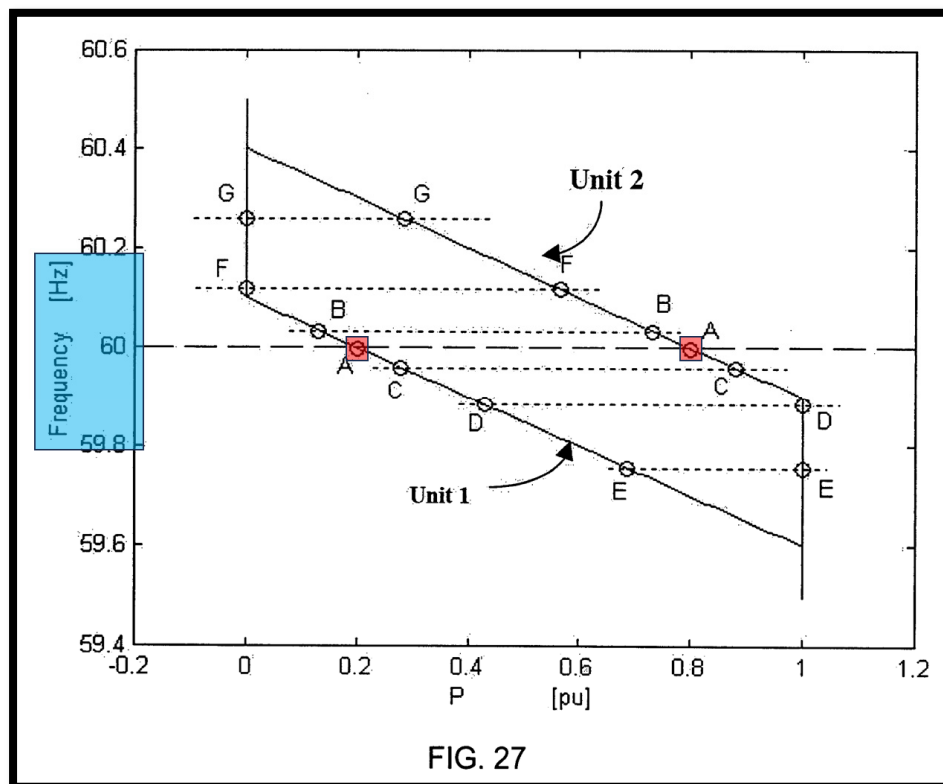


FIG. 25(b), depicts the same: 60Hz "grid connected" at time A until a "transfer to

island” occurs at time B (EX1003, ¶[0164]):

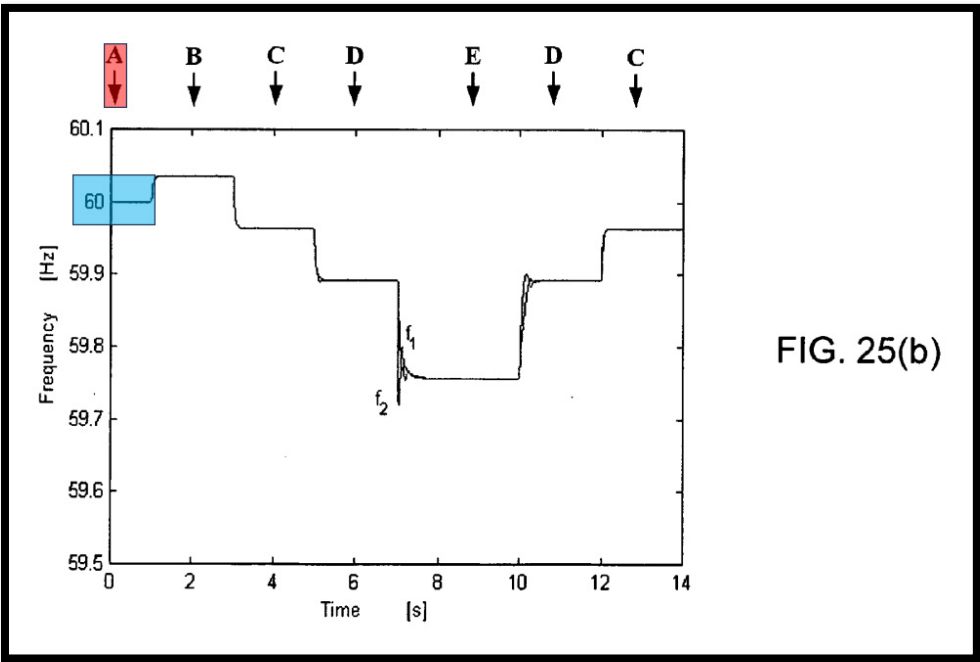
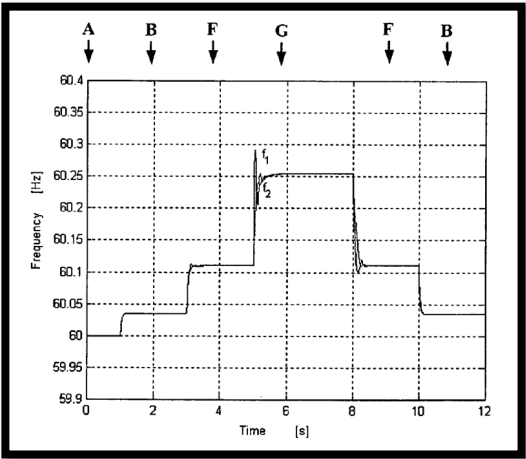


Figure 26(b) shows another example—the grid-connected frequency remains constant while in grid-mode (state A):



t = 0 sec	steady state, grid connected	operating at steady state A
t = 1 sec	transfer to island	transition to steady state B
t = 3 sec	first load inserted	transition to steady state C
t = 5 sec	second load inserted	transition to steady state D
t = 7 sec	third load inserted	transition to steady state E
t = 10 sec	third load removed	transition to steady state D
t = 12 sec	second load removed	transition to steady state C

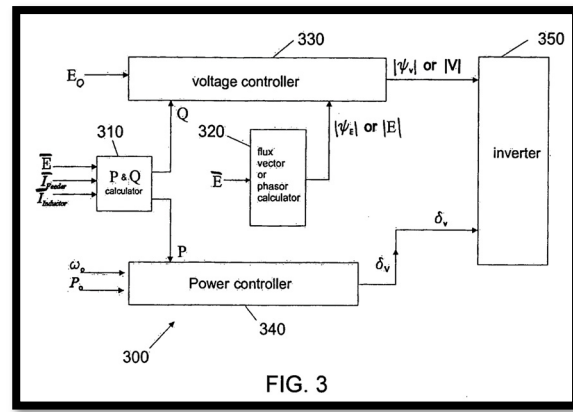
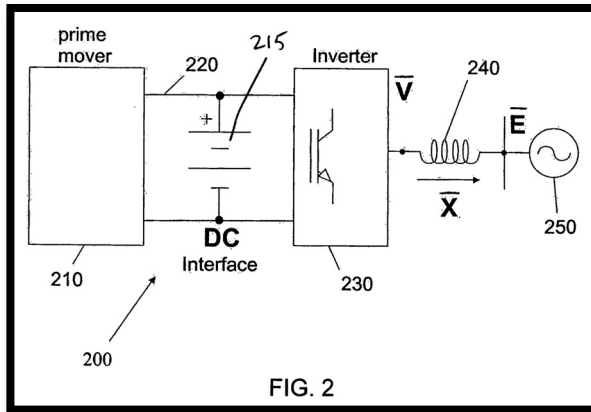
t = 0 sec	steady state, grid connected	operating at steady state A
t = 1 sec	transfer to island	transition to steady state B
t = 3 sec	first load removed	transition to steady state F
t = 5 sec	second load removed	transition to steady state G
t = 8 sec	second load inserted	transition to steady state F
t = 10 sec	first load inserted	transition to steady state B

POSITA would have understood, or found obvious, that microsources importing or exporting power to a utility grid would have the utility grid’s frequency to avoid system disturbances and potential instability. EX1003, ¶299.

“[W]hen the system islands,” and *synchronization is not desired*, “microsources” that “were importing power from the grid before islanding” must “increase their power outputs...by reducing their operating frequency.” EX1005, ¶[0111]. *AC frequency* is a *controlled parameter*—Lasseter discloses “control schemes for controlling the instantaneous frequency...from one or more microsources.” *Id.*, ¶[0058], ¶¶[0106]-[0142], ¶¶[0158]-[0171]; FIGS. 14-18, 25-29. This control *assists in managing the* DER’s *loading*: frequency of the microsources is controlled according to a “relationship between steady state unit power vs. frequency (P- ω),” *i.e., in response to the loading of the power source*. *Id.*, ¶[0110], ¶[0122], ¶[0133], ¶[0138]; EX1003, ¶300.

[45.b] a control circuit which may be part of the power source or otherwise, is responsive to one or more power source operating parameter which affects the power source operation, the control circuit operating at least when the output AC power is not synchronized to the power grid or another device, to control one or more parameter of the output AC power such that the AC power has at least first frequency when the power source is not overloaded including when it supplies excessive current which the AC power source can handle, and at least a second frequency when the power source is overloaded including when it supplies an excessive current for a period of time which if continued may risk power source damage or loss of AC power;

Lasseter’s microsources have *control circuits*—controller **300**—“that can be used with a microsource such as that of FIG. 2.” EX1005, ¶[0074]. Thus, controller **300** is *part of the power source or otherwise*. EX1003, ¶¶301-313.



Controller **300** is responsive to one or more power source operating parameter, P_{meas} , for its P&Q calculator **310** calculates “real power P [P_{meas}^1] being injected by the microsource” based on instantaneous current and voltage measurements at inverter **230**’s/**350**’s output. EX1005, ¶[0077]; EX1005, ¶[0073]; EX1003, ¶303 (citing EX1022, 63-64). “Exemplary inputs to the controller **300** can include...three measured states.” *Id.*, ¶[0075]. “[M]easured state variables can be

¹ Figure 3 depicts power controller **340** receiving ω_0 , P_0 , and Real Power P inputs to control ω_i . Figure 12’s power controller also receives ω_0 and P_0 as inputs to control ω_i , but labels its power input as P_{meas} . Though Figure 12 adds the “measured” subscript, Lasseter explains that Real Power P is calculated by P&Q calculator **310** based on measurements. EX1005 ¶[0073], ¶[0077]; EX1003, ¶¶301-13. Thus, Real Power P and P_{meas} refer to the same thing. EX1003, ¶303. Simply put: P_0 is the same in Fig. 3 and Fig. 12. P and P_{meas} are the same thing in Fig. 3 and Fig. 12.

obtained from instantaneous voltage or current measurements that can be made locally,” including “ I_{inductor} , the time varying current injected by the microsource” and “E: the system voltage at the connection point” – both *power source operating parameters*. *Id.* P_{meas} , I_{inductor} , and E are *parameters*, as defined by the ’857 patent, because each are “a quantity of...[an] attribute” of the microsources, *i.e.*, the output power, output current, and voltage, “which is treated as constant” throughout Lasseter (although it “may at times change”). EX1003, ¶304. Indeed, the ’857 patent lists power, current and voltage as example parameters. EX1001, 10:11-20.

P_{meas} , I_{inductor} , and E *affect power source operation*, because they represent the loading on the power source. For example, if P_{meas} exceeds the maximum operating power, P_{max} , the microsource can be overloaded (as discussed below). EX1003, ¶305.

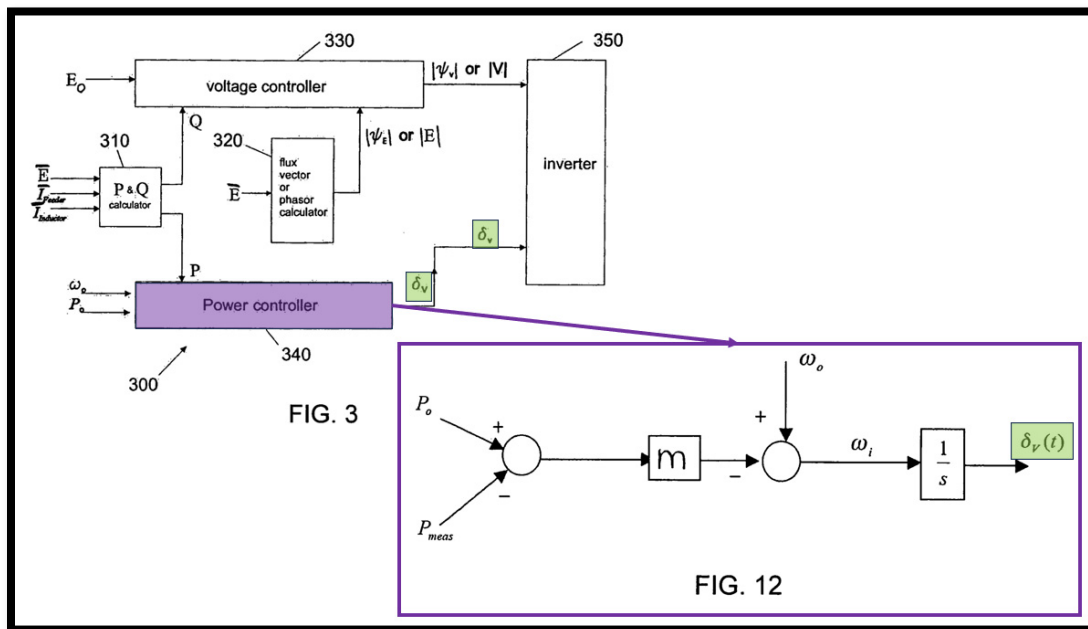
Lasseter’s *control circuit* “uses...the measured power P_{meas} to control the instantaneous operating frequency ω_i of the inverter.” *Id.*, ¶[0107]. Thus, changes in P_{meas} , I_{inductor} , and E also affect the power source operation by causing the control circuit to change the instantaneous frequency, ω_i , of the power output by the microsource. *Id.*; EX1003, ¶306. The same is true of E and I_{feeder} . *Id.*

$$\omega_i = \omega_0 - m(P_0 - P_{\text{meas}})$$

[Eq. 8]

Controller 300 operates at least when the output AC power is not

synchronized to the power grid or another device. Supra [45.a.2] (controller **300** in grid and island mode); EX1003, ¶307. Controller **300 operates to control one or more parameter of the output AC power**, including “the instantaneous operating frequency ω_i of the inverter,” “the operating phase angle of the inverter $\delta_v(t)$ ” and the “inverter output voltage $|V|$.” EX1005, ¶[0107], ¶[0076], Abstract, ¶¶[0086]-[0090], ¶¶[0105]-[0106]; EX1003, ¶307. Because the inverter’s phase angle sets voltage alignment of *output AC power*, it is also a *parameter*. EX1003, ¶307-08 (citing EX1022, 63-64). Phase angle is a parameter, “a quantity of...[an] attribute” of the microsources,” i.e., phase angle of the output power, “which is treated as constant” throughout Lasseter (although it “may at times change”). EX1003, ¶307-08.



“[B]y changing the operating phase angle of the inverter $\delta_v(t)$,” controller **300**

“control[s] the instantaneous operating frequency ω_i of the inverter.” EX1005, ¶¶[0105]-[0107], ¶[0057], Abstract. As shown in Equation 8, when P_{meas} exceeds power-set point, P_0 , frequency decreases from its *first frequency* ω_0 . EX1003, ¶309.

$$\omega_i = \omega_0 - m(P_0 - P_{\text{meas}})$$

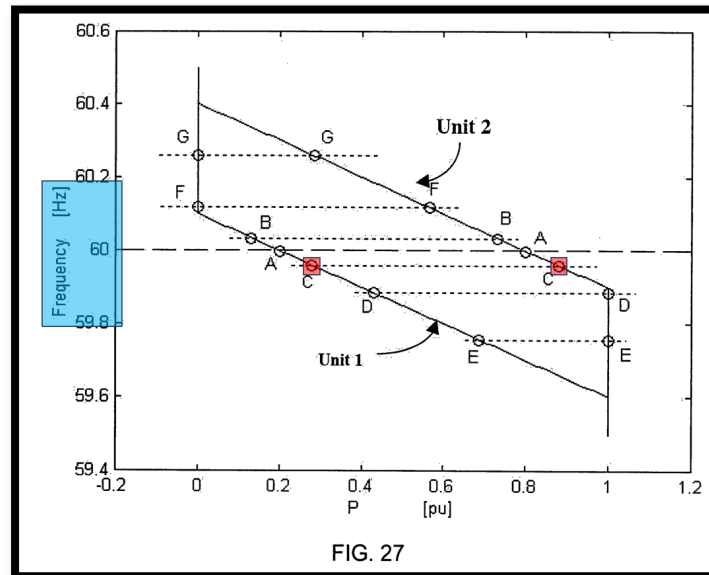
[Eq. 8]

When operating at the *first frequency* ω_0 , the microsources are *not overloaded*, as defined by the '857 patent, because they are operating within their rated power specification, between P_{min} and P_{max} . FIGS. 14-17; EX1003, ¶310. Thus, a load on a microsource between the minimum power, P_{min} , and maximum rated power, P_{max} , will not “cause a departure from specifications for the power output from the power source.” EX1003, ¶310.

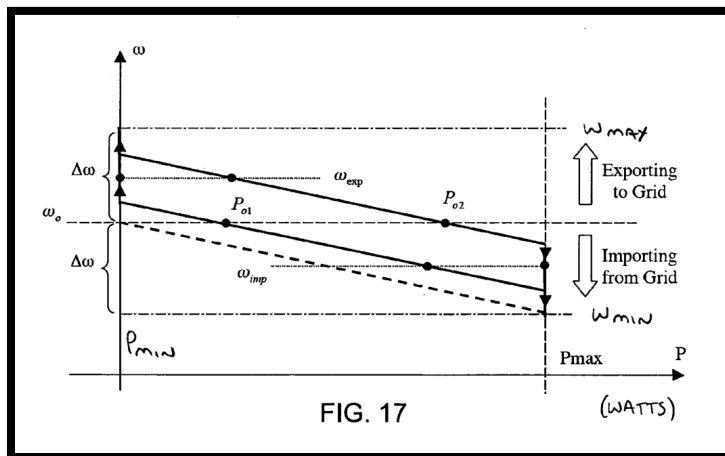
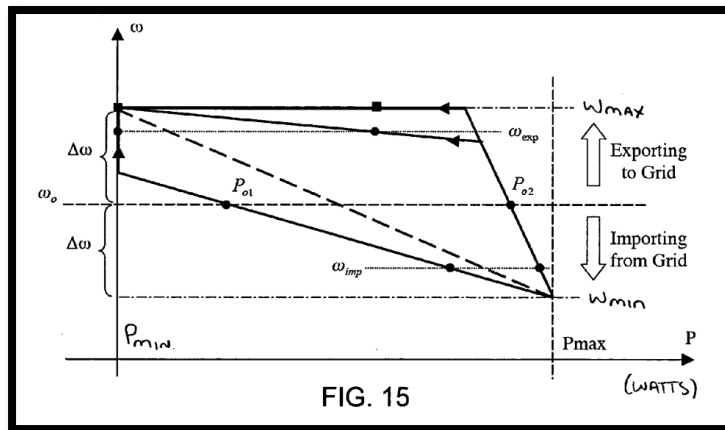
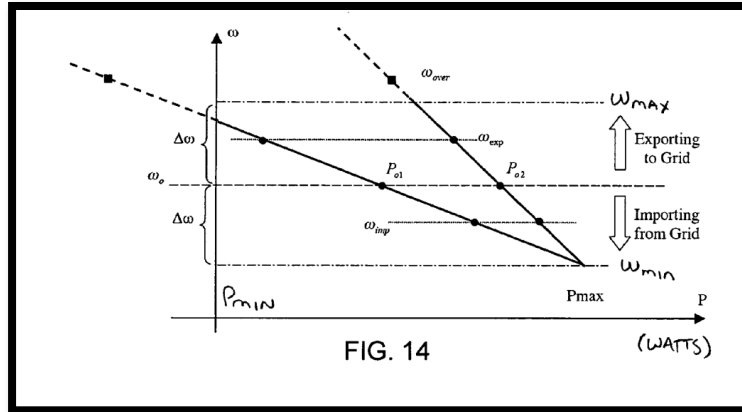
The power source is not overloaded *when it supplies excessive current*² beyond the current it provides at its steady state “power set point,” e.g., P_0 or Point A in FIG. 27, within its power specification. The system handles this *excessive*

² The claimed “excessive current” does not explain what the current is excessive in relation to; thus, any current could be “excessive” relative to another reference. Because the baseline current would be that provided when connected to the grid, current in excess of grid current would be among such “excessive” currents.

current by reaching other “steady states,” e.g., Point **C**, in FIG. 27, within the specification *which the AC power source can handle*. EX1005, ¶[0161], FIGS. 14-17; EX1003, ¶311. Increased power indicates increased current because they are directly proportional. *Id.*, 306-07.



This capability is evident in Figures 14, 15, and 17— ω_0 being the system frequency, which POSITA would have understood, or found obvious, matches the grid frequency when connected to the utility supply to ensure synchronization of the power. EX1003, ¶312.



If a “load exceeds the aggregate power capacity of the units,” and the microsource exceeds its “maximum power,” P_{max} , the microsources drop below “minimum operating frequency.” EX1005, ¶¶[0118]-[0119], ¶[0141], FIGS. 14-17.

This constitutes an *overload* by the '857 patent, and the frequency below the minimum frequency is *a second frequency*. *Supra*, §III.A.1 (beyond $P_{\max}$ is an overload); EX1003, ¶313; *supra*, §III.A.2 (overload); EX1011, 4-5, 8 (overload). Operating at or below this frequency and above $P_{\max}$ *for a period of time* could cause “[i]nverter overcurrents,” or insufficient power being provided to loads, resulting in power loss at the loads or damage to the power source. EX1011, 4, (*excessive current being supplied*); EX1003, ¶313.

[45.c] a processor circuit comprising one or more processors responsive to the one or more parameter of the output AC power, and in response to the occurrence of the second frequency operating to control the coupling of output AC power to at least one load of the one or more loads thereby helping to prevent or alleviate an overload of the power source.

Lopes supplies “controllable loads” and an algorithm for “shedding” them “based on the amplitude of frequency deviation.” EX1011, 4-5. Load shedding *controls the coupling of output A.C. power to the loads*, for load shedding “[a]llow[s] a temporary disconnection of less important loads.” *Id.* Shedding loads reduces the aggregate power demanded of the microsources, *preventing or alleviating* “frequency deviations and transient *overload[s]*” including an *overload of the power source* as defined by '857 patent, *e.g.*, excursions beyond Lasseter’s $P_{\max}$. *Id.*; EX1003, ¶314, ¶¶314-316.

Moreover, Lopes’ load-shedding algorithm *is responsive to* “the amplitude of the frequency deviation” (a *parameter* reflecting changes in *output A.C. power*),

specifying “a certain amount of load” to be “automatically shed through the activation of under-frequency load shedding relays” and LCs based on the “frequency deviation,” *i.e.*, ***the second frequency***. EX1011, 6; EX1003, ¶315. As discussed, POSITA would have been motivated to implement Lopes with specified frequency deviations corresponding to a microsource’s minimum frequency and below. *Id.*, 3, FIG. 4; EX1003, ¶315.

Finally, Lopes’ load-shedding algorithm is implemented on “controllers located at loads or groups of loads [load controller (LC)]” and “under-frequency relays,” constituting ***a processor circuit comprising one or more processors***. EX1011, 1, 2, 4, 6, FIG.1; EX1003, ¶316. Indeed, because processor circuits were well-known and their benefits well-understood, it would have been obvious (e.g., at least in view of EX1021, EX1024, EX1025, and EX1027) to implement the load-shedding algorithm on a processor circuit for the speed and convenience of computing and control systems. EX1003, ¶316 (citing EX1021, EX1024, EX1025, and EX1027 as examples of processors in load shedding applications).

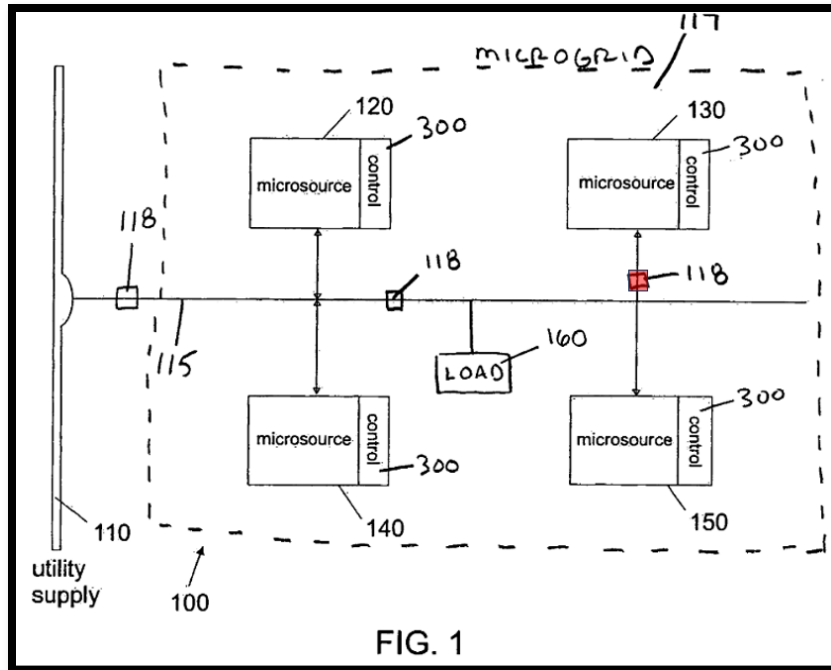
[46.] A power system as claimed in claim 45 which provides renewable and backup power in addition to grid power, wherein the power source provides output AC power which is coupled via one or more contactor or transfer switch to the one or more loads which without the output AC power would normally be powered by the grid, the output AC power being synchronized to and paralleled with the power grid power to reduce consumption of grid power when grid power is available.

Lasseter’s DERs “can provide more reliable power in critical applications, as

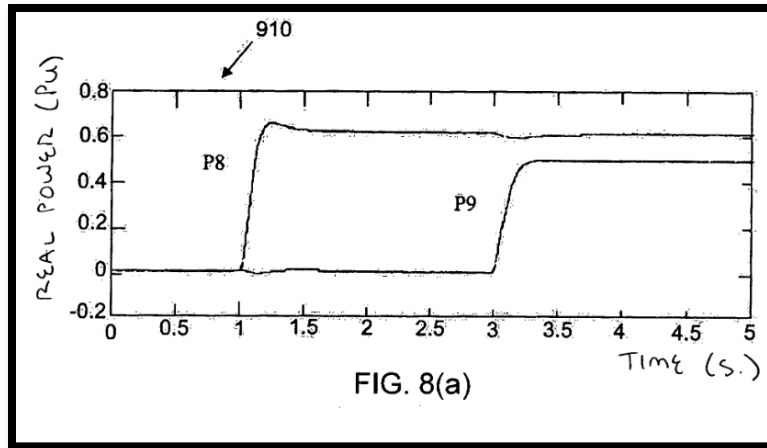
a **backup** to the primary electrical supply.” EX1005, ¶[0007]. “[W]hen the main power grid is available,” “these types of power sources can supplement,” i.e., **provide power in addition to grid power**, “or replace conventional power sources.” *Id.* ¶[0007]; EX1003, ¶317, ¶¶317-321. “[P]ower sources...provide **backup** to their owners when the main power grid is unavailable.” EX1005, ¶[0008]; EX1003, ¶317. Furthermore, Lasseter contemplates using batteries to provide power (another form of **backup power**). *Supra*, [45.a].

DERs can have “exemplary microsource **200**” that “can include a prime mover **210**” that “can be, for example...PV, or wind turbine.” EX1005, ¶[0070]. PV (photovoltaics) and wind turbines are **renewable** power sources. EX1003, ¶318.

Lasseter discloses **interface switches 118**, **a contactor or transfer switch**, that can isolate microsources from the utility supply **110** or “be positioned in other places,” like microsource **130** (**providing output AC power**, *supra* [45]), which is **coupled via interface switch 118 to loads 160**. EX1005, ¶¶[0064]-[0067].



Without power from microsources, loads **160** would be powered by utility supply **110** (*the grid*). EX1005, ¶¶[0064]-[0067]; EX1003, ¶320. For example, Lasseter’s microgrid can operate by “importing power from the grid.” EX1005, ¶[0111], ¶[0124], ¶[0134], ¶[0139], FIGS. 14-17. POSITA would have understood, or found obvious, the *loads to be normally powered by* the utility supply (*the grid*) and that, *without power supplied by the microsources*, the utility supply would be importing all power for the loads from the grid. EX1003, ¶320. Further, FIG. 7 “illustrate[s] the dynamics of the microsource controls described with reference to FIGS. 1-6” and FIG. 8(a) shows “power injections” made by the microsources. EX1005, ¶[0091]. When “microsources **755** and **765** are offline” at t=0 in Figure 8(a), there is “zero real...power injection.” EX1005, ¶[0096]. Instead, all power is supplied by the grid. EX[1003], ¶320.



As explained *supra* [45.a.2], *output AC power is synchronized with the power grid*. Lasseter's DER output AC power is *paralleled with the power grid* so that "power from a distributed energy resource can, in some cases, be sold back to the main power grid" and can "supplement or replace conventional power sources...when the main power grid is available." EX1005, ¶[0008]. The microsources can operate by "importing power from the grid" or "exporting power to the grid." EX1005, ¶¶[0111]-[0116], ¶[0124], ¶¶[0134]-[0136], ¶¶[0139]-[0140], FIGS. 14-17. Exporting power to be "sold back to the main power grid" or "supplement...when the main power grid is available," would *reduce consumption of grid power* even *when grid power is available*. EX1003, ¶321.

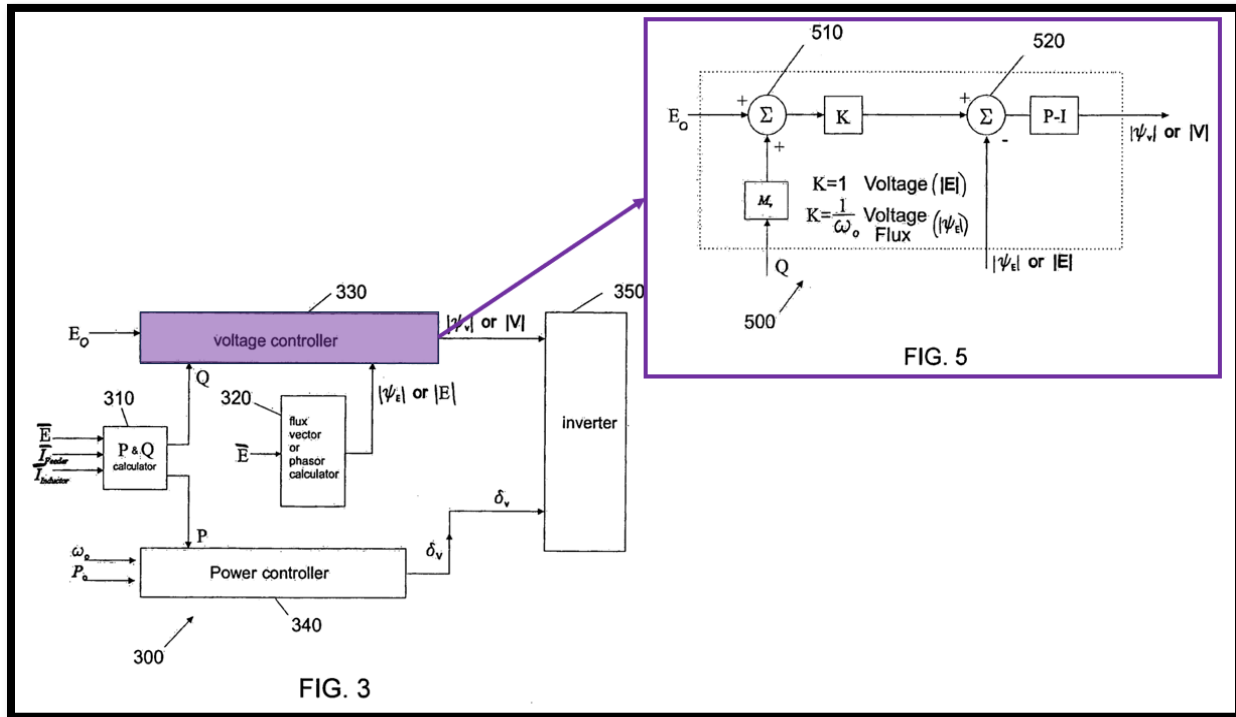
[47.] A power system as claimed in claim 45 which provides renewable and backup power in addition to grid power, wherein the power source provides output AC power which is coupled via one or more contactor or transfer switch to the one or more loads in parallel with grid power, and when grid power is not available the grid is decoupled from the output AC power leaving the output AC power to provide backup power for ones of the one or more loads.

Supra [46], EX1003, 322. Microsources “provide backup to their owners when *the main power grid is unavailable.*” EX1005, ¶[0008]. Microsources “move[] from grid connected to island operation by opening switch **725** to disconnect the plant **700** from the feeder **710** in response to the loss of power from the” utility, *decoupling* it. *Id.*, ¶[0101].

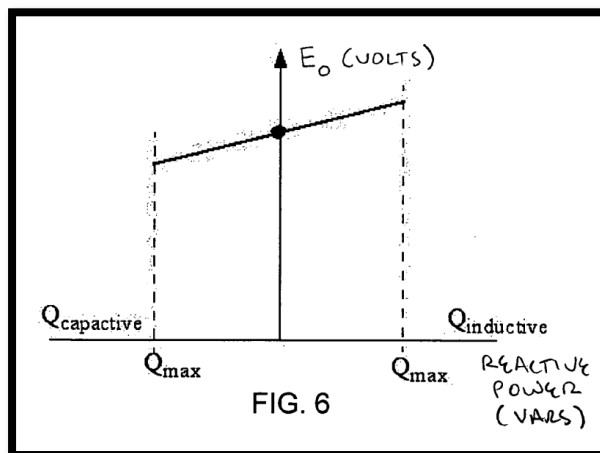
[49.] A power system as claimed in claim 45 wherein in b) the control circuit controls the output AC power voltage to decrease from a standard voltage to a first known amount when the power source has been supplying an excessive current for a period of time which if continued may risk power source damage or loss of AC power.

Controller **300** (*the control circuit*) *controls the output AC power voltage* via voltage controller **330**. “[V]oltage controller **500**...can be...voltage controller **330**.” EX1005, ¶[0085]-[0090]. “[V]oltage controller **500**...includes voltage vs. reactive current droop.” EX1005, ¶[0090]. “When the microsource generates capacitive reactive power...the voltage set point is lowered” to a new set point “defined by the slope” of voltage vs. reactive current droop. *Id.* Lasseter’s lowering “the voltage set point” is the claimed lowering the voltage *a first known amount* from the prior set point, E_0 , *a standard voltage*. EX1005, ¶[0090], FIGS. 3, 5-6; EX1003, ¶323, ¶¶323-

25.



The voltage decrease is *a known amount*, per the '857 patent, because it is lowered according to a known slope that POSITA would have understood, or found obvious, “to have been previously stored in a memory” of the voltage controller 330/500 to enable its use. EX1005, ¶[0090], FIGS. 5-6. EX1003, ¶324.



The microsources generate capacitive or inductive power, triggering an adjustment to the voltage set point, when reactive current changes. *Id.*, EX1003, ¶325 (reactive power is a function of current and voltage). “[S]mall errors in voltage set points can give rise to relatively large circulating reactive currents,” a type of ***excessive current***, which “can exceed the ratings of the microsources.” EX1005, ¶[0089], ¶[0085]. A reactive current exceeding the ratings of the microsource is a departure from the power output specifications—an overload—***which if continued for a period of time***, can ***risk damage*** to the microsource or cause ***loss of power***, e.g., by overheating or tripping. EX1003, ¶325.

[50.] A power system as claimed in claim 45 wherein in b) when the power source has been supplying an excessive current for a period of time which if continued may risk power source damage or loss of AC power, the control circuit controls the output AC power voltage to decrease from a first standard voltage to a second known voltage and further controls the frequency of the AC power to decrease from a first standard frequency to a second known frequency.

Supra [49]. Overload conditions can manifest as ***excessive***³ apparent ***current***—the total vector sum of real and reactive components—the full current

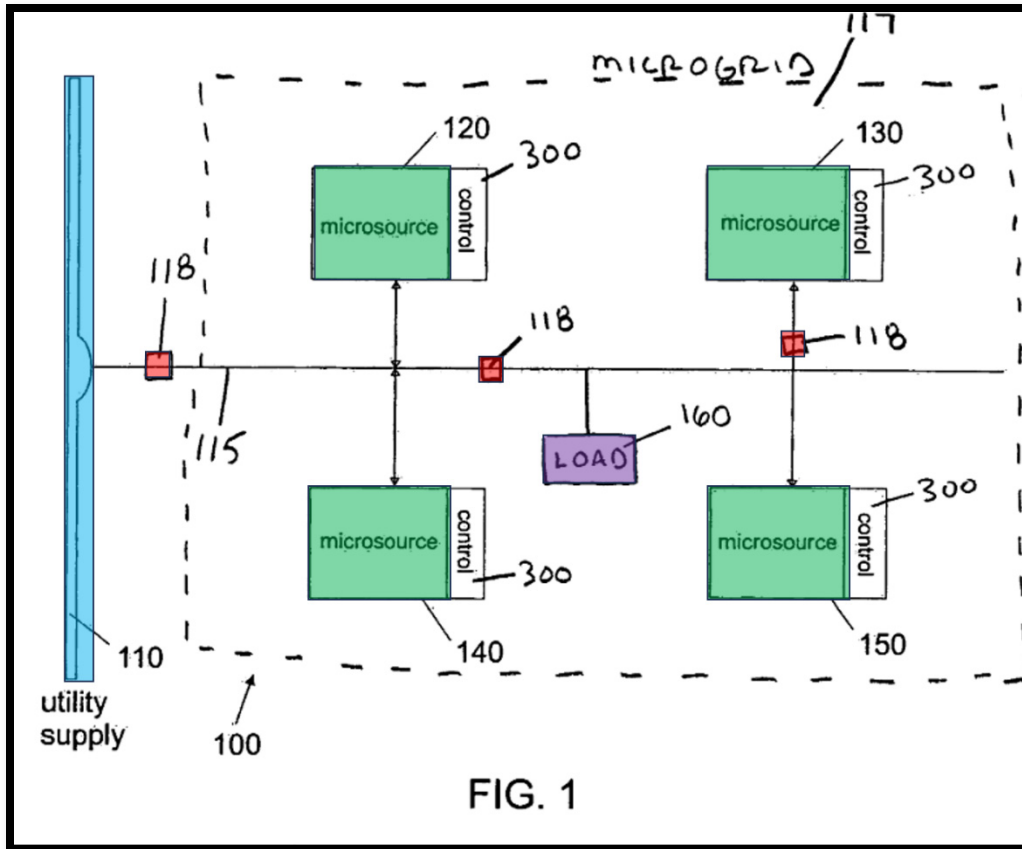
³ The claim language does not specify whether “excessive current” refers to real, reactive, or apparent current; POSITA would therefore read the term broadly to include any of these conditions consistent with the overload scenario described.

stress on the microsource. EX1003, ¶326. POSITA would have understood, or found obvious, that supplying an excessive current for a period of time which if continued may risk power source damage or loss of AC power is an overload condition caused by either (i) excess real current or (ii) excess reactive current. EX1003, ¶326. When both conditions occur simultaneously after a load is connected, controller **300** would decrease voltage *from a first standard voltage to a second known voltage, supra* [49], and *control the frequency of the AC power to decrease from a first standard frequency to a second known frequency, supra* [45.b]. EX1003, ¶326.

[51.] A power system as claimed in claim 45 which provides backup power for grid power wherein the one or more inverter providing output AC power which along with grid power is coupled via one or more contactor and/or transfer switch to loads in a manner that the loads are normally at least partially powered by the grid and when the grid power fails the grid is isolated from the power system output and at least one of the one or more loads with only backup power from the power source being coupled for use by the at least one of the one or more loads.

Supra [46] (backup power, loads partially powered by grid). EX1003, ¶¶327-

28.



“Interface switches 118” “can be positioned between the feeder line 115 and the main utility supply 110 so that...microsource systems” 120-50 and “one or more loads 160, can be *isolated* from the utility supply 110.” EX1005, ¶¶[0064]-[0067]. Lasseter’s DERs can “move[] from grid connected to island operation by opening switch 725 to disconnect the plant 700 from the feeder 710 [connecting utility supply 705 to the microgrid bus 730] in response to the loss of power from the” utility (i.e., *when the grid power fails*). *Id.*, ¶[0101]; EX1003, ¶328. When microsources 120-50 are isolated from utility supply 110, *only backup power from the* microsources is *coupled for use by* loads 160. *Id.*

[52.] A power system as claimed in claim 51 wherein the output AC voltage is controlled to have a first voltage when the power system is not overloaded and to have a second lower voltage when the power system is overloaded including when an excessive current has been supplied for a period of time which if continued may risk power source damage or loss of AC power.

Supra [49]. Lasseter's microsources, when operating at standard ***first voltage*** E_0 are ***not overloaded*** by reactive power Q because they operate at the setpoint between reactive and inductive power Q . EX1003, ¶329. But ***excessive current***, and corresponding reactive power Q , that "exceeds the ratings of the microsources," constitute an ***overload***, per the '857 patent, because it "depart[s] from the specification for the power output from the power source." If the departure from the power output specifications (e.g., the overload), ***continues for a period of time***, it can cause ***risk damage*** to the microsource or ***loss of power***, e.g., by overheating or tripping. EX1003, ¶329.

[53.] A power system as claimed in claim 45 which provides renewable and backup power in addition to grid power, wherein the one or more inverter receives DC power from at least one of a solar PV system or a rechargeable power storage system with the power system output AC power being coupled via one or more contactor and/or transfer switch to loads which are normally at least partially powered by the grid, the output AC power being synchronized to and paralleled with the power grid power to reduce consumption of grid power and when sufficient power is available from the power system additional output AC power is sent into the power grid.

Supra [45.a.1], [46]. ***When sufficient power is available, additional output AC power is sent into the power grid***, because Lasseter discloses situations where

microsources are “exporting power to the grid.” EX1005, ¶[0111]; *id.*, ¶[0115], ¶[0116], ¶[0124], FIGS. 14-15, 17, 27; EX1003, ¶330.

[54.] A power system as claimed in claim 45 wherein in b) the first frequency which is substantially the grid power frequency represents no overload and the second frequency which is lower than the first frequency represents an overload.

Supra [45.a.2] (ω_0 is grid frequency), [45.b] (first frequency no overload, second, lower frequency is overload); EX1003, ¶331.

[58.] A power system as claimed in claim 45 wherein the AC power of b) has at least a first voltage when the power source is not overloaded and at least a second voltage less than the first voltage when the power source is overloaded.

Supra [49] (first and second voltages), [52] (not overloaded, overloaded); EX1003, ¶332.

[59.] A power system as claimed in claim 45 wherein the AC power of b) has at least a first voltage when the power source is not overloaded and is not supplying excessive current, and at least a second voltage when the power source is not overloaded and is supplying excessive current.

Supra [49], [50]; EX1003, ¶¶333-34. Lasseter-Lopes discloses a nominal voltage set point (***first voltage***) when connected to the grid. EX1005, ¶333, ¶¶333-34. Grid-connected microsources are ***not overloaded***, because for microsources utilizing unit-power control when “connected to the grid, load changes are matched by a corresponding power injection from the utility.” EX1005, ¶¶[0107]-[0109]. Nor are grid-connected microsources ***supplying excessive current***—when the reference point for “excessive” is grid-supplied current, a grid-connected microsource would

not be *supplying excessive current*. EX1005, ¶333.

In contrast, Lasseter discloses a droop-adjusted voltage set point (*second voltage*) when injecting current more than what was supplied while connected to the grid. EX1005, ¶[0075], ¶¶[0086]-[0090], FIG. 6; EX1003, ¶334. Because “circulating reactive currents...*can* exceed the ratings of the microsources,” (as opposed to *necessarily* exceed), EX1005, ¶[0075], ¶¶[0086]-[0090], FIG. 6, there are situations where circulating reactive currents exceed those in grid-connected mode while the microsource *is not overloaded*. EX1003, ¶334; *supra* [49].

[60.] A power system as claimed in claim 45 wherein the AC power of b) has at least a first voltage when the power source is not overloaded and is not supplying excessive current, and at least a second voltage less than the first voltage when the power source is not overloaded and has started supplying excessive current and at least a third voltage less than the second voltage when the power system is overloaded and the excessive current has been supplied for a period of time which if continued may risk power source damage or loss of AC power.

Lasseter-Lopes discloses AC power that *has at least a first voltage when the power source is not overloaded and is not supplying excessive current, and at least a second voltage less than the first voltage when the power source is not overloaded and has started supplying excessive current*. *Supra* [59]; EX1003, ¶335, ¶¶335-36.

Lasseter-Lopes discloses *a third voltage less than the second voltage when the power system is overloaded and the excessive current has been supplied for a period of time which if continued may risk power source damage or loss of AC power*. *Supra* [49]; EX1003, ¶366. $Q_{\max}$ and beyond, e.g., when $P_{\max}$ is exceeded, or

a circulating current that “exceed[s] the ratings of the microsources,” each represent an *overload*, as defined by the ’857 patent. EX1003, ¶366.

[66.pre] A power system which manages the loading of at least one A.C. power sources which provides AC power with a controlled AC frequency, the power system comprising:

Supra [45.pre]; EX1003, ¶337, ¶¶337-351.

[66.a] one or more non-utility type power source comprising at least an AC power generating circuit which outputs sinusoidal single or multiple phase AC power which may be controllably coupled to one or more of a plurality of loads, the AC power having a plurality of parameters including at least a frequency, a voltage, sine wave distortion and a current which may range from zero to a maximum amount depending on the loading of the power source;

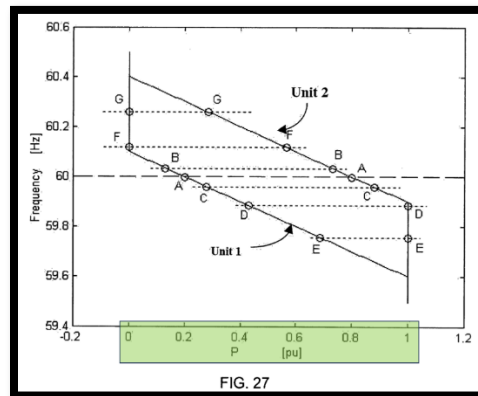
Supra [45.a.1] (non-utility-type power source), [45.b] (frequency, voltage, current parameters vary with loading), [49] (voltage/current vary with loading), [45.c] (controllably coupled to loads); EX1003, ¶¶338-43. Lasseter’s microsources include an AC power-generating circuit that *outputs sinusoidal single or multiple phase AC power* to “one or more loads 160.” EX1005, ¶[0063], ¶[0101], FIGS. 10(a)-10(b). “[I]nverter 230 controls [the] phase of its output voltage” and “control[s] the instantaneous operating frequency ω_i of the inverter by changing the operating phase angle of the inverter,” evidencing inverter 230/350 inverts the generated DC power to *sinusoidal* AC power. *Id.*, ¶[0071], ¶[0107], FIG. 1, 10(a) and (b) (sinusoidal); EX1003, ¶338.

In practice, all *AC power has a plurality of parameters including at least a*

frequency, a voltage, sine wave distortion and a current which may range from zero to a maximum amount. EX1003, ¶339. POSITA would have understood, or found obvious, that each parameter is *dependent on the loading of the power source*. *Id.* (explaining and citing EX1021 (sine wave distortion used to determine when a power source is overloaded)). Also, as explained *supra* [45.b], [49], controller **300** with a power controller **340** and a voltage controller **330/500** controls both *frequency* and *voltage* as a function of real and reactive output power of the microsource, *i.e., they depend on the loading of the power source*. Indeed, the power being measured and calculated based on “instantaneous voltage or current measurements” indicates that *voltage and current vary based on loading of the power source*. *Id.*, ¶[0075], FIG. 3; EX1003, ¶339 (citing EX1022, 63-64). Lasseter’s explanation confirms—even small differences between voltage setpoint and measured system voltage (*i.e.*, “voltage error”) “can give rise to relatively large circulating reactive currents.” EX1005, ¶[0088]-[0089]; EX1003, ¶339-41.

Lasseter’s microsources have a “maximum output power,” “minimum output power,” “maximum frequency,” “minimum frequency,” and current “ratings;” Lasseter explains how these parameters vary between the maximum and minimum of the range based on loading. *Id.*, EX1005, ¶[0015], ¶[0094], ¶¶[0112]-[0120], ¶¶[0122]-[0132], ¶¶[0138]-[0141]; FIGS. 6, 14-17. Although Lasseter describes a minimum output power, the output power can also drop to 0 depending on the

loading, shown by Figure 27:



When power drops to 0, so would frequency, voltage, sine-wave distortion, and current—thus, each *may range from zero to a maximum amount depending on the loading of the power source*. EX1003, ¶342.

The power parameter relates to output frequency parameter of the AC power:

$$\omega_i = \omega_0 - m(P_0 - P_{\text{meas}}) \quad [\text{Eq. 8}]$$

EX1005, ¶[0010], ¶[0012], ¶¶[0015]-[0018], ¶¶[0057]-[0058], FIGS. 10(a)-(c).

[66.b.1] one or more contactor and/or transfer switch whereby the AC power may be electrically paralleled with, or connected in place of or as a backup replacement for the grid power and the power source controls the AC power such that;

Lasseter-Lopes discloses *one or more contactor and/or transfer switches*. *Supra* [45.c], [46] (**interface switches 118**). Via **switches 118**, AC power may be *connected in place of grid power*, for **switches 118** can be selectively opened and closed to disconnect **utility supply 110** (far left **switch 118**) from **load 160** and

connect a **microsource 130** that was previously disconnected (**switch 118** connecting **microsource 130**) to **load 160**. EX1005, ¶¶[0064]-[0067]. Given the placement of switches selectively connecting **utility supply 110** and **microsource 130**, POSITA would also have found obvious that *AC power may be connected in place of grid power*. EX1005, ¶¶[0064]-[0067]; EX1003, ¶¶344-45.

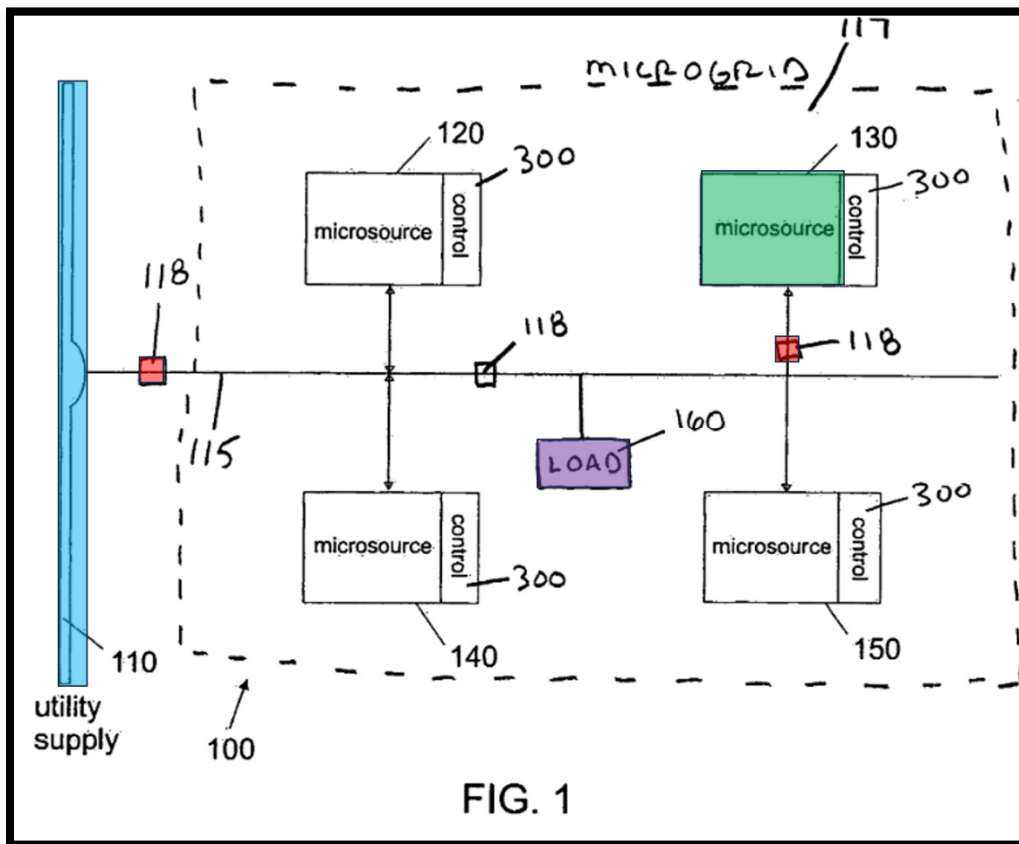
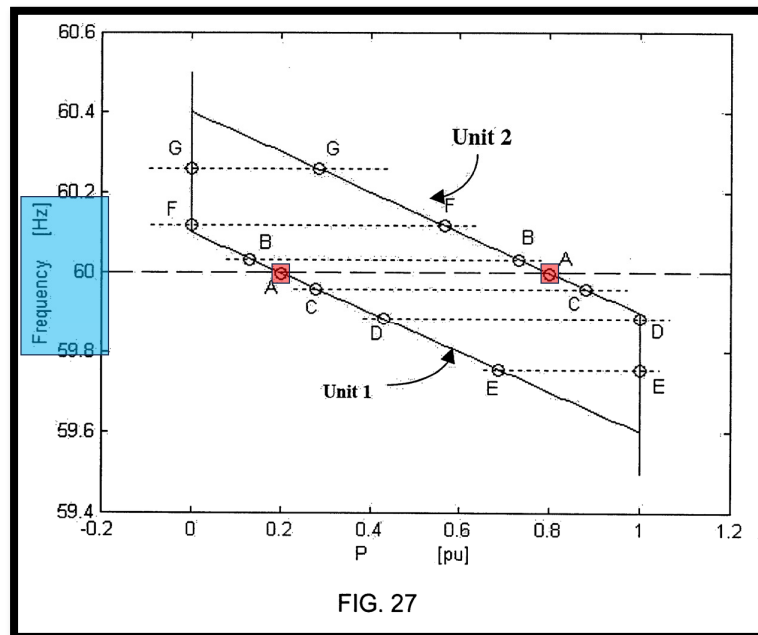


FIG. 1

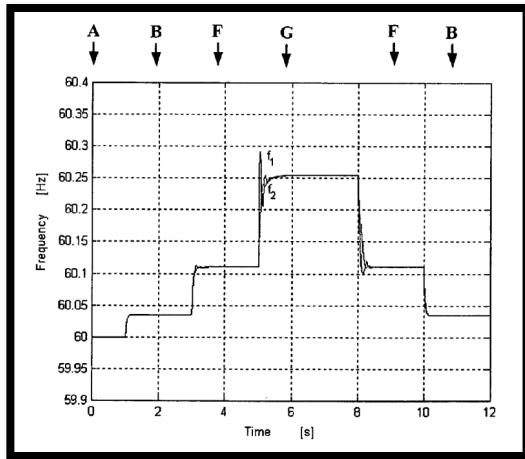
AC power may be connected as a backup replacement for the grid power. *Supra* [46]. *AC power may alternatively be electrically paralleled with the grid power.* *Supra* [46]. Lasseter discloses unit power controllers “[i]mporting” grid power. EX1005, FIGS. 14-15, 17, 27. Finally, the *power source* (microsource) *controls the AC power.* *Supra* [45.a.2].

[66.b.2] i. the frequency of the AC power is responsive to the grid power frequency when the AC power is provided in parallel with grid power so that connected loads receive power from one or both of the power source and grid; and

Microsources can provide power in parallel with the grid. *Supra* [46]. “During grid mode the system operates at system frequency, ω_o ” of the grid, making the **frequency of the AC power responsive to the grid power frequency**. EX1003, ¶346, ¶¶346-49. “When the microsources are connected to the grid...they both operate at the same nominal frequency ω_o .” EX1005, ¶[0111]-[0115], [0124], [0132], [0139], FIGS. 14-17. For example, at “grid connected” state A, EX1005, ¶[0165], frequency is 60 Hz:



In Figure 26(b), this grid-connected frequency remains constant while in grid-mode (state A):



t = 0 sec	steady state, grid connected	operating at steady state A
t = 1 sec	transfer to island	transition to steady state B
t = 3 sec	first load inserted	transition to steady state C
t = 5 sec	second load inserted	transition to steady state D
t = 7 sec	third load inserted	transition to steady state E
t = 10 sec	third load removed	transition to steady state D
t = 12 sec	second load removed	transition to steady state C

t = 0 sec	steady state, grid connected	operating at steady state A
t = 1 sec	transfer to island	transition to steady state B
t = 3 sec	first load removed	transition to steady state F
t = 5 sec	second load removed	transition to steady state G
t = 8 sec	second load inserted	transition to steady state F
t = 10 sec	first load inserted	transition to steady state B

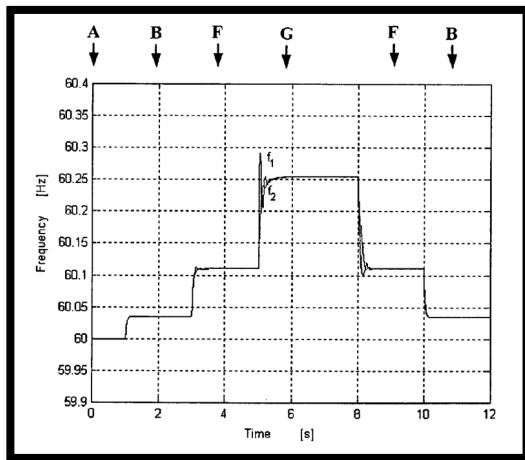
POSITA would have understood or found obvious that microsources importing or exporting power to a utility grid would need to match their operating frequency to the grid's to avoid system disturbances and potential instability. EX1003, ¶348.

When in grid mode, “output power of each microsource unit matches its corresponding power setpoint, P_{o1} and P_{o2} .” EX1005, ¶[0113], FIGS. 14-17. In grid mode, connected *loads receive power from both the power source and grid*, for power can be “injected by the grid before islanding.” EX1005, ¶[0134], ¶[0111] (when “importing power from the grid before islanding, the two microsources both increase their power outputs when the system islands”). Alternatively, connected loads *receive power from one of the power source and grid*, for microsources can “export[] power to the grid,” requiring output power to be “reduced when the system islands.” *Id.*, ¶[0111], [0124], [0136], [0140]. In such situations, microsources are providing more power than the loads need, solely supplying them and providing excess to the grid. EX1003, ¶349.

[66.b.3] ii. when the AC power is not paralleled with the grid, its frequency is responsive in a manner that the frequency represents the loading of the power source;

In island mode, *AC power is not paralleled with the grid. Supra [66.b.2].*

When not paralleled, AC power's *frequency is responsive in a manner that the frequency represents the loading of the power source*, for “microsources...increase their power outputs when the system islands, by reducing their operating frequency” or “reduced when the system islands, resulting in a frequency increase.” EX1005, ¶[0111]. For example, Figure 26 shows an islanded microsources' frequency *responsive to loading of the power sources*:



t = 0 sec	steady state, grid connected	operating at steady state A
t = 1 sec	transfer to island	transition to steady state B
t = 3 sec	first load inserted	transition to steady state C
t = 5 sec	second load inserted	transition to steady state D
t = 7 sec	third load inserted	transition to steady state E
t = 10 sec	third load removed	transition to steady state D
t = 12 sec	second load removed	transition to steady state C

t = 0 sec	steady state, grid connected	operating at steady state A
t = 1 sec	transfer to island	transition to steady state B
t = 3 sec	first load removed	transition to steady state F
t = 5 sec	second load removed	transition to steady state G
t = 8 sec	second load inserted	transition to steady state F
t = 10 sec	first load inserted	transition to steady state B

EX1005, ¶[0160], ¶[0165]; EX1003, ¶350.

[66.c] a load manager circuit comprising one or more processor, which load manager circuit may or may not be part of the power source, the load manager circuit responsive to the frequency of the AC power to provide AC power to at least one of the one or more of a plurality of loads when the power source is not overloaded and not provide AC power when the power source is overloaded.

Lasseter-Lopes discloses *a load manager circuit comprising one or more*

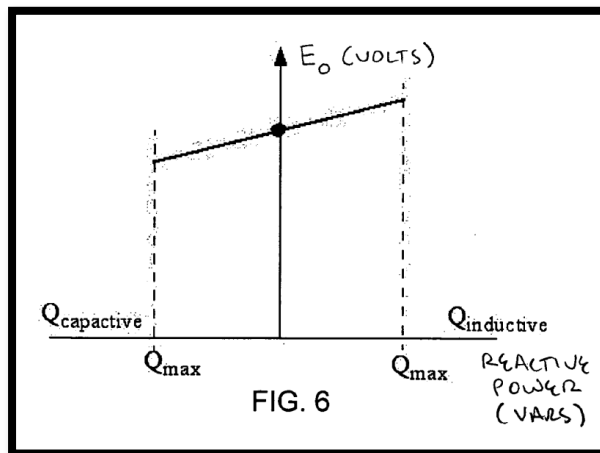
processor, LCs, alternatively or additionally, under-frequency relays. *Supra* [45.b]-[45.c]. The LCs and under-frequency relays are *responsive to the frequency of the AC power*, for when combining Lasseter with Lopes' load-shedding scheme, setting the "frequency deviation" to Lasseter's minimum frequency or below (i.e., the second frequency) results in load shedding when there is an "imbalance between local load and generation." *Supra* [45.c]; compare EX1011, 4 with EX1005, ¶[0130]; EX1003, ¶351. Above this frequency, *AC power is provided to at least one of the one or more of a plurality of loads*. *Supra* [45.c]. Below this frequency, shedding loads *stops providing AC power* (shed loads) *when the power source is overloaded* (when microsources operate at (or below) minimum frequency). EX1011, 4, 6; *supra* [45.c]; EX1003, ¶351.

[67.] The power system of claim 66 wherein in b) ii. the power source also controls a second parameter of the AC power in response to power source loading.

The microsource's "inverter **230** controls both the magnitude and phase" "of its output voltage" (at least voltage being *a second parameter of the AC power*, *supra* [45.b], [49]) when converting to "usable AC voltage." EX1005, ¶[0010], ¶¶[0070]-[0072], [0086]-[0090], FIGS. 5-6. Indeed, voltage is controlled *in response to power source loading*. *Id.*; EX1003, ¶352

[68.] The power system of claim 66 wherein in b) ii. the AC power has a first standard voltage when the power source is not overloaded and the power source further controls the voltage of the AC power to be a second voltage lower than the first voltage when the power source is near to being overloaded and to be a third voltage lower than the second voltage when the power source is overloaded.

Supra [60]. The first voltage E_0 is a **standard** voltage, because it is a set point. It is also a voltage set when grid connected, relative to grid voltage. EX1005, ¶[0160], FIG. 25(b) and 26(b) (t=0 “grid connected”). EX1003, ¶353. The voltage droop yields different voltages (i.e., a **first**, **second**, and **third** which can be an **overload**) as current rises, given that the slope. EX1003, ¶353; EX1005, ¶[0090], FIGS. 5-6.



[69.] The power system of claim 66 wherein in c) the load manager circuit is responsive to the AC power frequency and to at least a second parameter of the AC power to provide or not provide AC power to the at least one of the one or more of a plurality of loads.

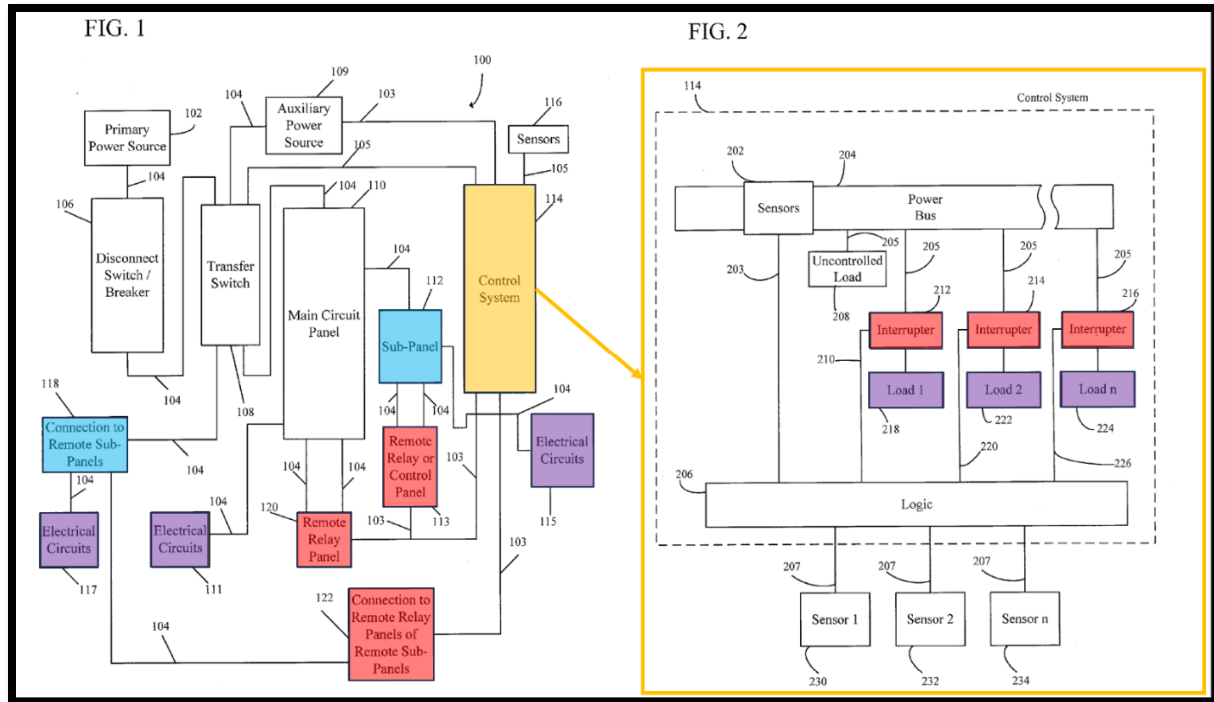
Lopes' load shedding scheme *is responsive to the AC power “frequency deviation”* when that deviation has existed for a “certain time interval” that is

“required for load shedding activation” (*second parameter*). EX1011, 4. A POSITA would also have found it obvious to require a deviation for a “certain time interval” to prevent load shedding for near instantaneous, not damaging excursions. EX1003, ¶354. Thus, when a certain frequency deviation and duration are satisfied, shedding commences, and power is not provided to the load. EX1011, 4; EX1003, ¶354.

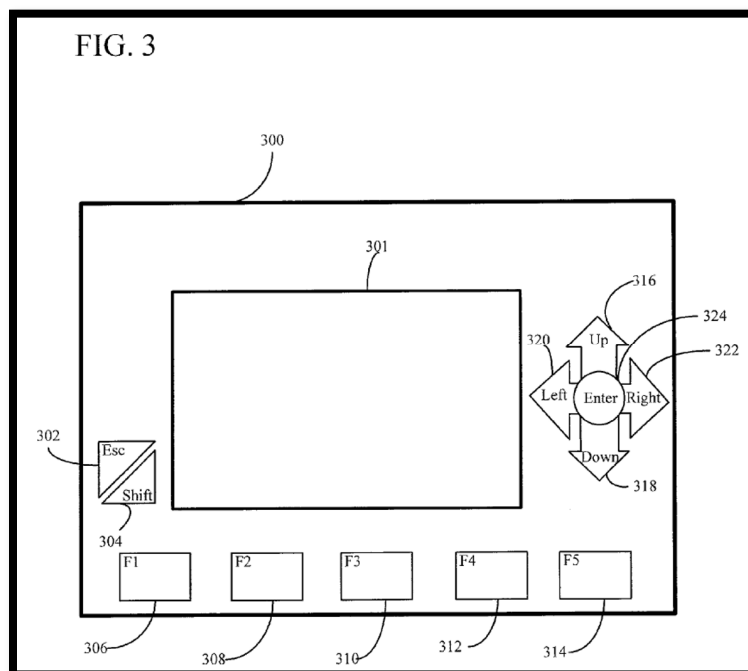
B. [GROUND 1B] – Claims 48, 56-57, And 71 Are Obvious Over Lasseter-Lopes-Baldassarre

1. Baldassarre (EX1021)

Baldassarre’s **control system 114** controls loads powered by auxiliary power sources after utility-power interruptions. EX1021, Abstract, ¶[0016], ¶[0023], ¶[0096]. Baldassarre manages electrical loads through current interrupting relays, connecting and disconnecting loads responsive to power-source conditions. EX1021, ¶[0058], ¶[0090], FIGS. 1-2. The “current interrupters” are “in series electrical connection with loads” and power source. EX1021, ¶[0090], FIGS. 1-2.



Baldassarre discloses user interactive device **300**, allowing users to program load priorities and sequence load shedding and reconnection. EX1021, ¶¶[0075]-[0076], ¶¶[0095]-[0103], ¶[0108].



Finally, Baldassarre describes “sub-panel 112” or “remote sub-panel 118,” noting that these panels are coupled to “loads or electrical circuits...115” or “electrical circuits 117,” indicating multiple loads are connected to a single panel. EX1021, ¶¶[0083]-[0088], FIGS. 1-2. Baldassarre “controls electrical circuits 111, 115, and 117...through the use of relays (not shown).” EX1021, ¶[0086], FIGS. 1-2. Like in Lopes, Baldassarre’s “relays (not shown)” are “coupled to as many electrical circuits as necessary to prevent overload of the auxiliary power source or generator contained within the specific panel.” EX1021, ¶¶[0085]-[0086].

2. The Combination, Reasons to Combine, & Expectation of Success

Because POSITA would have recognized the benefits of combining Lasseter-Lopes with Baldassarre, it would have been obvious. EX1003, ¶¶180-88, ¶¶269-70, ¶¶355-56. As discussed, Lasseter-Lopes discloses microsources that vary output frequency responsive to loading, automatically shedding loads via LCs and under-frequency relays. *Supra* Part III.A.3. Though Lopes discusses shedding loads based on relative importance (shedding different amounts of loads “based on the amplitude of frequency deviation”) and reconnecting loads gradually, EX1011, 3-6, Lopes does not discuss implementation, hardware, or a user-interface for setting load priorities. Baldassarre supplements Lopes, disclosing a processor-based control system with a user interface that automatically disconnects and restores loads based on user-defined priorities and real-time system conditions. EX1021, ¶¶[0075]-[0103], FIG.

3. POSITA would have been motivated to combine Baldassarre's priority-based load-management control—including its user interface, load priorities and time and sequenced disconnect/reconnection of loads—with the Lasseter-Lopes system to enable user control of load-shedding critical and non-critical loads. EX1003, ¶181. Lopes' load-shedding control could be augmented with Baldassarre's load-management control, or Baldassarre's load-management control implemented in place of Lasseter-Lopes' adjusted, as needed, to accommodate Lasseter-Lopes' system. EX1003, ¶181.

First, Lasseter-Lopes provide the control logic—frequency deviation and load-shedding thresholds—but not how users specify load-shedding or reconnection priority. POSITA would have looked to Baldassarre's control system, including its user interface and load-priority programming, as an obvious solution—providing hardware and software structure for setting load priorities, implementing time-based reconnection, and sequentially restoring power. EX1021, ¶¶[0056]-[0058], ¶¶[0061]-[0065], ¶¶[0083]-[0089], ¶¶[0093]-[0109], ¶¶[0121]-[0127], FIGS. 1, 5-7; EX1003, ¶182. Integrating Baldassarre's user interface with Lasseter-Lopes' distributed controllers yields a system that not only sheds loads automatically when frequency drops, but does so according to priorities set by a user—a desirable improvement for any DER with load-shedding capabilities. EX1003, ¶182. Incorporating these aspects of Baldassarre into Lasseter-Lopes would simply be “a

combination of familiar elements according to known methods,” (applying load-control systems with user interfaces and load-priority logic), to “yield predictable results,”—a load-shedding system allowing for user-definable priorities. *KSR*, 550 U.S. at 401; EX1003, ¶182.

Second, POSITA would have been motivated to combine Lasseter-Lopes with Baldassarre because Baldassarre solves a problem Lasseter-Lopes leaves unaddressed: conventional systems could not “continuously update the priorities of particular electrical loads in real time” or “allow a user to select in real-time which loads are essential.” EX1021, ¶[0007]. Combining Lasseter-Lopes’ frequency control and frequency-based load shedding with Baldassarre’s user-configurable interface enables user-tailored load-shedding schemes—avoiding the inflexibility of fixed frequency thresholds, improving system usability, efficiency, and safety. EX1003, ¶183.

Third, implementing Baldassarre’s control system 114 with the LCs and under-frequency relays of Lasseter-Lopes would have been straightforward and predictable. EX1003, ¶184. Lopes’ LCs and under-frequency relays would function as frequency-responsive devices that open at predetermined-frequency deviations, and Baldassarre’s control systems would provide a user-programmable means for managing and coordinating those relays. EX1021, ¶¶[0094]-[0104], ¶¶[0110]-[0119]; EX1003, ¶184. Through Baldassarre’s processor-based controller and user-

interactive device, users define load priorities, specify load-shedding conditions, and specify load restoration sequences. EX1021, ¶¶[0021]-[0027], ¶¶[0032]-[0034], ¶[0056], ¶¶[0090]-[0095]. POSITA would have recognized integrating this control scheme with Lopes' distributed load controllers (LCs) and under-frequency relays would enable user-determined prioritization of load shedding without altering the basic LC/relay operation, while eliminating the need to configure each individually at its respective load site. EX1003, ¶184. This approach is a predictable combination of known microprocessor-based control systems to achieve improved coordination and configurability in managing frequency-responsive load shedding. *KSR*, 550 U.S. at 417.

Fourth, POSITA would have been motivated by Baldassarre's additional benefit: real-time adjustment of load priorities. EX1021, ¶¶[0016], ¶[0030], ¶[0053], ¶[0081], ¶[0103]. While Lasseter-Lopes discloses relative load importance, EX1011, 4, it does not disclose ***when*** the importance is implemented. Because a user's needs change, POSITA would have employed Baldassarre's user interfaces to permit users to change load priorities as desired. EX1003, ¶¶185-185.

POSITA would have reasonably expected success. EX1003, ¶186. Each reference addresses managing power sources to maintain stable operation when loads vary. Lopes even contemplates "adopt[ing] standard protocols and open technologies...using off-the-shelf, low-cost, widely available, and fully-supported

hardware and software components.” EX1011, 2. Baldassarre’s controller performs conventional relay switching using processor logic, while Lasseter-Lopes’ control systems already use microcontrollers and relay-based load interfaces. EX1021, ¶186; EX1011, ¶¶[0025], ¶¶[0090]-[0091]. Integrating Baldassarre’s programmable interface and relay hardware with Lasseter-Lopes’ load-shedding control logic would have required only routine design adaptation and would predictably improve functionality: user-configurable, frequency-responsive load management in DERs. EX1003, ¶186.

Fifth, POSITA would have found it obvious to incorporate Baldassarre’s teaching of detecting overloads by monitoring distortion in the AC output’s sine wave within the Lasseter-Lopes system to improve overload detection. EX1003, ¶270; EX1021, ¶[0059]. Baldassarre explains that its “control system may sense the power through other means as well, such as...sine waves...to determine when the auxiliary power source is overloaded.” EX1021, ¶[0059]. POSITA would have recognized that evaluating sine-wave distortion provides an additional indication of loading, consistent with and additive to Lasseter-Lopes’ current- and voltage-based sensing, thereby increasing the reliability of overload detection. EX1003, ¶270. Without altering the operation of Lopes’ load controllers or under-frequency relays, Baldassarre’s approach could be another manner used to assess whether the microsources in the DER are overloaded, EX1021, ¶[0059], and to delay

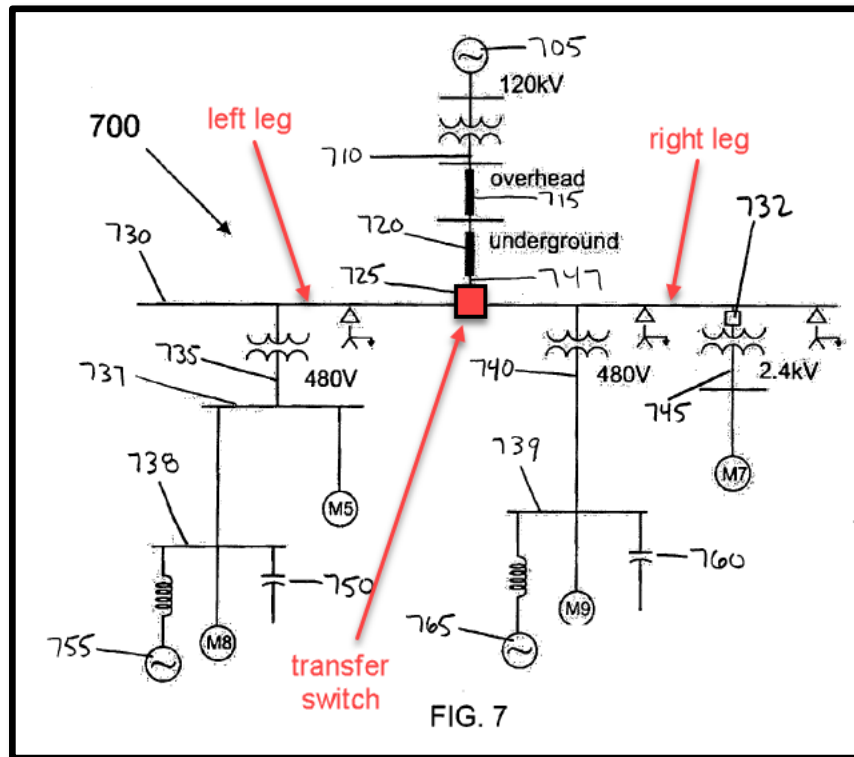
reconnection of lower-priority loads to avoid further stressing the power source.

POSITA would have a reasonable expectation of success in the combination because it is simply “a combination of familiar elements according to known methods,” *i.e.*, multiple methods of detecting overload conditions, to “yield predictable results,” *i.e.*, identifying overloads with more accuracy. *KSR*, 550 U.S. at 401; EX1003, ¶¶270, 278-282.

Also, POSITA would have found it obvious to incorporate Baldassarre’s multi-terminal transfer switch in Lasseter-Lopes, such as at the connection between utility supply feeder and the two legs of the power bus (*e.g.*, utility supply feeder **710** and left and right legs of power bus **730** of FIG. 7), enabling switching between utility supply and the power bus legs. POSITA would have been motivated to use the multi-terminal transfer switch because it is one of few ways to connect utility supply to a power bus with a transfer switch. EX1003, ¶187. POSITA would also have been motivated knowing that this configuration would allow one leg of the bus to operate normally in connecting/disconnecting from the grid at the switch while allowing the other leg to be not used, either by being disconnected from the switch or not selected via the switch, such as for safe maintenance/construction of the leg and the microsources and loads connected to it. *Id.* POSITA would have had a reasonable expectation of success because it is simply “a combination of familiar elements according to known methods,” (applying a multi-terminal switch between

multiple power paths), to “yield predictable results”—a switch operating to select power paths. *KSR*, 550 U.S. at 401; EX1003, ¶¶187-188.

Additionally, POSITA would have found obvious to combine Lopes’ “controllers located at loads or at groups of loads [load controller (LC)]” with Baldassarre’s control system 114 to conveniently disconnect groups of loads that are connected to a “sub-panel.” EX1003, ¶¶181-188, 269-270, 355-356. This allows for efficient, convenient, and rapid shedding and restoring of the specific “group of circuits” managed by that sub-panel in real-time, thereby optimizing the system’s ability to “maintain[] the total usage of power by the user at or just below the maximum capacity of the” microsource. EX1021, ¶[0016]; EX1003, ¶356. Baldassarre’s subpanels do not interfere with Lopes’ under-frequency load-shedding scheme but enhance it: Lopes’ relays would continue to respond to Lasseter’s frequency droop, yet the system could now isolate larger groups of non-essential loads in a single operation. The combination also obviates the need for multiple relays set to the same frequency threshold when simultaneous shedding of several non-essential loads is desired. POSITA would have a reasonable expectation of success in the combination because it is simply “a combination of familiar elements according to known methods,” *i.e.*, under-frequency load shed relays and sub-panels delivering power to various loads, to “yield predictable results,” *i.e.*, shedding multiple loads with a single relay. *KSR*, 550 U.S. at 401; EX1003, ¶356.



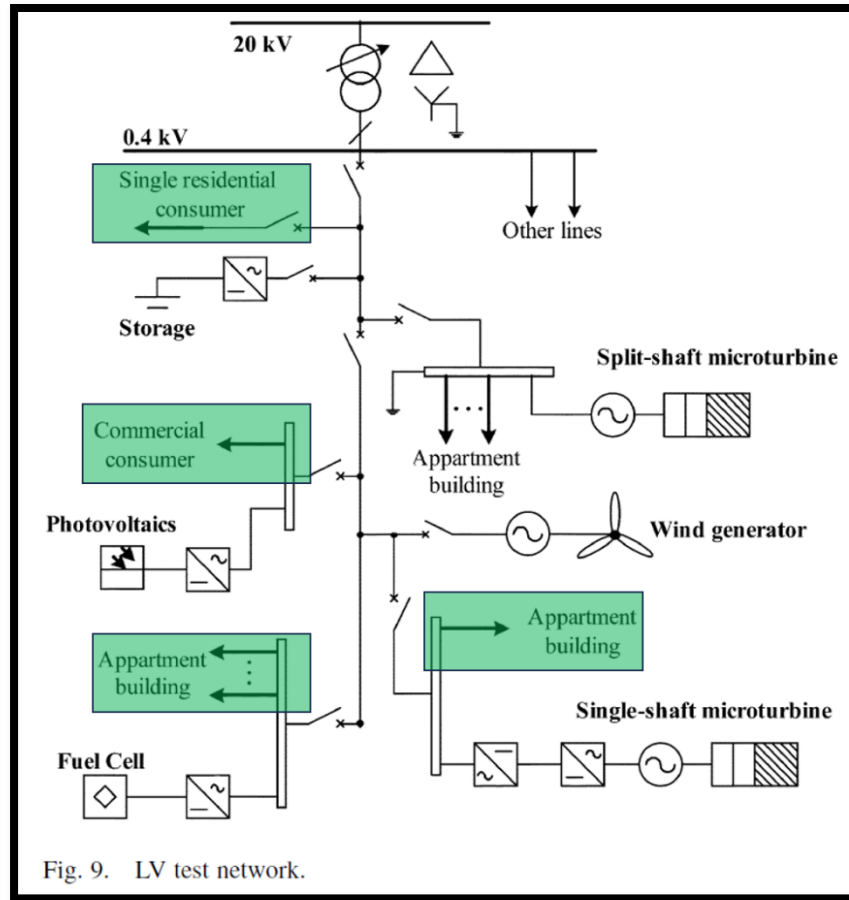
EX1005, FIG. 7.

3. Claim Element Analysis

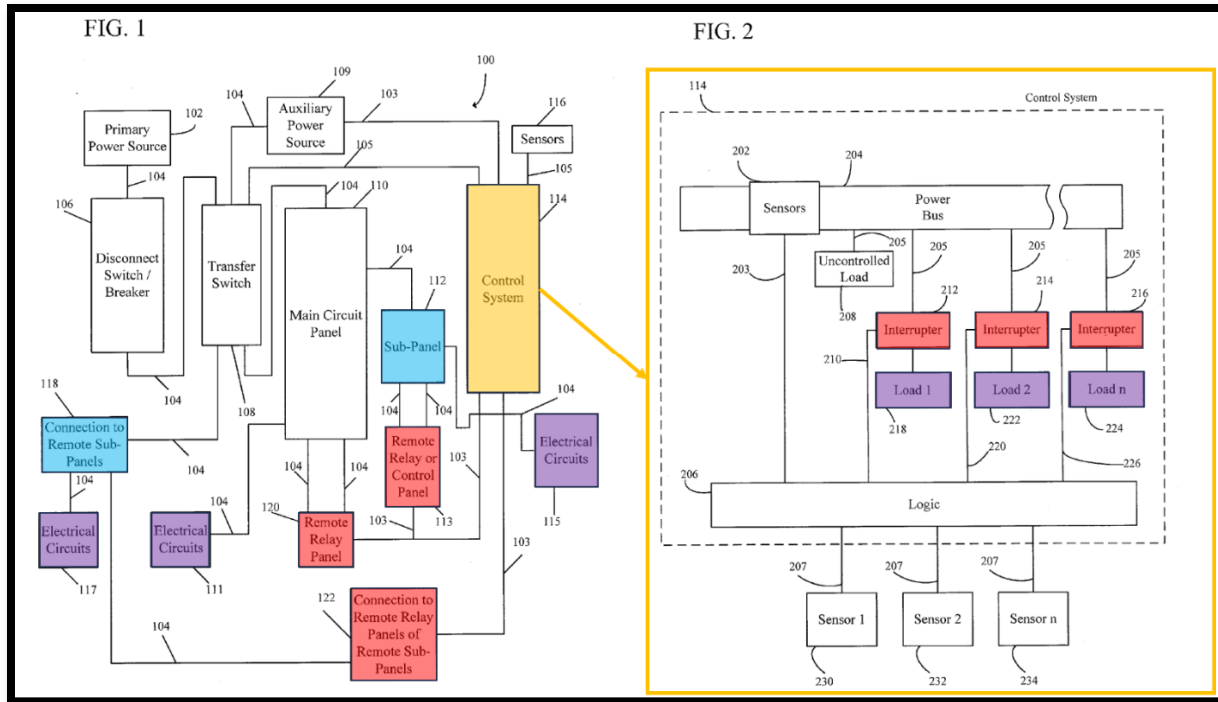
[48.] A power system as claimed in claim 45 which provides renewable and backup power in addition to grid power to a sub-panel, wherein the power source provides output AC power which is coupled via one or more contactor or transfer switch to the sub-panel to power a plurality of loads, each of which is electrically coupled thereto via a processor circuit c).

Supra Lasseter-Lopes [46]; EX1003, ¶¶357-60. Lopes discloses “controllers located at loads or at groups of loads [load controller (LC)].” EX1011, 2. LCs or under-frequency relays (each comprising *processor circuits* and *contactors or transfer switches*) electrically *couple AC power to the loads*. EX1011, 1-2, 4, 6; EX1003, ¶357. Given that Lopes depicts residential, commercial, and apartment building loads, POSITA would have understood or found obvious that the referenced

“groups of loads” would be grouped in sub-panels to facilitate connections of loads at discrete locations at premises, particularly given the ubiquity of sub-panels in residential, commercial and apartment applications for this purpose. EX1011, FIG. 9; EX1003, ¶357 (citing EX1022, 481). Indeed, it would have been obvious in view of Baldassarre’s disclosure of a “sub-panel 112” “with loads or electric circuits” (plural) and connected “remote sub panels” and explanation that sub-panels are “commonly known in the art as implemented within electrical systems of a dwelling or building.” EX1021, ¶¶[0083]-[0084]. POSITA would have been motivated to implement sub-panels in Lasseter-Lopes and have had a reasonable expectation of success, because it was a “commonly known” arrangement that would enable supplying power to multiple loads at discrete locations at premises apart from a main circuit panel. EX1003, ¶357.



The LCs or under-frequency relays would couple Lasseter-Lopes' microsources to the *sub-panel to power the loads*, because that is what sub-panels do - pass power to loads or circuits connected at the sub-panel. EX1003, ¶¶358-59.



Lopes' under-frequency relays would “control[] electrical circuits 111, 115, and 117...through the use of relays (not shown).” EX1021, ¶[0086], FIGS. 1-2. Lopes' “relays (not shown)” would be *electrically* “coupled to...electrical circuits...within the specific panel.” EX1021, ¶¶[0085]-[0086]; EX1003, ¶¶359-60.

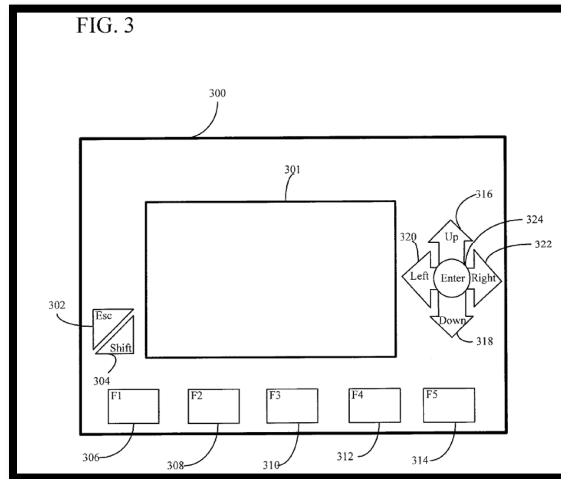
POSITA would have been motivated to combine the concept of Lopes' “controllers located at loads or at groups of loads [load controller (LC)]” with Baldassarre's control system 114 to conveniently disconnect groups of loads that are connected to a “sub-panel.” EX1003, ¶¶359-60. Baldassarre describes “sub-panel 112” or “remote sub-panel 118,” noting that these panels are coupled to “loads or electrical circuits...115” or “electrical circuits 117,” indicating multiple loads are connected to a single panel. EX1021, ¶¶[0083]-[0088], FIGS. 1-2.

[56.] A power system as claimed in claim 45 wherein in c) the processor circuit is part of the power source and controls coupling output AC power to a plurality of loads of the one or more loads whereby each of the plurality of loads is disconnected for at least a corresponding time period which is responsive to a corresponding load priority with each of the load priorities being selected via a user interface.

Lopes provides LCs (or under-frequency relays) (*processor circuits*) that *control coupling output AC power* to the *loads*. *Supra* Lassetter-Lopes [45.c]. POSITA would have found obvious coordinating Lassetter's microsource control and Lopes' LCs' (or under-frequency relays') functionality with a processor that is *part of* the microsource, given that this reduces system cost and complexity. EX1003, ¶361, ¶¶361-64. The location of the processor circuit is an obvious matters of design choice and an option that a POSITA would readily envisage. *In re Japikse*, 181 F.2d 1019 (CCPA 1950); *In re Kuhle*, 526 F.2d 533 (CCPA 1975); *Kennametal, Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376, 1381, 114 USPQ2d 1250, 1254 (Fed. Cir. 2015). POSITA would have been motivated to locate the processor circuit as part of the power source as a matter of convenience, e.g., commonly packaging aspects of Lassetter-Lopes that operate together for manufacturing and installation efficiencies, reducing the number separate sets of processors in the system, and improving access to all of the systems for maintenance and access from one location. EX1003, ¶361.

Moreover, as discussed, POSITA would have been motivated to use Baldassarre's control system **114** and user interactive device **300** to control Lopes'

LCs' (or under-frequency relays') operating parameters. *Supra* Part III.C.2; EX1003, ¶362. Baldassarre's "user interactive device **300** is a graphical *user interface*." EX1021, ¶[0097].



In the combination, "user interactive device **300** is used for controlling control system **114**." EX1021, ¶[0076], ¶¶[0082]-[0083], FIGS. 1-3. After a *time period* wherein "control system **114** determines that the generator power source is below its middle and/or maximum threshold, control system **114** automatically restores the loads in a *predetermined sequence* or by a user." EX1021, ¶[0103]. "[T]he user can program the microprocessor to...restore the various controlled loads in any desired sequence." EX1021, ¶¶[0095]-[0098]. Because loads are reconnected in a priority order selected via user interactive device **300**, loads are disconnected for a *time period which is responsive to a load priority*. EX1003, ¶363. Each of the *load priorities being selected via a user interface*. EX1003, ¶363.

Finally, though Lopes' LCs and under-frequency relays are located near the

loads they control, POSITA would have been motivated to incorporate Baldassarre's teachings of control over "remote sub-panel 118" that "controls electrical circuits 117...via electrical wire 104." The inclusion of remote relays allows the control system to manage loads contained in these distant panels without needing additional processors for each relay. EX1003, ¶364. A remote sub-panel may contain a "third controlled electrical load coupled to at least one relay within a remote relay panel." As taught in Baldassarre, "[c]ontrol system 114 may be coupled to auxiliary power source 109," making it *part of the* backup power source. EX1021, ¶[0086]; EX1003, ¶364.

[57.] A power system as in claim 45 comprising a plurality of physically distinct processor circuits c) each being contained in its own enclosure and not physically part of the power source, with each processor circuit being physically wired to the power source output to receive the output AC power, and physically wired to a corresponding at least one load of the one or more loads; with each distinct processor circuit c) responsive to the occurrence of the second frequency to control coupling of output AC power by disconnecting the corresponding load for at least a period of time which is responsive to a load priority for that corresponding load, the priority being selected via a user interface.

Lopes' LCs and under-frequency relays (*processor circuits*) are *physically distinct*, located at the loads themselves. EX1011, 2-4, 6, FIG. 1. POSITA would have understood or found obvious (e.g., at least from Lopes' boxed representations of the LC (FIG.1) and Lasseter's enclosed switches 118 (EX1022, 454)) that the distinct processor circuits located at different loads would have their *own enclosures*. EX1003, ¶365-66; EX1005, FIG. 1 (switch 118 showing box enclosure);

EX1022, 454 (“Enclosing the Circuit”). The LCs and under-frequency relays are *physically wired* between the microsources’ *output (receiving the output AC power)* and the loads so they can break the electrical connection and flow of current from a power source to a load. EX1003, ¶365.

Each LC and under-frequency relay (*processor circuit*) is responsive to the occurrence of the second frequency to disconnect loads. *Supra* Lasseter-Lopes [45.c]. Because this is a “*temporary* disconnection of less important loads,” POSITA would have understood or found obvious that such loads reconnect. EX1011, 4, 6; EX1003, ¶366. POSITA would also be motivated to control Lopes’ under-frequency relays via Baldassarre’s user interactive device **300** given that the Lopes’ relay is a coupling circuit for controllably coupling at least some of the AC power from the power source to at least a first load just like the relays disclosed in Baldassarre. *Supra* [56]. Because loads are reconnected in a *priority being selected via user* interactive device **300**, loads are disconnected *for at least a period of time which is responsive to a load priority*. EX1003, ¶366.

[71.] The power system of claim 66 wherein in c) the load manager circuit is responsive to the AC power frequency and to at least the sine distortion of the AC power to provide or not provide AC power to the at least one of the one or more of a plurality of loads.

As depicted in Lasseter, AC power is typically delivered in “sinusoidal” waves. EX1005, ¶[0101], FIGS. 10(a)-(b). Baldassarre notes that its “control system may sense the power through other means as well, such as...sine waves...to

determine when the auxiliary power source is overloaded.” EX1021, ¶[0059]. In Lasseter-Lopes-Baldassarre, the sine wave distortion is sensed to determine whether the DER’s microsources are overloaded, EX1021, ¶[0059], and delay reconnection of low-priority loads, thus, *not providing AC power to the at least one of the one or more of a plurality of loads*. EX1003, ¶¶367-68.

C. [GROUND 1C] – Claims 69-70 Is Obvious Over Lasseter-Lopes-Tsukida

1. Tsukida et al. (EX1023)

Tsukida discloses “managing a power system” using an “underfrequency level detection unit” to determine the magnitude of frequency drop in a power system. EX1023, Abstract. When the “frequency drops resulting from power generation shortage,” Tsukida’s system “sheds loads [chosen] in advance” based on the degree of underfrequency, the time the system is in an underfrequency state, and the voltage output to the loads. *Id.* ¶[0029]-[0041], FIG. 1-2.

2. The Combination, Reasons to Combine, & Expectation of Success

Because POSITA would have recognized the benefits of combining Lasseter-Lopes with Tsukida, it would have been obvious. EX1003, ¶¶278-282, ¶369. POSITA would have been motivated to incorporate Tsukida’s load-shedding into Lasseter-Lopes to improve the process for selectively shedding loads responsive to frequency deviations. EX1023, Abstract; EX1003, ¶¶278. In the Lasseter-Lopes combination, Lopes’ LC and under-frequency relays shed loads responsive to

frequency. *Supra* [66.c]. Lopes also indicates there is a time “required for load shedding application.” EX1011, 4. But Lopes does not teach an algorithm for those LCs and relays. EX1003, ¶278. Thus, POSITA would have found obvious to implement load-shedding like Tsukida’s in Lasseter-Lopes. EX1003, ¶¶278-282, ¶369.

First, while Lopes refers to LC and under-frequency relays for load shedding at certain thresholds, EX1011, 4-5, Lopes only generally discusses its load-shedding algorithm. Tsukida supplements Lopes by teaching specific underfrequency load shedding and an associated logic for so doing. EX1023, ¶¶[0029]-[0042], ¶¶[0046]-[0050], ¶¶[0054]-[0057], ¶¶[0060]-[0068], ¶¶[0075]-[0090]. POSITA implementing Lasseter-Lopes would have looked to Tsukida to determine appropriate operations for Lopes’ under-frequency relays. EX1003, ¶279. Indeed, applying Tsukida’s load shedding in Lasseter-Lopes would simply be “a combination of familiar elements according to known methods,” *i.e.*, applying load shedding for its intended purpose of controlling a load, to “yield predictable results”—load shedding based on frequency, voltage, and time. *KSR*, 550 U.S. at 401; EX1003, ¶279.

Second, POSITA would have been motivated to incorporate Tsukida’s load shedding in Lasseter-Lopes because it would avoid false-positives. EX1003, ¶280. Tsukida distinguishes between under-frequency caused by an overload and that caused by an “out-of-step condition,” only shedding loads in the former case.

EX1023, ¶¶[0038]-[0039], ¶¶[0064]-[0065]. While Lopes discusses shedding loads based on frequency deviations at certain thresholds, EX1011, 4-5, Lopes does not disclose mechanisms to prevent unnecessary shedding when the system is “out-of-step.” Incorporating Tsukida’s load shedding would improve Lasseter-Lopes by preventing false-positive sheds and ensuring load shedding occurs only under overload conditions. EX1003, ¶280.

Third, POSITA would have been motivated to incorporate Tsukida because it provides staggered load shedding based on progressive time intervals. EX1003, ¶281. Lopes refers to determining that an underfrequency exists for a certain time intervals before load shedding occurs, EX1011, 4-5, but Lopes does not discuss time intervals to use between successive shed operations. Tsukida supplies this information and gives exemplary timing schemes. EX1023, ¶[0037], ¶¶[0047]-[0049]. For example, Tsukida provides exemplary tables of frequency deviations and corresponding time intervals:

	SET VALUE Hz	TIME Sec	LOAD TO BE SHED %
L1a L1b L1c L1d	48.5	0.5	4
		1.0	4
		2.0	4
		3.0	4
		4.0	4
		5.0	4
		6.0	4
		7.0	4
L2a L2b L2c L2d	48.0	0.2	8
		0.5	8
		1.0	4
		2.0	4
		3.0	4
		4.0	4

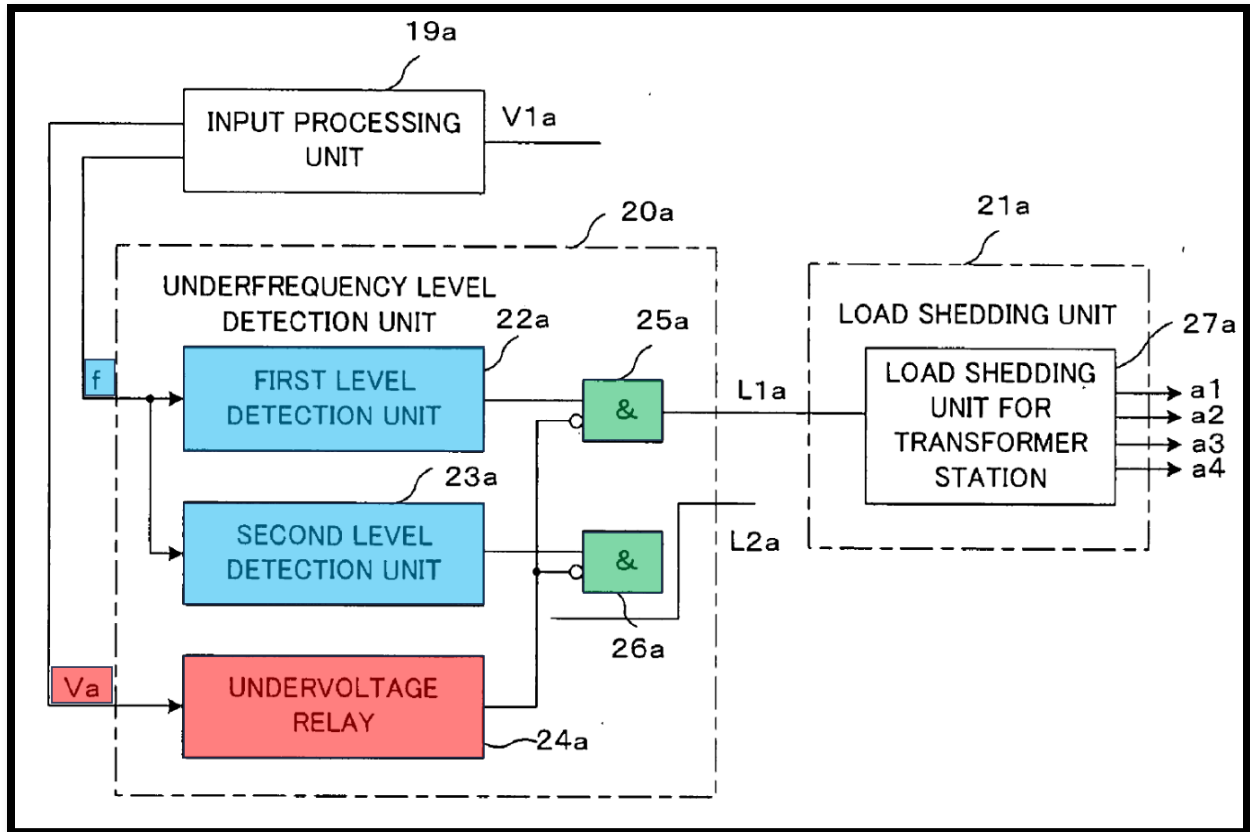
EX1023, FIG. 3, ¶¶[0030]-[0038], ¶¶[0045]-[0050]. Tsukida thus supplies concrete implementation guidance that would enhance the performance of the Lasseter-Lopes system. EX1003, ¶281.

POSITA would have reasonably expected success in the above-discussed combination of Tsukida and Lasseter-Lopes. EX1003, ¶281. Lopes already discloses using processors to execute a load-shedding strategy. Tsukida provides the strategy for determining to shed loads and teaches several additional advantages. Thus, the result of the Lasseter-Lopes-Tsukida combination would have been predictable to POSITA, and POSITA would have expected it to work. *Id.*

3. Claim Element Analysis

[70.] The power system of claim 66 wherein in c) the load manager circuit is responsive to the AC power frequency and to at least the voltage of the AC power to provide or not provide AC power to the at least one of the one or more of a plurality of loads.

In Lasseter-Lopes, Tsukida adds “underfrequency load-shedding” that “stably manag[es] a power system” by incorporating undervoltage sensing to avoid load shedding when a power source’s frequency drops not due to increased loading, but instead “out of step.” EX1023, ¶[0001], ¶[0038]-[0039], ¶¶[0064]-[0065]; EX1003, ¶¶370-71. In Tsukida, a processor “receives the voltage *V_{la}* detected by the voltage transformer” on the bus-bar 18a to which the loads “A1 to A_i” are connected (*responsive to the voltage of the AC power*). EX1023, ¶¶[0026]-[0033], FIGS. 1-2. The processor also “obtains a power system frequency,” “judges the underfrequency level of the power system,” (*responsive to the AC power frequency*). *Id.* If appropriate, Tsukida’s system “outputs a load shedding command” (*provide or not provide AC power to the loads*). *Id.* ¶[0028], ¶¶[0034]-[0041], FIG. 2.



Tsukida uses voltage to “distinguish[] the drop phenomenon of the power system frequency f due to the out of step from the drop phenomenon of the power system frequency f due to the power generation shortage of the power system” to ensure that loads are not shed “in the case of the drop phenomenon of the power system frequency f due to the out of step.” *Id.*, ¶¶[0038]-[0039], ¶¶[0064]-[0065]. “[W]hen the voltage value...is equal to or less than a predetermined value,” the detection “outputs the logical value ‘1’.” *Id.*, ¶[0033], ¶[0038]. The value is incorporated with a value representing frequency state into circuitry logic to determine whether to “output[] the load shedding commands $a1$ to $a4$ to loads $A1$ to $A4$.” *Id.*, ¶¶[0030]-[0040], ¶¶[0061]-[0067], ¶[0071], ¶¶[0081]-[0090].

Accordingly, the system *is responsive to the AC power frequency and voltage* and determines whether to shed (*provide or not provide power to*) loads. Lasseter-Lopes implementing Tsukida, would operate similarly.

[69.] The power system of claim 66 wherein in c) the load manager circuit is responsive to the AC power frequency and to at least a second parameter of the AC power to provide or not provide AC power to the at least one of the one or more of a plurality of loads.

Supra [70].

D. [GROUND 1D] – Claim 55 Is Obvious Over Lasseter-Lopes-Baldassarre-Tsukida

1. The Combination, Reasons to Combine, & Expectation of Success

Because POSITA would have recognized the benefits of combining Lasseter-Lopes with Baldassarre and Tsukida, it would have been obvious. EX1003, ¶372, ¶¶372-374. The motivations for combining Baldassarre and Tsukida individually to Lasseter-Lopes apply equally when combined collectively. EX1003, ¶372. As discussed above, Baldassarre improves Lasseter-Lopes by providing a user interface and processor-based control system for managing load priorities and reconnecting loads according to user-defined criteria. *Supra* Part III.B.2. Likewise, Tsukida improves Lasseter-Lopes by supplying the algorithmic logic governing how loads are shed and reconnected in response to frequency deviations, including filtering out false triggers and using graduated time intervals. *Supra* Part III.B.3. POSITA would have recognized these improvements are complementary rather than competing—

Baldassarre enables user configuration and monitoring of load-management behavior, while Tsukida supplies the logic executed by those control processors to carry out the desired load-shedding operations. EX1003, ¶372.

POSITA would have found further motivation integrating Baldassarre's user interface with Tsukida's load shedding control because it enhances the system by allowing users to configure frequency-deviation thresholds underlying Tsukida's logic. *Id.* Though Tsukida teaches determining when and how to shed loads based on measured frequency, voltage and elapsed time, it does not disclose how users input relevant timing intervals, setpoints, or thresholds. But Baldassarre's interface and controller 114 expressly allow users to define and adjust parameters like those for which Baldassarre discloses configurability—including load priority, restoration order, and timing sequences. *Id.* Combining the two would have allowed use of Baldassarre's interface to set the time intervals and thresholds implemented by Tsukida's algorithm—thereby improving system transparency, adaptability, and maintainability without altering the underlying logic of either reference. *Id.*

POSITA would have reasonably expected success combining Baldassarre and Tsukida in the Lasseter-Lopes system. EX1003, ¶374. All references disclose microprocessor-based control logic operating relays or contactors to shed loads in response to power-system conditions, and both operate in the same technical field of AC power control and distributed-energy-resource management. EX1021, Abstract,

¶¶[0025]-[0027]; EX1023, Abstract. Their hardware and software structures are compatible—Tsukida’s algorithm can be executed by the same processors that Baldassarre employs to control relays and user-defined settings. Integration would have required only routine engineering effort and would predictably yield a unified, user-programmable load-management system that executes Tsukida’s algorithm under user-selected parameters via Baldassarre’s control interface. EX1003, ¶374.

2. Claim Element Analysis

[55.] A power system as claimed in claim 54 wherein in c) the processor circuit helps to prevent or alleviate an overload by controlling coupling output AC power to the at least one load by disconnecting that load and keeping it disconnected for a first time period which is responsive to the load’s priority which is selected via a user interface, with the disconnection of the load taking place in response to the second frequency being present for at least a second time period or a third frequency being present for at least a third time period which is shorter than the second time period.

Supra [45.c] (coupling), *id.* (overload), [48] (user interactive device **300**), [56] (disconnected for a first time period based on load priority set via user interactive device **300**); EX1003, 375-378.

Tsukida adds a “predetermined power system frequency” (*first frequency*), a “first level range,” (*second frequency*), and a “second level range” (*third frequency*). EX1023, ¶[0037]. If the “system frequency *f* stays in the first level range or the second level range for a predetermined time,” then “loads determined in advance...are shed sequentially” (*responsive to the load’s priority*). *Id.*, ¶[0046]

If “the power system frequency *f* is within the first level range and above the

second level range,” (*second frequency*), and “stays for a time equal to or more than 0.5 sec.,” (*second time period*), loads begin to shed. *Id.*, ¶[0047]. But if “the power system frequency *f* comes to fall [initially] within the second level range” (*third frequency*), and “stays for a short predetermined time of 0.2 sec.,” (*third time period which is shorter than the second time period*), loads begin to shed. *Id.*, ¶[0049]. “Therefore, the load...is shed when the [*second frequency*] continues for a time equal to or more than 0.5 sec. or the [*third frequency*] continues for a time equal to or more than 0.2 sec.” *Id.*, ¶[0051], FIG. 3.

FIG. 3

	SET VALUE Hz	TIME Sec	LOAD TO BE SHED %
L1a L1b L1c L1d	48.5	0.5	4
		1.0	4
		2.0	4
		3.0	4
		4.0	4
		5.0	4
		6.0	4
		7.0	4
L2a L2b L2c L2d	48.0	0.2	8
		0.5	8
		1.0	4
		2.0	4
		3.0	4
		4.0	4

The shed loads are kept disconnected for a time period responsive to the

load's priority selected via a user interface. Supra [57]; EX1003, ¶¶375-378.

IV. CONCLUSION

The Challenged Claims are unpatentable.

V. FEES

Petitioner authorizes charge of fees to Deposit Account 06-1050.

VI. MANDATORY NOTICES UNDER 37 C.F.R § 42.8(a)(1)

A. Real Party-In-Interest Under 37 C.F.R. § 42.8(b)(1)

Generac Power Systems, Inc. is the real party-in-interest.

B. Related Matters Under 37 C.F.R. § 42.8(b)(2)

The '857 Patent is the subject of civil action *PSLC LLC v. Generac Power Systems, Inc.*, 2-24-cv-01270 filed October 7, 2024. Petitioner is not aware of any disclaimers, reexamination certificates, or IPR petitions addressing the '857 Patent.

C. Lead And Back-Up Counsel Under 37 C.F.R. § 42.8(b)(3)

Petitioner provides the following designation of counsel.

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D. Service Information

Please address all correspondence and service to the address listed above.

Petitioner consents to electronic service by email at IPR58936-0002IP3@fr.com

(referencing No. 58936-0002IP3 and cc'ing PTABInbound@fr.com).

Respectfully submitted,

Dated October 10, 2025

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CERTIFICATION UNDER 37 CFR § 42.24

Under the provisions of 37 CFR § 42.24(d), the undersigned hereby certifies that the word count for the foregoing Petition for Inter Partes Review totals 13,990 words, which is less than the 14,000 allowed under 37 CFR § 42.24.

Dated October 10, 2025

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CERTIFICATE OF SERVICE

Pursuant to 37 CFR §§ 42.6(e)(4)(i) et seq. and 42.105(b), the undersigned certifies that on October 10, 2025, a complete and entire copy of this Petition for Inter Partes Review and all supporting exhibits were provided by Federal Express, to the Patent Owner, by serving the correspondence address of record as follows:

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