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For: POWER SOURCE LOAD CONTROL

**DECLARATION OF DR. STEVEN B. LEEB IN SUPPORT OF
PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 11,967,857**

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	[1.pre] A power system which provides A.C. power with a controlled A.C. frequency to assist in managing the loading thereof, the power system comprising:	75

- [1.a] a non-utility type power source comprising an inverter which provides single or multiple phase output A.C. power to one or more of a plurality of loads, the power source having at least one maximum output power parameter which if exceeded causes an overload of the power source, the output A.C. power having an A.C. frequency, which frequency is controlled in response to the timely amount of the output A.C. power; 75
- [1.b] a power sensing circuit which may be part of the power source or otherwise and is responsive to the timely amount of the output A.C. power, the power source operating in response to the power sensing circuit to control the frequency of the output A.C. power to have a first frequency when the power source is not overloaded and a second frequency when the power source is overloaded or is near to being overloaded; 78
- [1.c] a processor circuit comprising one or more processors responsive to the output A.C. power, the processor circuit operating in response to the occurrence of the second frequency to control the output A.C. power consumed by at least one load of the one or more loads thereby helping to prevent or alleviate an overload of the power source. 83
- [2.] A power system as claimed in claim 1 wherein when the one or more loads demand more power than the inverter can produce, the power source changes the A.C. power output frequency from the first frequency to the second frequency to signal the processor circuit to shed one or more of the plurality of loads to help the power source to recover from an overload. 85
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- [39.a] a non-utility type power source having one or more inverter which provides single or multiple phase output AC power to one or more of a plurality of loads, the power source having at least one power system parameter which if exceeded indicates an actual or potential overload of the power source, the output AC power having an AC frequency, which frequency is controlled in response to a timely amount of a parameter of the power source; 96
- [39.b] a sensing circuit which may be part of the power source or otherwise and is responsive to the timely amount of at least one loading parameter of the power source, the power source operating in response to the sensing circuit and the at least one power system parameter 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 is near to being overloaded; 97
- [39.c] a processor circuit comprising one or more processors responsive to the output AC power, the processor circuit operating in response to the occurrence of the second frequency to control the output AC power consumed by at least one load of the one or more loads thereby helping to prevent or alleviate an overload of the power source. 97
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- [61.pre] A power system which provides AC power with one or more controlled power parameters to assist in managing the loading thereof, the power system comprising: 102
- [61.a] a non-utility type power source comprising an inverter which provides single or multiple phase output AC power to one or more of a plurality of loads, the power source having at least one maximum power source parameter which if exceeded for a specified period of time may cause a loss of output AC power or damage to the power source, the output AC power having one or more timely power parameter, including AC frequency, which may be changed; 103
- [61.b] a power sensing circuit which may be part of the power source or otherwise and is responsive to the timely power parameter, the power source operating in response to the power sensing circuit and the maximum output power parameter to control the frequency of the output AC power to indicate the loading of the power source; 105
- [61.c] a processor circuit comprising one or more processors responsive to the frequency of the output AC power to control the coupling of power to at least one load of the one or more loads thereby helping to prevent or alleviate an overload of the power source. 108
- [62.] A power system as claimed in claim 61 wherein the processor circuit of c) is a physically distinct device contained in its own enclosure and not physically part of the power source of a), the processor circuit c) being physically wired to the power source output to receive the output AC power, and physically wired to the at least one load of the one or more loads, the processor circuit operating to controllably couple power from the power source output to the at least one load. 109
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[7.] A power system as claimed in claim 6 wherein the power system controls the charging of the at least one rechargeable battery from a power grid. 120

[8.] A power system as claimed in claim 6 wherein the power system controls the charging of the at least one rechargeable battery from at least one solar panel. 121

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[16.] A power system as claimed in claim 5 further including a transfer switch which may output power from a power grid or from the power source to provide power to the one or more of a plurality of loads, the power system operating to charge the at least one rechargeable battery from the power grid via the transfer switch output when the transfer switch outputs grid power, with the power system stopping the charging of the at least one rechargeable battery via the output of the transfer switch when the transfer switch outputs power from the power source to provide power to the one or more of a plurality of loads.....	123
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[44.] A power system as claimed in claim 39 wherein in c) the processor circuit operates to disconnect output AC power from the at least one or more loads for at least a time period which is responsive to a load priority which is selected via a user interface.	132
[63.pre] A power system as claimed in claim 61 wherein the processor circuit of c) is a physically distinct device contained in its own enclosure and not physically part of the power source of a), the enclosure containing:.....	134
[63.d] a printed circuit assembly on which at least the one or more processor and supporting circuitry is mounted;...	134

- [63.e] at least one electrically controlled electro-mechanical switch, relay or contactor with one or more input electrical terminals via which it may be physically wired to the power source output to receive the output AC power, and one or more load electrical terminals via which it may be physically wired to the at least one load of the one or more loads and at least one control electrical terminal which is connected to the printed circuit assembly in order that the one or more processor can control connecting the output AC power to the at least one load via the input electrical terminals and the load electrical terminals; 135
- [63.f] a power supply receiving the output AC power of d) and providing DC power for the one or more processors, the power supply circuit being partially or totally mounted on the printed circuit board or otherwise; 139
- [63.g] a user interface circuit being partially or totally mounted on the printed circuit or otherwise, the user interface providing information to a user or installer and providing the capability to enter a priority for the at least one load of e). 139
- [64.pre] A power system as claimed in claim 61 wherein there are a plurality of processor circuits of c) the power system comprising: a plurality of processor circuits of c) each being a physically distinct device contained in its own enclosure and not physically part of the power source of a) or other processor circuits c), each enclosure containing:.....140
- [64.d)] a printed circuit assembly on which at least the one or more processor and supporting circuitry is mounted;...140
- [64.e)] at least one electrically controlled electro-mechanical switch, relay or contactor with one or more input electrical terminals via which it may be physically wired to the power source output to receive the output AC power, and one or more load electrical terminals via which it may be physically wired to the at least one load of the one or more loads and at least one control electrical terminal which is connected to the printed circuit assembly in order that the one or more processor can control connecting the output AC power to the at least one load via the input electrical terminals and the load electrical terminals; 140

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[17.pre] A power system which provides AC power with a changeably controlled AC frequency to assist in managing the loading thereof, the power system comprising:	145

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- [17.a] a power source comprising one or more DC to AC inverter which provides output AC power to one or more of a plurality of loads, the power source having a known at least one power source parameter corresponding to the maximum output power capability of the power source; 145
- [17.b] the output AC power having one or more timely power parameter which is sensed and compared to at least one corresponding power source parameter by a power source monitor which may be part of the power source or otherwise, the power source operating in response to the power source monitor to control the frequency of the output AC power to have at least a first frequency when the power source is not overloaded and a second frequency when the power source is overloaded including by supplying an excessive current for a period of time which if continued may risk damage or loss of power; 147
- [17.c] a processor circuit comprising one or more processors responsive to the output AC power and operating in response to the occurrence of the second frequency 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. 151
- [18.] A power system as claimed in claim 17 wherein the at least one power source parameter of a) corresponds to at least one of the power source not being overloaded or being overloaded.....153
- [19.] A power system as claimed in claim 17 wherein in b) the one or more timely power parameter includes at least a voltage of the output AC power and is compared to the at least one power source parameter of a) which includes at least a voltage amount.....153
- [20.] A power system as claimed in claim 17 wherein in b) the one or more timely power parameter includes at least a current of the output AC power and is compared the at least one power source parameter of a) which includes at least a current amount. 155
- [21.pre] An electronic power system which provides single or multiple phase AC power having parameters including but not limited to voltage, current and frequency, the AC frequency being changeably controllable to assist in managing the loading of the power system, the power system comprising at least: 156

- [21.a] a power source comprising one or more DC to AC inverter circuit which receives DC power from a DC power source and converts it to AC power having a changeably controlled frequency; 156
- [21.b] a power source monitor circuit which may be part of the power source or otherwise operating in response to the operating condition of the power source to control the AC power frequency to be one of a plurality of frequencies including at least a first frequency which represents when the power source is being operated with loading that does not create an overload and a second frequency which represents when the power source is being operated with loading that if continued will risk damage to or loss of power by the power source; 157
- [21.c] the power system further comprising a coupling circuit for controllably coupling at least some of the AC power from the power source to at least a first load of one or more loads, the coupling being responsive to the frequency of the output AC power in a manner such that it performs at one or more of helping to prevent overloading; helping to mitigate overloading or helping to not increase the overloading of the power source.....158
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- [25.] A power system as claimed in claim 21 wherein in b) the power source monitor circuit is responsive to a wattage of the AC power rising above a known wattage to control the AC power frequency to be the second frequency. ..161
- [27.pre] An electronic power system which provides AC power, the power system comprising at least: 162
- [27.a] an AC power source having one or more DC to AC inverter which converts DC power to AC power having a changeably controlled frequency, the AC power source having at least one timely operating parameter from which an overload of the AC power source may be determined; 162

- [27.b] a power source monitor, which may be part of the power source or otherwise, operating in response to the at least one timely operating parameter to control the AC power frequency to have a timely one of a plurality of frequencies including least a first frequency when there is no overload and a second frequency when there is an overload; 162
- [27.c] the power system further comprising a coupling circuit for controllably coupling the AC power to at least a first load of the one or more loads, the first coupling being responsive to the loading of the AC power source in a manner that it performs at least one of helping to prevent, or helping to mitigate, overloading of the power source. 162
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- [32.] A power system as claimed in claim 27 wherein in b) the power source monitor circuit is responsive to the at least one timely operating parameter which is a wattage of the AC power. 164
- [33.] A power system as claimed in claim 32 wherein in b) when a wattage of the AC power increases above a known wattage the AC power frequency is controlled to be the second frequency. 164
- [34.pre] An electronic power system which provides AC power to one or more loads, the power system comprising at least: 164

- [34.a] an AC power source having one or more DC to AC inverter which converts DC power to AC power which may be controlled to change to different known frequencies, the AC power source having at least one timely operating parameter from which an overload of the AC power source may be determined; 164
- [34.b] a power source monitor operating in response to the at least one timely AC power source operating parameter to control the AC power frequency to have a timely one of a plurality of frequencies including least a first frequency when there is no overload and a second frequency when there is an overload; 165
- [34.c] the power system further comprising a first coupling circuit for controllably coupling the AC power to at least a first load of the one or more loads in a manner to mitigate overloading of the power source after the AC power takes on the second frequency; and 165
- [34.d] further comprising a second coupling circuit for controllably coupling the AC power to at least a second load of the one or more loads, the second coupling circuit being responsive to at least one AC power source timely operating parameter, which may be the same as or different than the at least one timely operating parameter of b) to perform at least one of i) prevent an overload, ii) alleviate an overload or iii) prevent further overload if the power source is already overloaded. 167
- [35.] An electronic power system as claimed in claim 34 wherein in d) the second coupling circuit is responsive to the at least one AC power source timely operating parameter which is a voltage of the AC power. 168
- [36.] An electronic power system as claimed in claim 35 wherein in d) the second coupling circuit is responsive to a voltage of the AC power increasing above a known value. 169
- [37.] An electronic power system as claimed in claim 34 wherein in d) the second coupling circuit is responsive to the at least one AC power source timely operating parameter which is a current of the AC power. 169
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A	POSITA would have found claims 24 and 26 obvious in view of the combination of Lasseter-Lopes-Baldassarre.	171
[24.]	A power system as claimed in claim 21 wherein the AC power has a sine wave distortion parameter and in c) the coupling circuit is additionally responsive to the AC power sine wave distortion to performs at one or more of helping to prevent overloading; helping to mitigate overloading or helping to not increase the overloading of the power source.	171
[26.]	A power system as claimed in claim 21 wherein in c) the coupling circuit comprises a contactor having input terminals for electrically connecting to the power source and output terminals for electrically connecting to the first load and providing AC power thereto when the contactor is closed, the coupling circuit further comprising a user interface whereby the user may configure the manner in which the coupling circuit responds to the frequency of the AC power to open the contactor thereby disconnecting the AC power from the first load.	172
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[36.]	An electronic power system as claimed in claim 35 wherein in d) the second coupling circuit is responsive to a voltage of the AC power increasing above a known value.	182
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1. The Lasseter-Lopes Combination would have been obvious to a POSITA. 184
- A POSITA would have found claims 45-47, 49-54, 58-60, 66-69 obvious in view of the combination of Lasseter and Lopes. 184
- [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: 184
- [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; 185
- [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; 187
- [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;.....191

- [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. 198
- [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. 199
- [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.....203
- [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. 203
- [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.....206

- [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. 207
- [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. 209
- [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. 209
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- [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. 212
- [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: 212
- [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; 212
- [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; 215
- [66.b.2] 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 216
- [66.b.3] 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; 219

[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.	220
[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.	220
[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.	221
[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.	222
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	A POSITA would have found claims 48, 56-57, and 71 obvious in view of the combination of Lasseter-Lopes-Baldassarre.	223
[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).	223

	[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.....	227
	[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.	229
	[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.....	231
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	1. The Lasseter-Lopes-Baldassarre-Tsukida Combination would have been obvious to a POSITA.	235

A POSITA would have found claim 55 obvious in view of the combination of Lasseter-Lopes-Baldassarre-Tsukida.

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[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. 237

X. CONCLUSION 239

LISTING OF CHALLENGED CLAIMS

Claim 1	
[1pre]	A power system which provides A.C. power with a controlled A.C. frequency to assist in managing the loading thereof, the power system comprising:
[1.1]	a) a non-utility type power source comprising an inverter which provides single or multiple phase output A.C. power to one or more of a plurality of loads, the power source having at least one maximum output power parameter which if exceeded causes an overload of the power source, the output A.C. power having an A.C. frequency, which frequency is controlled in response to the timely amount of the output A.C. power;
[1.2]	b) a power sensing circuit which may be part of the power source or otherwise and is responsive to the timely amount of the output A.C. power, the power source operating in response to the power sensing circuit to control the frequency of the output A.C. power to have a first frequency when the power source is not overloaded and a second frequency when the power source is overloaded or is near to being overloaded;
[1.3]	c) a processor circuit comprising one or more processors responsive to the output A.C. power, the processor circuit operating in response to the occurrence of the second frequency to control the output A.C. power consumed by at least one load of the one or more loads thereby helping to prevent or alleviate an overload of the power source.
Claim 2	
[2]	A power system as claimed in claim 1 wherein when the one or more loads demand more power than the inverter can produce, the power source changes the A.C. power output frequency from the first frequency to the second frequency to signal the processor circuit to shed one or more of the plurality of loads to help the power source to recover from an overload.
Claim 3	
[3]	A power system as claimed in claim 1 wherein the power source is used as a backup power source when utility power fails.
Claim 4	
[4]	A power system as claimed in claim 1 wherein the inverter is responsive to power provided by a generator comprising an internal combustion engine to provide the output A.C. power.
Claim 5	
[5]	A power system as claimed in claim 1 wherein the inverter is responsive to at least one rechargeable battery to provide the output A.C. power.
Claim 6	
[6]	A power system as claimed in claim 5 wherein the power system controls the charging of the at least one rechargeable battery.

Claim 7	
[7]	A power system as claimed in claim 6 wherein the power system controls the charging of the at least one rechargeable battery from a power grid.
Claim 8	
[8]	A power system as claimed in claim 6 wherein the power system controls the charging of the at least one rechargeable battery from at least one solar panel.
Claim 9	
[9]	A power system as claimed in claim 6 wherein the power system controls the charging of the at least one rechargeable battery from a non-grid internal combustion powered electrical power source.
Claim 10	
[10]	A power system as claimed in claim 6 wherein a power grid and at least one solar panel are available to charge the battery and the power system controls the selection of at least one of the power grid and the at least one solar panel to charge the at least one rechargeable battery.
Claim 11	
[11]	A power system as claimed in claim 6 wherein a power grid and a non-grid internal combustion powered electrical power source are available to charge the at least one rechargeable battery and the power system controls the selection of at least one of the power grid and the non-grid internal combustion powered electrical power source to charge the at least one rechargeable battery.
Claim 12	
[12]	A power system as claimed in claim 6 wherein a power grid, a solar panel array and a non-grid internal combustion powered electrical power source are available to charge the at least one rechargeable battery and the power system controls the selection of one or more of the power grid, the solar panel array and the non-grid internal combustion powered electrical power source to charge the at least one rechargeable battery.
Claim 13	
[13]	A power system as claimed in claim 1 further including a transfer switch which may select a power grid or the power source to provide power to the one or more of a plurality of loads, the transfer switch outputting power from the grid power meets acceptable parameters and to output power from the power source when the grid power does not meet acceptable standards.
Claim 14	
[14]	A power system as claimed in claim 1 further including a transfer switch which may select a power grid or the power source to provide power to the one or more of a plurality of loads, the transfer switch outputting power from the power grid when grid power meets acceptable standards and may output power from the

	power source when the grid power does not meet acceptable standards, the power sensing circuit of b) comprising one or more current sensors electrically located to sense current output from the transfer switch.
Claim 15	
[15]	A power system as claimed in claim 1 further including a transfer switch which may select a power grid or the power source to provide power to the one or more of a plurality of loads, the transfer switch operating to select the power grid when grid power meets acceptable standards and to select the power source when the grid power does not meet acceptable standards, the power sensing circuit of b) comprising one or more current sensors electrically located to sense current output from the transfer switch and thereby are responsive to the amount of current being provided to the one or more of a plurality of loads by the power grid when the transfer switch selects the power grid and to sense the amount of current being provided to the one or more of a plurality of loads by the power source when the transfer switch selects the power source.
Claim 16	
[16]	A power system as claimed in claim 5 further including a transfer switch which may output power from a power grid or from the power source to provide power to the one or more of a plurality of loads, the power system operating to charge the at least one rechargeable battery from the power grid via the transfer switch output when the transfer switch outputs grid power, with the power system stopping the charging of the at least one rechargeable battery via the output of the transfer switch when the transfer switch outputs power from the power source to provide power to the one or more of a plurality of loads.
Claim 17	
[17pre]	A power system which provides AC power with a changeably controlled AC frequency to assist in managing the loading thereof, the power system comprising:
[17.1]	a) a power source comprising one or more DC to AC inverter which provides output AC power to one or more of a plurality of loads, the power source having a known at least one power source parameter corresponding to the maximum output power capability of the power source;
[17.2]	b) the output AC power having one or more timely power parameter which is sensed and compared to at least one corresponding power source parameter by a power source monitor which may be part of the power source or otherwise, the power source operating in response to the power source monitor to control the frequency of the output AC power to have at least a first frequency when the power source is not overloaded and a second frequency when the power source is overloaded including by supplying an excessive current for a period of time which if continued may risk damage or loss of power;
[17.3]	c) a processor circuit comprising one or more processors responsive to the output AC power and operating in response to the occurrence of the second frequency 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.
Claim 18	
[18]	A power system as claimed in claim 17 wherein the at least one power source parameter of a) corresponds to at least one of the power source not being overloaded or being overloaded.
Claim 19	
[19]	A power system as claimed in claim 17 wherein in b) the one or more timely power parameter includes at least a voltage of the output AC power and is compared to the at least one power source parameter of a) which includes at least a voltage amount.
Claim 20	
[20]	A power system as claimed in claim 17 wherein in b) the one or more timely power parameter includes at least a current of the output AC power and is compared the at least one power source parameter of a) which includes at least a current amount.
Claim 21	
[21pre]	An electronic power system which provides single or multiple phase AC power having parameters including but not limited to voltage, current and frequency, the AC frequency being changeably controllable to assist in managing the loading of the power system, the power system comprising at least:
[21.1]	a) a power source comprising one or more DC to AC inverter circuit which receives DC power from a DC power source and converts it to AC power having a changeably controlled frequency;
[21.2]	b) a power source monitor circuit which may be part of the power source or otherwise operating in response to the operating condition of the power source to control the AC power frequency to be one of a plurality of frequencies including at least a first frequency which represents when the power source is being operated with loading that does not create an overload and a second frequency which represents when the power source is being operated with loading that if continued will risk damage to or loss of power by the power source;
[21.3]	c) the power system further comprising a coupling circuit for controllably coupling at least some of the AC power from the power source to at least a first load of one or more loads, the coupling being responsive to the frequency of the output AC power in a manner such that it performs at one or more of helping to prevent overloading; helping to mitigate overloading or helping to not increase the overloading of the power source.
Claim 22	
[22]	A power system as claimed in claim 21 wherein in b) the power source monitor circuit is responsive to the operating condition of the power source which is a voltage of the AC power to control the AC power frequency.

Claim 23	
[23]	A power system as claimed in claim 21 wherein in b) the power source monitor circuit is responsive to a voltage of the AC power dropping below a known voltage to control the AC power frequency to be the second frequency.
Claim 24	
[24]	A power system as claimed in claim 21 wherein the AC power has a sine wave distortion parameter and in c) the coupling circuit is additionally responsive to the AC power sine wave distortion to performs at one or more of helping to prevent overloading; helping to mitigate overloading or helping to not increase the overloading of the power source.
Claim 25	
[25]	A power system as claimed in claim 21 wherein in b) the power source monitor circuit is responsive to a wattage of the AC power rising above a known wattage to control the AC power frequency to be the second frequency.
Claim 26	
[26]	A power system as claimed in claim 21 wherein in c) the coupling circuit comprises a contactor having input terminals for electrically connecting to the power source and output terminals for electrically connecting to the first load and providing AC power thereto when the contactor is closed, the coupling circuit further comprising a user interface whereby the user may configure the manner in which the coupling circuit responds to the frequency of the AC power to open the contactor thereby disconnecting the AC power from the first load.
Claim 27	
[27 Pre]	An electronic power system which provides AC power, the power system comprising at least:
[27.1]	a) an AC power source having one or more DC to AC inverter which converts DC power to AC power having a changeably controlled frequency, the AC power source having at least one timely operating parameter from which an overload of the AC power source may be determined;
[27.2]	b) a power source monitor, which may be part of the power source or otherwise, operating in response to the at least one timely operating parameter to control the AC power frequency to have a timely one of a plurality of frequencies including least a first frequency when there is no overload and a second frequency when there is an overload;
[27.3]	c) the power system further comprising a coupling circuit for controllably coupling the AC power to at least a first load of the one or more loads, the first coupling being responsive to the loading of the AC power source in a manner that it performs at least one of helping to prevent, or helping to mitigate, overloading of the power source.
Claim 28	

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[28]	A power system as claimed in claim 27 wherein in b) the power source monitor is responsive to the at least one timely operating parameter which is a voltage of the AC power to control the AC power frequency.
Claim 29	
[29]	A power system as claimed in claim 28 wherein in b) when a voltage of the AC power drops below a known voltage the AC power frequency is controlled to be the second frequency.
Claim 30	
[30]	A power system as claimed in claim 27 wherein in b) the power source monitor is responsive to the at least one timely operating parameter which is a current of the AC power to control the AC power frequency.
Claim 31	
[31]	A power system as claimed in claim 30 wherein in b) when a current of the AC power increases above a known current the AC power frequency is controlled to be the second frequency.
Claim 32	
[32]	A power system as claimed in claim 27 wherein in b) the power source monitor circuit is responsive to the at least one timely operating parameter which is a wattage of the AC power.
Claim 33	
[33]	A power system as claimed in claim 32 wherein in b) when a wattage of the AC power increases above a known wattage the AC power frequency is controlled to be the second frequency.
Claim 34	
[34 Pre]	An electronic power system which provides AC power to one or more loads, the power system comprising at least:
[34.1]	a) an AC power source having one or more DC to AC inverter which converts DC power to AC power which may be controlled to change to different known frequencies, the AC power source having at least one timely operating parameter from which an overload of the AC power source may be determined;
[34.2]	b) a power source monitor operating in response to the at least one timely AC power source operating parameter to control the AC power frequency to have a timely one of a plurality of frequencies including least a first frequency when there is no overload and a second frequency when there is an overload;
[34.3]	c) the power system further comprising a first coupling circuit for controllably coupling the AC power to at least a first load of the one or more loads in a manner to mitigate overloading of the power source after the AC power takes on the second frequency; and
[34.4]	d) further comprising a second coupling circuit for controllably coupling the AC power to at least a second load of the one or more loads, the second coupling circuit being responsive to at least one AC power source timely operating

	parameter, which may be the same as or different than the at least one timely operating parameter of b) to perform at least one of i) prevent an overload, ii) alleviate an overload or iii) prevent further overload if the power source is already overloaded.
Claim 35	
[35]	An electronic power system as claimed in claim 34 wherein in d) the second coupling circuit is responsive to the at least one AC power source timely operating parameter which is a voltage of the AC power.
Claim 36	
[36]	An electronic power system as claimed in claim 35 wherein in d) the second coupling circuit is responsive to a voltage of the AC power increasing above a known value.
Claim 37	
[37]	An electronic power system as claimed in claim 34 wherein in d) the second coupling circuit is responsive to the at least one AC power source timely operating parameter which is a current of the AC power.
Claim 38	
[38]	An electronic power system as claimed in claim 35 wherein in d) the second coupling circuit is responsive to a current of the AC power increasing above a known value.
Claim 39	
[39 Pre]	A power system which provides AC power with a controlled AC frequency to assist in managing the loading thereof, the power system comprising:
[39.1]	a) a non-utility type power source having one or more inverter which provides single or multiple phase output AC power to one or more of a plurality of loads, the power source having at least one power system parameter which if exceeded indicates an actual or potential overload of the power source, the output AC power having an AC frequency, which frequency is controlled in response to a timely amount of a parameter of the power source;
[39.2]	b) a sensing circuit which may be part of the power source or otherwise and is responsive to the timely amount of at least one loading parameter of the power source, the power source operating in response to the sensing circuit and the at least one power system parameter 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 is near to being overloaded;
[39.3]	c) a processor circuit comprising one or more processors responsive to the output AC power, the processor circuit operating in response to the occurrence of the second frequency to control the output AC power consumed by at least one load of the one or more loads thereby helping to prevent or alleviate an overload of the power source.

Claim 40	
[40]	A power system as claimed in claim 39 wherein in b) the at least one loading parameter is a voltage of the output AC power.
Claim 41	
[41]	A power system as claimed in claim 40 wherein in a) the at least one power system parameter is an amount of voltage and when in b) the voltage of the output AC power is less than the voltage amount the frequency of the output AC power is controlled to have the second frequency.
Claim 42	
[42]	A power system as claimed in claim 39 wherein in b) the at least one loading parameter is a current of the output AC power.
Claim 43	
[43]	A power system as claimed in claim 42 wherein in a) the at least one power system parameter is an amount of current and when in b) the current of the output AC power is greater than the current amount the frequency of the output AC power is controlled to have the second frequency.
Claim 44	
[44]	A power system as claimed in claim 39 wherein in c) the processor circuit operates to disconnect output AC power from the at least one or more loads for at least a time period which is responsive to a load priority which is selected via a user interface.
Claim 45	
[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:
[45.1]	a) a non-utility type power source comprising one or more inverter which receives power from one or more of:
[45.2]	i) a rechargeable power storage system;
[45.3]	ii) a vehicle battery;
[45.4]	iii) a solar PV system;
[45.5]	iv) an other green renewable power system;
[45.6]	v) an internal combustion power generator;
[45.7]	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;
[45.8]	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;
[45.9]	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.
Claim 46	
[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.
Claim 47	
[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.
Claim 48	
[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).
Claim 49	

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[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.
Claim 50	
[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.
Claim 51	
[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.
Claim 52	
[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.
Claim 53	
[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.
Claim 54	
[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.

Claim 55	
[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.
Claim 56	
[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.
Claim 57	
[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.
Claim 58	
[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.
Claim 59	
[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.
Claim 60	
[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.
Claim 61	
[61 Pre]	A power system which provides AC power with one or more controlled power parameters to assist in managing the loading thereof, the power system comprising:
[61.1]	a) a non-utility type power source comprising an inverter which provides single or multiple phase output AC power to one or more of a plurality of loads, the power source having at least one maximum power source parameter which if exceeded for a specified period of time may cause a loss of output AC power or damage to the power source, the output AC power having one or more timely power parameter, including AC frequency, which may be changed;
[61.2]	b) a power sensing circuit which may be part of the power source or otherwise and is responsive to the timely power parameter, the power source operating in response to the power sensing circuit and the maximum output power parameter to control the frequency of the output AC power to indicate the loading of the power source;
[61.3]	c) a processor circuit comprising one or more processors responsive to the frequency of the output AC power to control the coupling of power to at least one load of the one or more loads thereby helping to prevent or alleviate an overload of the power source.
Claim 62	
[62]	A power system as claimed in claim 61 wherein the processor circuit of c) is a physically distinct device contained in its own enclosure and not physically part of the power source of a), the processor circuit c) being physically wired to the power source output to receive the output AC power, and physically wired to the at least one load of the one or more loads, the processor circuit operating to controllably couple power from the power source output to the at least one load.
Claim 63	
[63 Pre]	A power system as claimed in claim 61 wherein the processor circuit of c) is a physically distinct device contained in its own enclosure and not physically part of the power source of a), the enclosure containing:
[63.1]	d) a printed circuit assembly on which at least the one or more processor and supporting circuitry is mounted;
[63.2]	e) at least one electrically controlled electro-mechanical switch, relay or contactor with one or more input electrical terminals via which it may be physically wired to the power source output to receive the output AC power, and one or more load electrical terminals via which it may be physically wired to the at least one load of the one or more loads and at least one control electrical terminal which is connected to the printed circuit assembly in order that the one or more processor can control connecting the output AC power to the at least one load via the input electrical terminals and the load electrical terminals;

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[63.3]	f) a power supply receiving the output AC power of d) and providing DC power for the one or more processors, the power supply circuit being partially or totally mounted on the printed circuit board or otherwise;
[63.4]	g) a user interface circuit being partially or totally mounted on the printed circuit or otherwise, the user interface providing information to a user or installer and providing the capability to enter a priority for the at least one load of e).
Claim 64	
[64 Pre]	A power system as claimed in claim 61 wherein there are a plurality of processor circuits of c) the power system comprising:
[64.1]	a plurality of processor circuits of c) each being a physically distinct device contained in its own enclosure and not physically part of the power source of a) or other processor circuits c), each enclosure containing:
[64.2]	d) a printed circuit assembly on which at least the one or more processor and supporting circuitry is mounted;
[64.3]	e) at least one electrically controlled electro-mechanical switch, relay or contactor with one or more input electrical terminals via which it may be physically wired to the power source output to receive the output AC power, and one or more load electrical terminals via which it may be physically wired to the at least one load of the one or more loads and at least one control electrical terminal which is connected to the printed circuit assembly in order that the one or more processor can control connecting the output AC power to the at least one load via the input electrical terminals and the load electrical terminals;
[64.4]	f) a power supply receiving the output AC power of d) and providing DC power for the one or more processors, the power supply circuit being partially or totally mounted on the printed circuit board or otherwise;
[64.5]	g) a user interface circuit being partially or totally mounted on the printed circuit or otherwise, the user interface providing information to a user or installer and providing the capability to enter a priority for the at least one load of e).
Claim 65	
[65 Pre]	A power system as claimed in claim 61 wherein in a) the one or more inverter is a DC to AC inverter and receives DC power from one or more of:
[65.1]	i) a power grid
[65.2]	ii) a rechargeable power storage system;
[65.3]	iii) a solar PV system;
[65.4]	iv) another green renewable power system;
[65.5]	v) an internal combustion power generator.
Claim 66	

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[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:
[66.1]	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;
[66.2]	b) 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;
[66.3]	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
[66.4]	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;
[66.5]	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.
Claim 67	
[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.
Claim 68	
[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.
Claim 69	
[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.
Claim 70	
[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.
Claim 71	

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[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.
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I. Introduction

1. My name is Steven B. Leeb. I am a Professor of Electrical Engineering and Computer Science and Mechanical Engineering at the Massachusetts Institute of Technology.

2. I have been retained by Generac Power Systems, Inc. (“Generac” or “Petitioner”) to provide my opinion concerning the validity of U.S. Patent No. 11,967,857 (attached to the accompanying Petition as EX1001 and henceforth referred to as “the ’857 patent”) in support of this Petition for *inter partes* Review.

3. I am being compensated for my time in connection with this IPR at my hourly rate of \$750. My compensation is not dependent in any way upon the outcome of this matter.

II. Qualifications

4. In this section, I summarize my educational background, work history, and other relevant background and qualifications. A copy of my curriculum vitae (“CV”) is found at EX1003, and includes detailed information pertaining to my education, experience, and qualifications.

5. I am a tenured Professor in the Electrical Engineering and Computer Science Department at the Massachusetts Institute of Technology (“MIT”), and I have a joint appointment in the Department of Mechanical Engineering at MIT. In 2004, I was appointed as a MacVicar Faculty Fellow, a program honoring MIT

teachers and mentors who have made outstanding contributions to undergraduate education.

6. I earned a Bachelor of Science (S.B.) degree, a Master of Science (S.M.) degree, an Electrical Engineering (E.E.) degree, and a Doctorate (Ph.D.) degree from MIT in 1987, 1989, 1990, and 1993, respectively.

7. I have over 36 years of experience in the fields of electrical engineering, computer science, and mechanical engineering, with particular experience in the fields of power electronics, energy conversion systems, and motor drives. My work in the area of power electronics, energy conversion systems, and motor drives has included extensive research activities on the health and operation of refrigeration/air conditioning systems.

8. From 1987 to 1991, I worked part-time as a United States Air Force (“USAF”) Reservist at the Wright Research and Development Center at Wright Patterson Air Force Base in Ohio, in its avionics branch, developing and studying power supplies for use in advanced avionics systems. During my time on the MIT faculty from 1993 to present, I have designed several power electronic products that include microcontrollers and that employ advanced control techniques, including variable speed drives for motor control. My work in the area of power electronics has included extensive study, analysis, and use of control systems, electromechanical system monitoring, HVAC systems, power factor correction,

monitoring power consumption, electronic circuits, voltage regulation, and voltage regulators.

9. As part of my research at MIT, I have developed power electronic circuits for power supplies, motor drives, induction heating units, and charging systems, among numerous other applications.

10. Since 1995, I have taught several courses at MIT that cover the use of power electronics, microcontrollers, and electromechanical systems. I have taught graduate and undergraduate level courses at MIT in motor and generator design, microcomputer control, power electronic circuit design, motor drives, field theory, circuit analysis, signal processing, feedback control, and power systems. In these courses, I have taught extensively regarding the design of electromechanical systems, converters and drives, and protection circuits. I also have supervised over 150 theses and advanced undergraduate projects since I joined the MIT faculty in 1993. I have won the MIT Edgerton and Bose awards for excellence in teaching and research, MIT's Spira teaching award, and several other recognitions, including a teaching award from an undergraduate student honor society (HKN).

11. I have authored or co-authored more than 200 technical publications and am a named inventor on over 28 U.S. patents, with others pending in the areas of power electronics and power systems design, analysis, monitoring, and control. My CV includes a sample list of these publications. *See* Ex. 100X. For example, a

paper that I co-authored, “*Current and Voltage Reconstruction from Non-Contact Field Measurements*,” 16 (15) IEEE SENSORS JOURNAL (2016), was recognized as one of the 25 most downloaded Sensors Journal papers in 2016. I have been invited to give plenary session papers and presentations, for example, at the IEEE Applied Power Electronics Conference (APEC) in 2004 for a paper I authored entitled “*Putting Profit into Power Electronic Products with Digital Control*.” Another recent paper that I co-authored, “*Capacitor-less Photovoltaic (PV) Cell-Level Power Balancing using Diffusion Charge Redistribution*,” received a “Best Presentation” award in its session at the APEC 2014 conference. A paper I co-authored entitled “*Rule the Joule: An Energy Management Design Guide for Self-Powered Sensors*,” received the 2025 IEEE Sensors Journal Best Paper Award.

12. Some of my research work has been directed at systems involved with motors and drive systems for electric motors and generators. Publications I have co-authored with examples of this work include, but are not limited to, “*A Comparison of Switched Doubly-Fed Machine Drive Topologies for High Power Applications*” presented at the 2015 IEEE International Electric Machines and Drives Conference, “*Adaptive Control of Power Electronic Drives for Servomechanical Systems*,” 15(6) IEEE TRANSACTIONS ON POWER ELECTRONICS (2000), and “*Nonintrusive Induction Motor Speed Detection*,” 9(5) IET ENERGY AND POWER APPLICATIONS JOURNAL (2015).

13. Examples of peer-reviewed publications resulting from my research in HVAC systems can be found, for instance, in “*Detection of HVAC Faults via Electrical Load Monitoring*,” 8(1) INTERNATIONAL JOURNAL OF HVAC&R RESEARCH (2002), “*Monitoring HVAC Equipment Electrical Loads from a Centralized Location—Methods and Field Test Results*,” 108(1) ASHRAE TRANSACTIONS (2002), and “*Nonintrusive Ventilation System Diagnostics*,” in 21(17) IEEE SENSORS JOURNAL (2021).

14. In 1999, I co-founded Talking Lights, LLC, a company in Massachusetts. The company worked to commercialize inventions that I developed relating to a “Talking Lights” system. The system included electronic ballast circuits that modulated the arc in a fluorescent lamp and drivers that modulated the current in an LED lamp in order to transmit information and illumination to the blind or hard-of-hearing. As part of the design of these systems, I developed voltage regulators for these lighting ballasts. In 2003 and 2004, I co-developed commercial products that have passed regulatory approval with the Underwriters’ Laboratory and the Federal Communications Commission. The Talking Lights system has been sold commercially.

15. I received a National Science Foundation CAREER Award in 1996. I was named Technology Review’s TR100 Outstanding Young Innovator. I was also named the IEEE Outstanding Young Power Electronics Engineer in 1999. I have

received two R&D 100 awards for products I developed at Talking Lights, LLC, a Massachusetts company that I co-founded.

16. In 2007, I was named a Fellow of the Institute of Electrical and Electronics Engineers (“IEEE”). The IEEE is the professional organization for electrical engineering in general, and for power electronic circuit designers. The rank of “Fellow” is granted to members of the IEEE judged by an extensive review process to have made “extraordinary accomplishments” in a field of IEEE’s interest.

17. In 2021, I was appointed as the chair holder of the Emanuel E. Landsman Professorship at MIT.

III. Summary of Materials Reviewed and Considered

18. In forming my opinions herein, I have relied on my general and specific experience from my educational background and my years of work in the field.

19. I have also carefully reviewed documents and evidence as discussed throughout my report and listed in the table below. I have reviewed and considered any document or evidence discussed in this report, even if omitted from the table below.

Ex.	Description
1001	U.S. Patent No. 11,967,857

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Ex.	Description
1002	File History for United States Patent No. 11,967,857
1003	Declaration and Curriculum Vitae of Steven B. Leeb
1004	Complaint, PSLC LLC v. Generac Power Systems, Inc., 2:24-cv-01270-SCD filed October 7, 2024
1005	U.S. Patent Appl. No. 2006/0208574
1006	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)
1007	Alexander Kusko & Marc T. Thompson, POWER QUALITY IN ELECTRICAL SYSTEMS (2007)
1008	U.S. Patent No. 8,410,633
1009	U.S. Patent No. 7,149,605
1011	J.A. Peças Lopes et al., <i>Defining Control Strategies for MicroGrids Islanded Operation</i> , 21 IEEE Transactions Power Systems 916 (May 2006)
1012	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)
1013	Netra Gyawali & Yasuharu Ohsawa, <i>Improved Power Sharing Scheme for a Microgrid with Multiple Distributed Generators</i> , 128 IEEJ Transactions on Elecs., Info. & Systems 1635 (2008)
1014	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)
1015	Robert Lasseter, <i>Providing Premium Power Through Distributed Resources</i> , Procs. 33rd Hawaii Int'l Conf. Sys. Scis. (2000)
1016	R. H. Lasseter, <i>Smart Distribution: Coupled Microgrids</i> , 99 Procs. IEEE 1074 (June 2011)

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Ex.	Description
1017	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)
1019	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)
1020	U.S. Patent Appl. No. 2004/0051387
1021	U.S. Patent Publ. No. 2010/0019574
1022	Paul Sherz, PRACTICAL ELECTRONICS FOR INVENTORS (2000)
1023	U.S. Patent Publ. No. 2007/0222294
1024	U.S. Patent No. 8,204,632
1025	U.S. Patent No. 7,356,422
1026	U.S. Patent No. 7,274,975
1027	U.S. Patent No. 6,314,378
1028	Lasseter et al., <i>White Paper on Integration of Distributed Energy Resources</i> , Consortium for Electric Reliability Technology Solutions (Apr. 2002)
1029	Lasseter & Pablo Piagi, <i>Microgrid: A Conceptual Solution</i> , PESCS' Aachen, Germany (June 25, 2004)
1030	STANDARD FOR EMERGENCY AND STANDBY POWER SYSTEMS, NFPA® 110 (2010 ed.)

20. Where citations to non-patent literature are presented in this Declaration, they refer to the exhibits absolute page number, not the original pagination of the document. For patent references, I refer to the column and line

number and paragraph number as appropriate. All emphasis in quoted text should be presumed to be added, except for bolded figure numbers.

21. My opinions are additionally guided by my appreciation of how a person of ordinary skill in the art (“POSITA”) would have understood the claims of the ’857 patent at the time of the alleged invention, which I have been asked to assume is May 26, 2011, for all claims.

IV. Understanding of Legal Standards

22. I am not an attorney, and I do not opine on matters of law. However, I have been informed by counsel of certain legal standards, which are set forth below. I have applied those standards in my analysis in this declaration. The material in this section has been supplied to me by counsel.

23. I have been informed by Counsel that the validity analysis is a two-step process. First, the patent claims are construed to ascertain their proper scope. Second, the construed claims are compared to the identified prior art to determine if the claims are valid over the prior art.

A. Person of Ordinary Skill in the Art (“POSITA”)

24. I understand that the factors considered in determining the ordinary level of skill in a field of art include: the level of education and experience of persons working in the field; the types of problems encountered in the field; the teachings of the prior art regarding solutions to such problems; and the

sophistication of the technology at the time of the alleged invention. I understand that a person of ordinary skill in the art (“POSITA”) is not a specific real individual, but rather is a hypothetical individual having the qualities reflected by the factors above and knowledge of all relevant prior art references, including the references I cite below.

25. It is my opinion that a person of ordinary skill in the art in the May 26, 2011, timeframe 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. It is my opinion that additional graduate education could substitute for work experience.

26. Such experience would have exposed the POSITA to the electrical, mechanical, electro-mechanical, and thermodynamic concepts and technology for power systems, standby power, uninterruptible power supplies, and power electronics. The experience would also have exposed the POSITA to well-known applications of backup power engineering.

27. As of May 26, 2011, I would have qualified as at least a POSITA, and my opinions herein are informed by my own knowledge based on my personal experiences and observing others of various skill levels (including those above and below the level of a POSITA’s experience).

28. My opinions below are not restricted to the precise definition of a POSITA above. The claims of the '857 patent are directed to backup power systems with power electronics employ automatic control. The claimed limitations were well-known in the art and taught by numerous prior art references, including the references discussed below. Thus, my opinions below would apply under any reasonable definition of a POSITA.

B. Obviousness

29. I have been informed that a patent claim is invalid as “obvious” in light of one or more prior art references if it would have been obvious to a POSITA at the time of the alleged invention, taking into account (1) the scope and content of the prior art, (2) the differences between the prior art and the claims, (3) the level of ordinary skill in the art, and (4) any so called “secondary considerations” of nonobviousness, which include: (i) “long-felt but unresolved need” for the claimed invention, (ii) commercial success attributable to the claimed invention, (iii) unexpected results of the claimed invention, and (iv) “copying” of the claimed invention by others.

30. I am aware that the '857 patent's earliest claimed priority date is May 26, 2011. I have used this date for purposes of my obviousness analysis.

31. I have been informed that a claim can be obvious in light of a single prior art reference or multiple prior art references. To be obvious in light of a single

prior art reference or multiple prior art references, there must be a reason that would have prompted a POSITA to modify or supplement the single prior art reference, or to combine two or more references, in a manner that provides the elements of the claimed invention. This reason may come from a teaching, suggestion, or motivation to combine, or may come from the reference(s) themselves, the knowledge or “common sense” of a POSITA, or from the nature of the problem to be solved, and this reason may be explicit or implicit from the prior art as a whole. I have been informed that, under the law, the combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results. I also understand it is improper to rely on hindsight in making the obviousness determination.

32. I understand that an obviousness determination also requires that a POSITA would have had a reasonable expectation of success. This concept has been explained to me as relating to the relative likelihood or predictability—from the perspective of a POSITA—of successfully modifying the prior art in a manner that would meet the claimed limitations of the patent being challenged (here the '857 patent). I understand that the expectation of success need only be “reasonable” and, thus, does not require the absolute certainty gleaned from physically creating the proposed prior art modification.

C. Claim Interpretation

33. I understand that, for purposes of my analysis in this inter partes review proceeding, unless stated or expressly defined otherwise, the terms appearing in the patent claims should be interpreted according to their “ordinary and customary meaning.” In determining the ordinary and customary meaning, I understand that the words of a claim are first given their plain meaning that those words would have had to a person of ordinary skill in the art at the time of the alleged invention. I also understand that the structure of the claims, the specification and file history may be used to better construe a claim. Moreover, I understand that even treatises and dictionaries may be used, albeit under limited circumstances, to determine the meaning attributed by a person of ordinary skill in the art to a claim term.

34. “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.

35. “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 of parameters of interest herein include various horsepower, mechanical load, temperature, pressure (including altitude), humidity, power, wattage, voltage, current, including maximums, minimums, safe, starting, limited, instant, real time, near real time and timely.” *Id.*

36. “Timely” is expressly defined as “instant, real time, close to real time or a suitable time.” EX1001, 25:60-66.

37. “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.

V. The '857 Patent (EX1001)

A. Summary

38. I carefully reviewed the '857 patent (EX1001).

39. The '857 patent is entitled Power Source Load Control. The patent describes systems for controlling backup power source's AC-power frequency “in response to the loading on the power source.” EX1001, Abstract. Based on a given system's loading, the claimed systems “can determine the amount of remaining power available from the power source,” if any. *Id.* Where power is insufficient to power the connected loads, the claimed system can alter its frequency to so indicate. *Id.*

B. Overview of the File History (EX1002)

40. I reviewed the File History for the patent application 16/592,007 (EX1002), which issued as the '857 patent, in addition to reviewing the '857 patent.

41. The File History shows that patent application 16/592,007 was filed on November 18, 2020. The '857 patent claims priority to the 61/490,253 provisional application, filed on May 26, 2011. The 16/592,007 was filed as a divisional application.

42. The Examiner issued a “restriction and/or election requirement” for the claims in the 16/592,007. EX1002, 257. The Examiner believed that the alleged “inventions” claimed were “independent or distinct, each from the other.” EX1002, 74.

43. The applicant filed his “RESPONSE TO RESTRICTION REQUIREMENT” on October 26, 2022. EX1002, 61. “the Election/Restriction Requirements given in the 10/26/2022 [sic] Office communication are incomplete in that the communication is missing several required sections (set out above) and thus Applicant does not here have the information needed to properly respond to and traverse the election requirement.” EX1002, 70.

44. The Examiner maintained that all claims were still “subject to restriction and/or election.” EX1002, 56. The Examiner concluded that “the

Applicant fails to identify the embodiment elected by number, as well as a species elected along with the claims corresponding to the elected species.” EX1002, 57.

45. Applicant responded, and “under protest,” the Applicant “elect[ed]... Claims 29-44” of the 16/592,007 application. EX1002, 52.

46. The Examiner responded in a lengthy Office Action that noted claims 1-28 and 45-71” were withdrawn. EX1002, 36. The Examiner also noted that claims 29-44 were allowed. EX1002, 36.

47. In this same Office Action, the Examiner identified the “Allowable Subject Matter.” EX1002, 39. Application 16/592,007 was allowable because the following limitations, in the examiner’s summary, were absent from the prior art: “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.

48. Applicant subsequently filed a request for continued examination after Claim 29 was allowed. EX1002, 11. In the request for continued examination, Applicant added dozens of pages of claims. EX1002, 14-34.

49. But the Examiner is incorrect—the claimed processor circuit was part of the prior art, predating at least May 26, 2011, and earlier. The claims Petitioner challenges are obvious, which the Examiner would have realized had he been faced with the prior art presented below.

VI. Overview of the Technology and Cited Prior Art

A. Overview of Lasseter (EX1005)

50. Lasseter concerns the field of “distributed energy resources (DER)” or “microgrids,” which refer to “small independent power generation and storage systems which may be owned by, and located near, consumers of electrical power.” *Id.*, ¶[0006], FIG. 1. DERs “can provide more reliable power...as a backup to the primary electrical supply.” *Id.*, ¶[0007]. DER power sources are called “microsources.” *Id.*, ¶[0009]. Generally, Lasseter discloses methods for controlling these DERs or microgrids.¹ EX1005, Abstract.

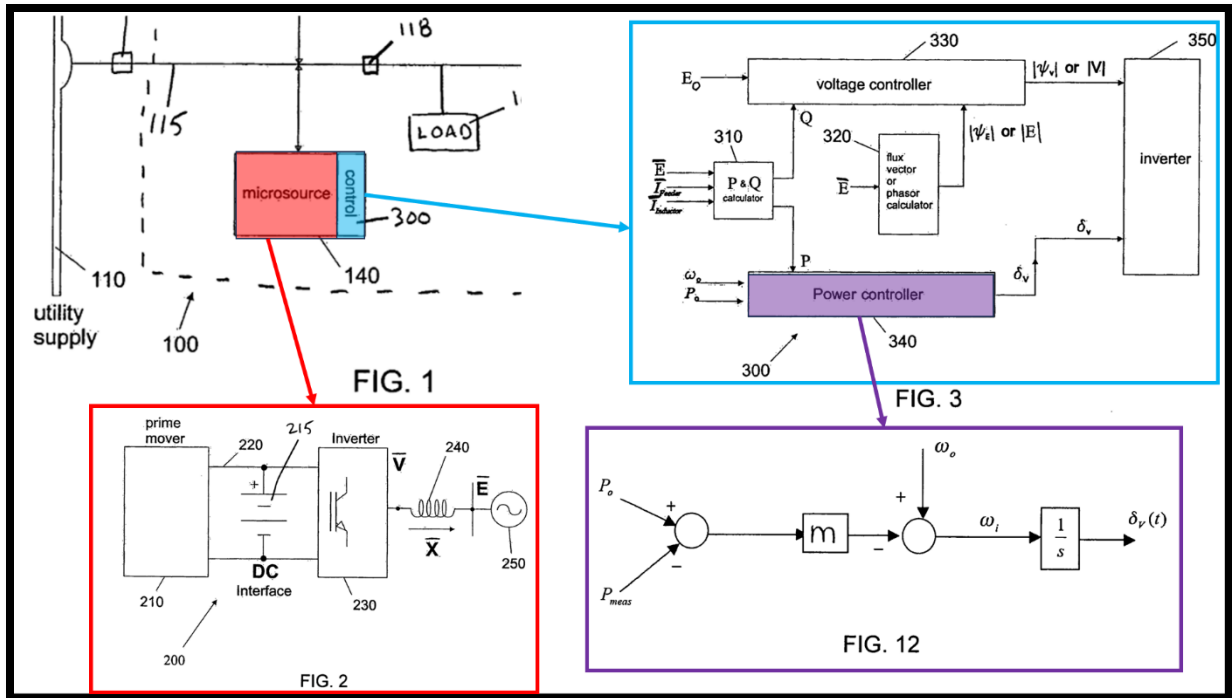
51. Lasseter (EX1005) represents one example of a broader body of work that Robert Lasseter conducted and published concerning distributed energy resources (“DERs”) and microgrids. EX1005 is consistent with and reflects the same concepts and control strategies described across many of Lasseter’s academic and industry publications—for example, in *Providing Premium Power Through*

¹ Like Lasseter, the terms DER and microgrid are used interchangeably throughout this report.

Distributed Resources, Procs. 33rd Hawaii Int'l Conf. Sys. Scis. (2000) (EX1015); *White Paper on Integration of Distributed Energy Resources*, Consortium for Electric Reliability Technology Solutions (Apr. 2002) (EX1028); and *Microgrid: A Conceptual Solution*, PESCE' Aachen, Germany (June 25, 2004) (EX1029). Each of these works builds upon the same foundational principles Lasseter developed regarding inverter-based microsources, droop control, and distributed coordination of generation and load. Collectively, they show that Lasseter's DER control techniques were well known and widely disseminated in the field at the time of the invention.

52. These control methods specifically involve “controlling the 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. To implement these methods, a microsource has “controllers that reduce the operating frequency of the” microsource “to increase its unit output power.” *Id.*, Abstract, ¶[0110]. The control focuses “on what needs to be done in response to events such as islanding or new loads.” *Id.*

53. The following image depicts Figures 1-3 and 12 from Lasseter:

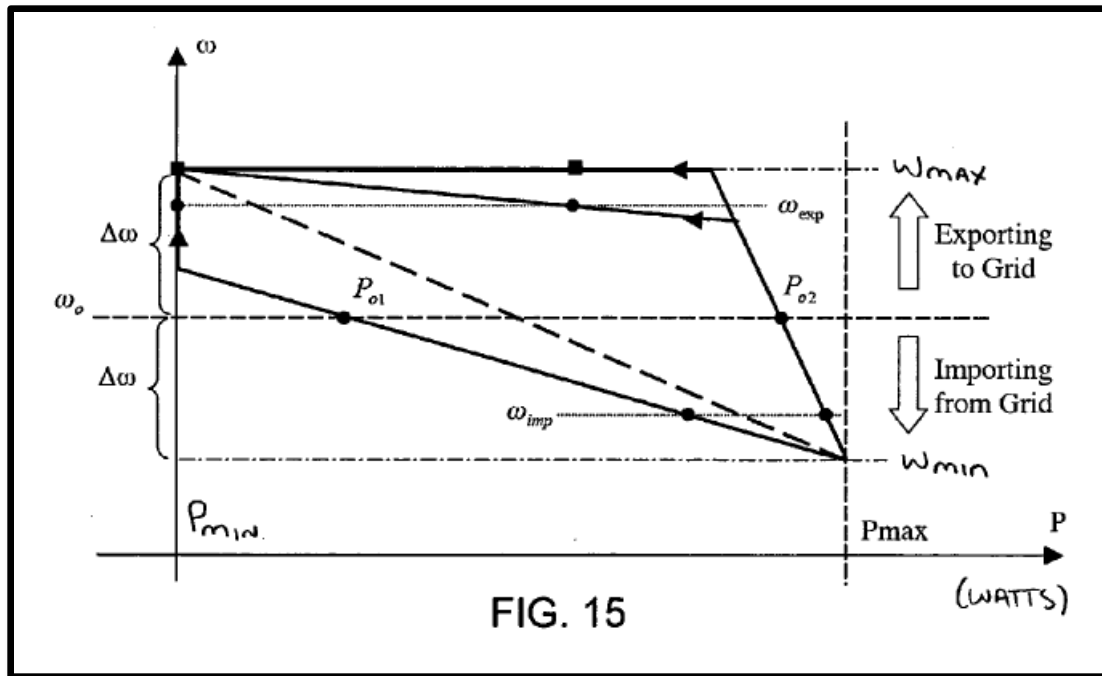


54. As Figure 1 shows, “feeder lines 115 [] interconnect microsource systems 120, 130, 140, and 150 and one or more loads.” *Id.*, ¶[0063], FIG. 1. “The feeder line 115, the interconnected microsource systems 120, 130, 140 and 150, and the one or more loads 160 can form a microgrid 117.” *Id.* “FIG. 2 is a diagram of an exemplary microsource 200 that can be used in a distributed energy resource system such as that of FIG. 1” *Id.*, ¶[0070], FIG. 2.

55. “FIG. 3 is a diagram of a controller 300 that can be used with a microsource such as that of FIG. 2, for example, 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]. As can be seen in Figure 3, controller 300 includes two controllers—voltage controller 330 and a power controller 340. Voltage

controller 330 controls “the magnitude of the inverter output voltage $|V|$,” and is discussed in more detail around FIG. 5. *Id.*, ¶¶[0074]-[0076], [0086]-[0090], FIG. 5. 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]. Figure 12 shows an example of the power controller. *Id.*, ¶¶[0105]-[0107].

56. The power controller is used in the unit-power control scheme. Figures 14-17 depict “unit power control” scheme variations, each for controlling the frequency-power output from a microsource that can be implemented by the power controller. *Id.*, ¶¶[0105], [0110]-[0141]. For example, FIG. 15 depicts an example “relationship between steady state unit power vs. frequency ($P-\omega$)...for two exemplary microsources.” *Id.*, ¶[0122]. The two microsources have different power-frequency slopes “that depend[] on the power set point, P_0 and the maximum power output, $P_{\max}$, of that microsource.” *Id.*, ¶¶[0122]-[0132].



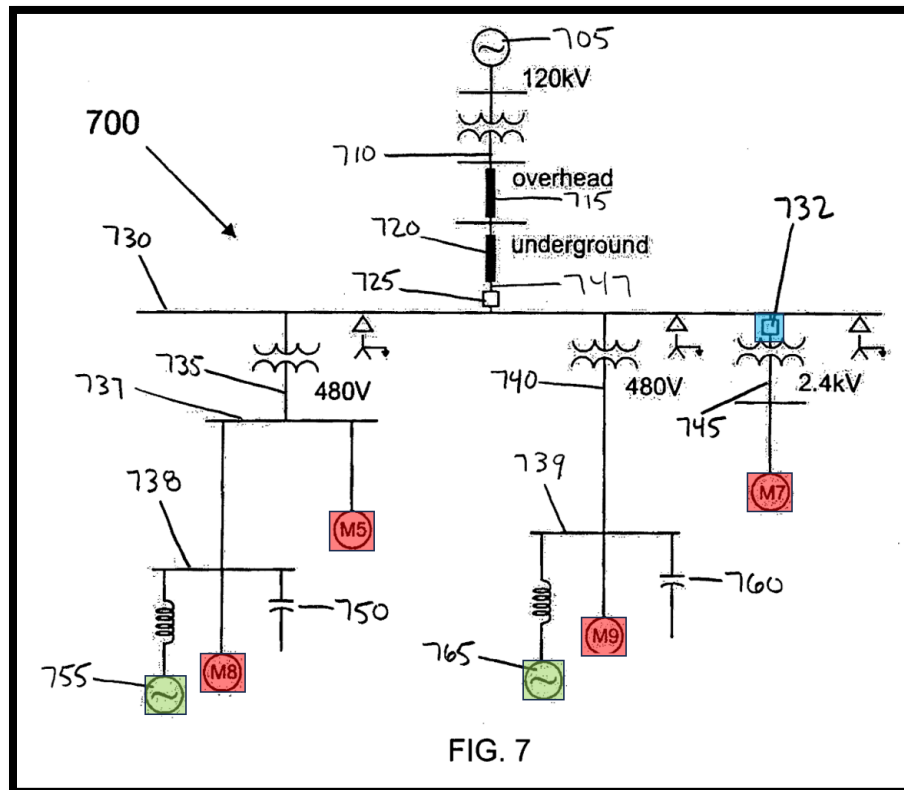
57. In systems with multiple microsources, “operating characteristics for all the units converge at the point of maximum power and minimum frequency,” allowing “the power to increase more in the units that are less loaded (unit1) and increase less in the units that are more loaded (unit2).” EX1005, ¶¶[0117]-[0018].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

58. Lasseter’s disclosure is centered on scenarios where the microsources can supply the connected loads, “assuming enough generation” to supply the loads or that total load is “smaller than sum of all generation.” *Id.*, ¶¶[0137], [0141]. For example, the lines in FIGS. 14-17 representing the power-frequency relationship end at the minimum power, P_{min} , and maximum power, P_{max} . But Lasseter explains that “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 in the microgrid.” EX1005, ¶[0130]. This is also true in the other unit power schemes of FIGS. 14 and 17. *Id.*, ¶[0119], [0141]. Lasseter’s FIGS. 25(a) and 25(b), implementing the power-frequency relationship of FIG. 17, also show power exceeding $P_{\max}$. *Id.*, FIGS. 25(a) and 25(b) (showing a power and frequency spike between D and E). POSITA would have understood that $P_{\max}$ is a maximum rated power of the microsource, or at least have found it obvious to set $P_{\max}$ as such, from Lasseter’s teaching to control power output between $P_{\min}$ and $P_{\max}$. This is confirmed by Lasseter’s incorporation by reference, which states that “ $P_{\max}$ is the maximum rated power of the machine.” EX1020, ¶[0112] (incorporated by reference into EX1005). Exceeding $P_{\max}$ is an “overload,” as defined by the ’857 patent, because a load greater than $P_{\max}$ represents “a load” on the microsource that will “cause a departure from specifications for the power output from the source” in both a departure from the microsource’s rated power specification ($P_{\min}$ - $P_{\max}$) and a departure below Lasseter’s minimum frequency specification. POSITA would have understood that operating a microsource beyond its maximum rated power for enough time will, if not stopped, e.g., by tripping a circuit breaker, cause damage to the microsource. Power is a function of voltage, current and frequency. *Id.* (citing EX1022, 64).

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

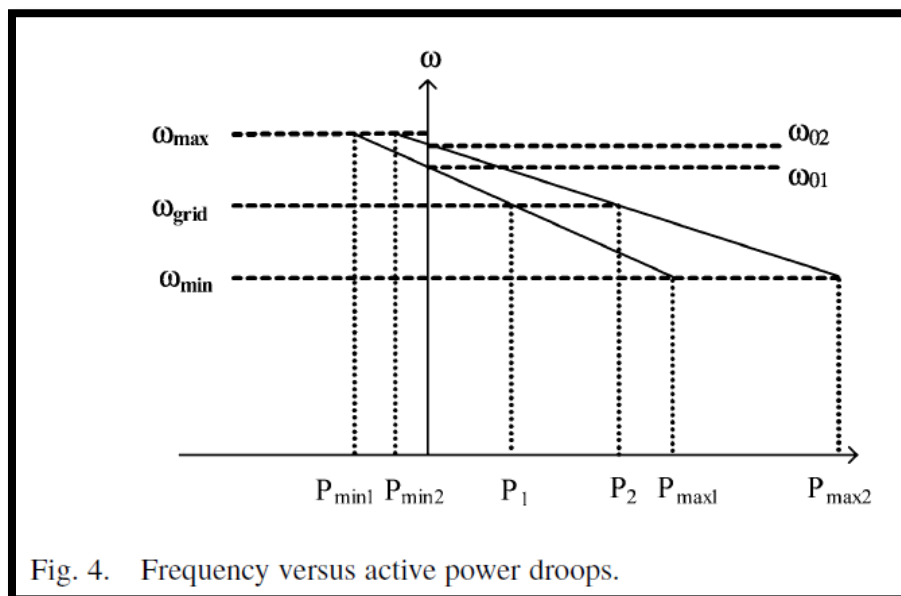
59. When Lasseter anticipates that “the combined power capacity of the microsources...is not adequate to supply the total load from loads,” it preemptively “disconnects” loads. *Id.*, ¶[0099]. For example, in one embodiment, “the combined power capacity of the microsources 755 and 765 is adequate to supply the combined load from loads M5, M8, and M9” but not M7. *Id.* “For this reason, when” the power system disconnects from the grid (when islanded), “switch 732 can also be opened to disconnect feeder 745 and its associated load M7.” *Id.*



B. Overview of Lopes (EX1006)

60. Lopes concerns control strategies for microsources like those found in Lasseter in the context of islanded-DER operation. EX1011, 1. Indeed, Lopes “further developed” a “control scheme based on droop concepts to operate in terms of feeding a standalone ac system” which is a similar controlled droop system to Lasseter. *Id.*, 8 (citing EX1015, an earlier Lasseter paper); EX1015 at 3, Fig 1, 6, 7, FIGS. 11-11, 8 FIGS. 12-14. Like in Lasseter, Lopes’ inverters actively “control[] voltage and frequency on the ac system...through droops.” EX1011, 3-4.

61. After disconnecting from the grid, DERs “must have the ability to operate stably and autonomously.” EX1011, 1. Like Lasseter, as shown in Lopes’ Figure 4, Lopes’ microsources increase their power generation by changing their output frequency up to their max power outputs:

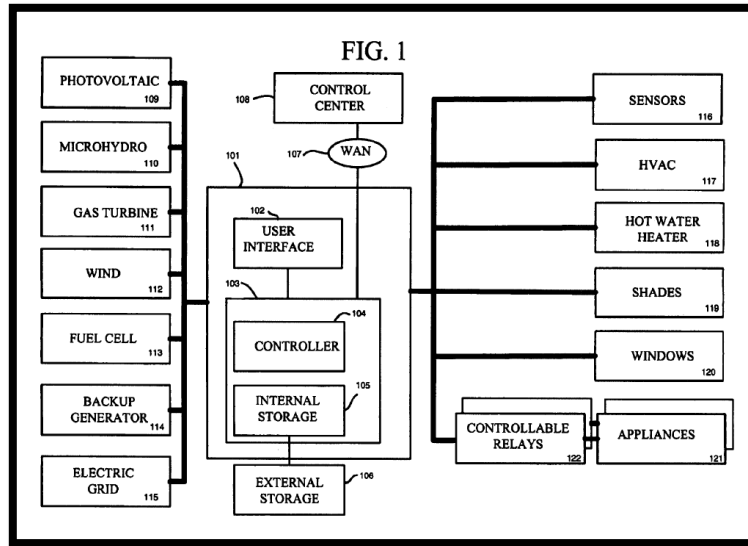


62. Lopes is explicit in that microsources can “overload” when loads exceed generation capacity, *Id.*, 4. A “high imbalance between local load and generation may lead to large frequency deviations and transient overload of the” inverter. EX1011, 4. Lopes’ solution involves “a temporary disconnection of less important loads...activated by under-frequency relays.” *Id.*, 6. Lopes refers to this solution as a “load shedding strateg[y]” which helps “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.

C. Overview of Miller (EX1006)

63. Miller concerns rechargeable batteries and algorithms for power-source management. Specifically, Miller discloses “an integrated control device” that “manages the supply of energy from various sources.” EX1026, 1:53-62. The various sources can include the “electric grid, battery, photovoltaic cells, fuel cells.” EX1026, 1:53-62. This management is performed by “[a]n optimization algorithm” that “determines based on various factors when to activate the energy sources.” EX1026, 1:53-62. “[T]he algorithm” can take “into account such factors as the supply of charge on batteries” or “the dynamic price of electricity...in order to schedule and activate energy supplies.” EX1026, 1:63-67. An exemplary “system employing various principles of the present invention” is depicted in FIG.

1, including “apparatus **101**” that “includes a unit **103** comprising a controller **104** and an internal storage device **105**.” EX1026, 3:54-57.



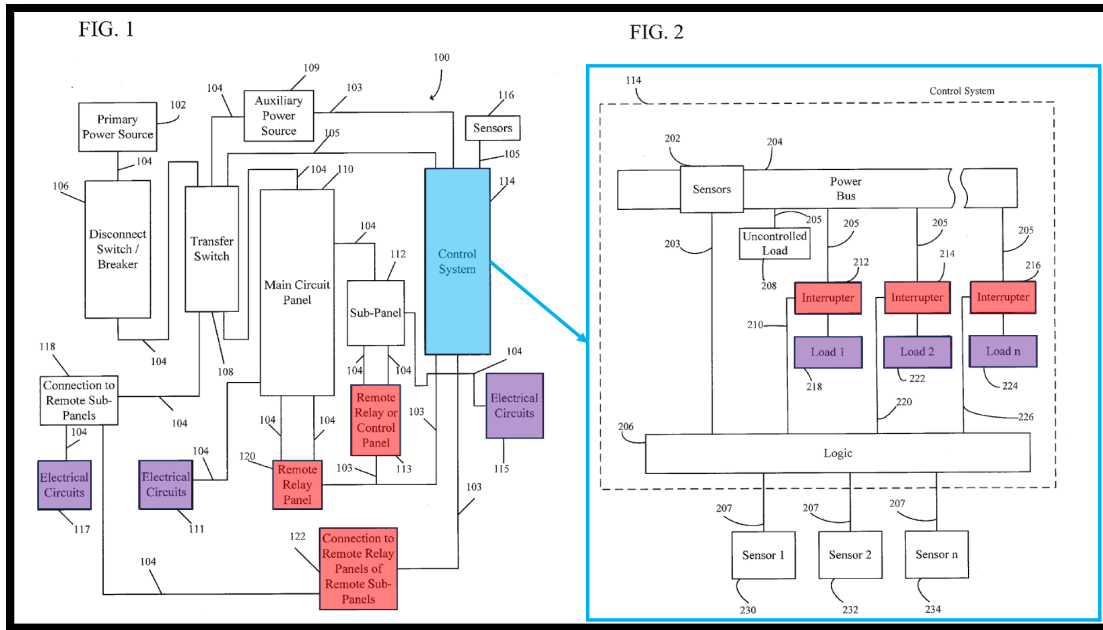
64. Miller provides an exemplary list of “internal storage device[s] **105**,” including “a plurality of lead-acid or nickel-metal-hydrate storage batteries for storing electrical energy.” EX1026, 2:54-61. Beyond batteries, apparatus **101** also includes “[c]ontroller **104**,” which is programmed with “computer software for controlling the operation of apparatus **101** in order to receive electrical power from power sources **109** through **115**.” EX1026, 3:22-28. “During normal operation, power from one or more of the power sources can be used to *charge* storage units **105** and **106**.” EX1026, 4:4-12. These power sources can include “the electric utility grid **115**” as well as “alternative energy sources **109** through **113**” in Figure 1 that “provide electrical power to the

apparatus,” which “include photovoltaic (PV) cells **109**,” “gas turbines **111**,” and “wind-based devices **112**.” EX1026, 3:56-4:3, FIG. 1.

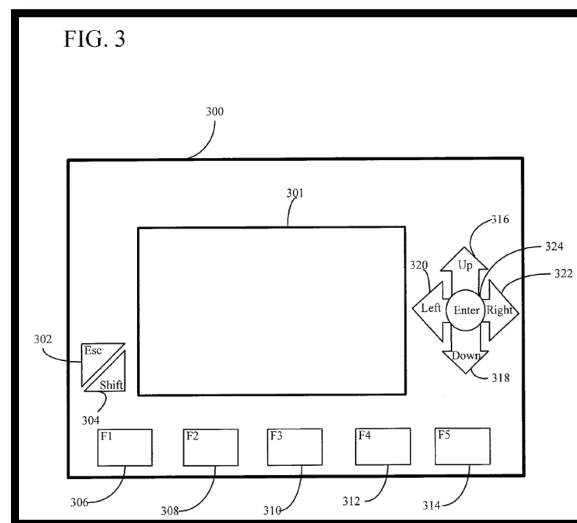
65. Apparatus **101** manages power sources with an aim, in part, toward cost efficiency—apparatus **101** seeks “to deliver power in the most efficient way, where efficiency is defined in terms of the amount of energy used, cost, or a balance of the two.” EX1026, 5:9–18. For example, claims 1 and 23 involve determining a “marginal cost for each of a plurality of energy sources” including a “non-grid source” and “whether to store electrical energy in a battery for later use and, if such determination is made, causing such storage to occur.”

D. Overview of Baldassarre (EX1006)

66. Directed to systems with a primary and auxiliary power source, Baldassarre discloses control system **114**. Control system 114 concerns the control of loads that the auxiliary power source supplies following the interruption of grid power. EX1021, Abstract, ¶[0016], ¶[0023], ¶[0096]. Baldassarre manages electrical loads through current interrupting relays that connect and disconnect loads in response to power source conditions. EX1021, ¶[0058], ¶[0090], FIGS. 1-2. Though not depicted in its figures, the interrupting relays are physically wired in series between the power source and the loads. EX1021, ¶[0075], ¶¶[0085]-[0086], ¶¶[0089]-[0091], ¶[0094], FIGS. 1-2.



67. Baldassarre also concerns a user interface for control system 114—user interactive device 300. User interactive device 300 is a user interface that allows users to program load priorities and control the sequence in which loads are disconnected and reconnected. EX1021, ¶¶[0075]-[0076], ¶¶[0095]-[0103], ¶[0108].



E. Overview of Tsukida (EX1023)

68. 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 time the system is in an underfrequency state. *Id.* Tsukida discloses determining an underfrequency to actuate load shedding based on both frequency and voltage. *Id.*, ¶[0029]-[0041], FIG. 1-2.

VII. PETITION 1

A. GROUND 1A: The Lasseter-Lopes Combination

1. The Lasseter-Lopes Combination would have been obvious to a POSITA.

69. POSITA would have seen the benefits of combining Lasseter and Lopes, so the combination would have been obvious. That this is apparent is clear from Lopes’ own references to Lasseter’s work; Lopes cites multiple Lasseter papers directed to similar subject matter in the microgrid field. *E.g.*, EX1015; EX1028; EX1029.

70. Lasseter teaches controlling a power source’s frequency to adjust its output power as load conditions change. Lasseter discusses this output power control in the context of situations in which its microsources are able to provide the full steady-state power required by the connected loads. But Lasseter

acknowledges that “the combined power capacity of the microsources...is not” always “adequate to supply the total load from loads.” *Id.*, ¶[0099]. As a result, Lasseter identifies a scenario that it expects POSITA to have long understood based on conventional operation of electric power systems: scenarios where the total generation capacity cannot meet the full demand of the connected loads.

71. Based on the art at the time of invention, POSITA would have found it obvious to combine Lasseter and Lopes. It would have been obvious to ensure sufficient generation capacity for the connected loads’ expected steady-state operation while also employing a responsive load-shedding approach, like that taught by Lopes, in Lasseter’s system to temporarily disconnect lower-priority (e.g., non-critical) loads when needed. Engaging load shedding based on frequency deviations was a well-known technique to POSITA at the time, as seen in numerous examples. EX1006, 7 (“The benefits derived from such a scheme are well-known.”); EX1023, ¶¶[0002]-[0004] (“[W]hen the power system frequency drops considerably, part of loads determined in advance are shed.”).

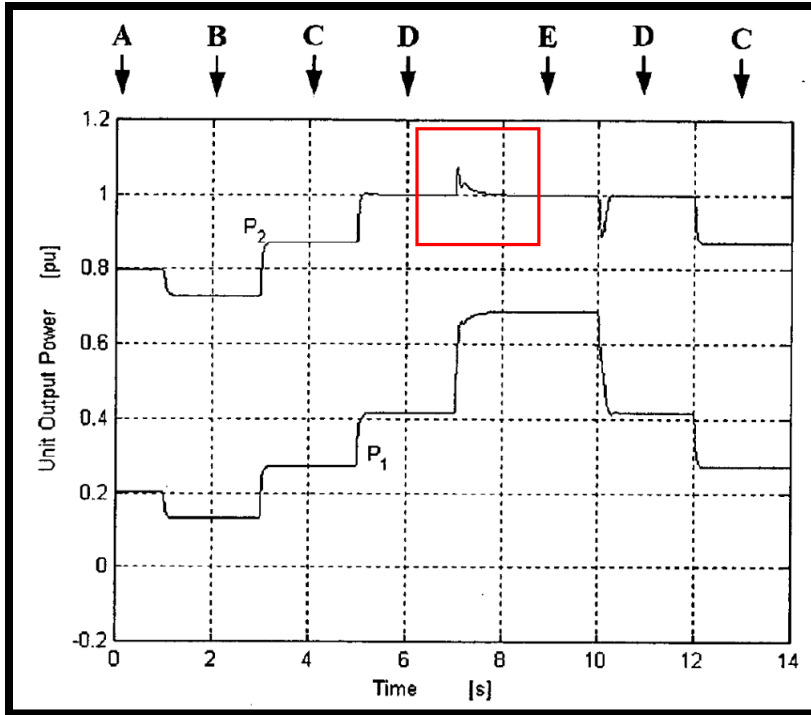
72. It would have been obvious to POSITA to designate particular frequencies at which load shedding would trigger—such as at or below Lasseter’s minimum frequency—to permit controlled frequency deviation consistent with variations in system loading. Use of such thresholds was common. EX1006, 7 (“The implementation adopted in this paper uses four steps of load shedding, each

one corresponding to a certain deviation in the system's frequency and a load reconnection implemented in small steps after frequency improvement."); *id.*, Table 1; EX1023, ¶[0004] ("[L]oad shedding at the time of drop of the power system frequency is performed in such a way as follows: limit values for a plurality of levels are set in advance and when the power system frequency drops below the limit value of a first level, part of loads determined in advance are shed."); *id.*, FIG. 3; EX1005, FIG. 25(a). POSITA would have been motivated to combine Lasseter with Lopes' frequency-deviation-load-shedding strategy for multiple reasons.

73. **First**, the recognition of under-frequency overload conditions and the absence of further detailed discussion in Lasseter about addressing situations where there is inadequate microsource generation capacity to meet the total potential load is indicative of the fact that load shedding and control techniques have been known and in use for decades prior to the '857 patent. POSITA would have looked to Lopes and its responsive frequency-based load-shedding scheme for one example of a specific solution. POSITA would have been motivated to apply responsive load shedding, as in Lopes, instead of providing excess generation capacity, which has the drawbacks that I identify below. 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 activation threshold for load-shedding 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.*

74. Based on my experience and the ways that POSITA arranged their load shedding schemes, POSITA would have understood how to set an overload threshold of his choice, as indicated in EX1008, to trade off various criteria to optimize generation efficiency and equipment health. EX1008, 5:30-34; EX1006, 7 (requiring frequency deviations occur for a certain amount of time), EX1023, ¶[0004] (same). Because of the additional output power capability, POSITA would have understood that a threshold 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). EX1008, 5:30-32 ("As an example, the preset maximum amount of load on the standby generator 34 is 85%, although other percentages can be used."); EX1021, ¶[0117] ("If the user did not force on a load or after control system 114 has forced on a user specified load, control system 114 then determines if the auxiliary power source is at or above the middle threshold level, generally 80% or 85% of total available power, at step 434."). Lasseter depicts just this scenario in FIG. 25(a), where there is a brief, less significant excursion in power as shown, with an associated deviation in frequency:



75. Applying Lopes’ load shedding based on a threshold at or below the minimum frequency disclosed in Lasseter would simply be “a combination of familiar elements according to known methods.” That is, 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).

76. **Second**, keeping power sources with unused generation capacity online in expectation of a high load condition creates inefficiency during normal operation because power sources generally work most efficiently when running near their full load rating. EX1001, 7:29-32 (“[I]t may be desirable to control the

total load to keep the power source at or near its optimum power output to achieve high or maximum efficiency.”). Without responsive load shedding, systems must maintain more generative capacity than total potential load. But this is inefficient—typical loads do not constantly operate at maximum power, resulting is unnecessary cost from unused generative capacity. EX1021, ¶[0054] (“Since the control system of the present invention allows the implementation of a generally smaller auxiliary or back-up generator, the user in turn is able to save on the consumption of fuel needed to generate power for the generator.”); EX1016, 1 (“Its efficiency and use of resources are also poor....Approximately 20% of the generation capacity exists to meet peak demand 5% of the time.”). There are cost, size, fuel consumption, and system complexity implications to having excess generative capacity in backup power sources. EX1001, 7:29-32 (“[I]t may be desirable to control the total load to keep the power source at or near its optimum power output to achieve high or maximum efficiency.”). In view of Lopes’ express example of load shedding for power management, POSITA would have found it obvious to ensure generative capacity was sufficient for typical operation and deploy Lopes’ load-shedding strategies in situations when Lasseter reached or exceeded its minimum frequency and maximum power output. Doing so would avoid the inefficiencies of excess generative capacity while always providing adequate power to the connected loads during typical operation.

77. **Third**, even though one could “actively enforce[]” power output limits as certain Lasseter embodiments teach, EX1005, ¶[0137], POSITA would have understood that loads may demand more power than could be provided. Lasseter describes active power limits as a “disadvantage” compared to situations with “enough generation” to power the loads. EX1005, ¶[0137]. Supplying less than demanded power is not desirable, especially for critical loads that cannot be interrupted (*e.g.*, life support). In contrast, shedding and reconnecting “less important” loads—only as needed—ensures critical loads can continue to receive power. EX1011, 4. POSITA would have been motivated to use solutions like load shedding instead of enforcing power limits in certain situations.

78. **Fourth**, that POSITA would look for solutions other than enforcing power limits is clear in situations where loads are truly critical—POSITA would have been especially motivated to employ load shedding in these situations. Hospitals are classic examples: “an interruption of power...can have life-threatening consequences.” EX1005, ¶[0007]. Under normal operation, DERs may supply both critical loads (*e.g.*, life-support machines) and non-critical loads (*e.g.*, air conditioning). *Id.*, ¶[0099]. Lasseter discloses a system that preemptively disconnects non-critical loads like air conditioning (M7) in favor of critical loads such as life support (M5, M8, M9). EX1005, ¶[0099]. But because loads vary over time, there may be periods when both critical and non-critical loads can be

adequately powered. *Id.*, ¶[0104]. In such circumstances—systems 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.

79. ***Fifth***, combining Lasseter and Lopes also ensures the disconnection techniques taught in Lasseter are employed responsively, avoiding downsides from preemptively disconnecting loads like that described by one of Lasseter’s embodiments, further motivating POSITA. EX1005, ¶[0099]. Though doing so can prevent loads from exceeding generation at times of high-power demand, preemptive load disconnection also prevents the power source from powering said loads at times of low power demand. Even if a power source cannot supply the maximum load possible, it may supply sufficient power to loads during times of low-power demand. EX1001, 7:5-22. Doing so could avoid costs and inconvenience associated with pre-emptive disconnection of lower priority loads that might include sensitive electronics with significant restart or “boot” times or manufacturing processes where interruption results in “wasted material in process that must be scrapped.” EX1005, ¶[0099]. Disconnecting low-priority loads can have drawbacks which need not be borne in all instances when a system employs Lopes’ load-shedding strategy rather than preemptively disconnecting loads.

80. ***Sixth***, power sources operate most efficiently near full loading. But power sources operating near full loading are prone to overloading. POSITA would have been motivated to maximize efficiency and load availability while protecting the system with load shedding as Lopes teaches. Lasseter and the '857 Patent agree that operating near maximum power output is typically more efficient: “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. Preemptively shedding loads may result in shedding some loads the microsource could have otherwise powered, wherein the microsource would have operated nearer to its maximum (and most efficient) power output. Employing load shedding in Lopes based on the frequency droop indicative of loading would result in a more efficient use of power resources.

81. For the combination of Lopes and Lasseter, POSITA would have reasonably expected success. The combination merely sheds loads in response to decreased frequency (something with “well-known” benefits) in the context of Lasseter’s microsource systems—systems that already decrease their frequency as a function of increased loading. EX1005, Abstract; 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. Lasseter teaches POSITA to disconnect loads when needed, and Lopes provides an example of how to do that based on the well-known technique of controlling loads based on system frequency deviations.

82. When operating at maximum output power, this combination supplies a commonsense implementation to the operating principle of Lasseter's microsources. At max-power output, further loading will not receive the demanded power. Lasseter already prescribes a minimum frequency for the max-power; Lopes supplies the obvious implementation detail that Lasseter points POSITA to: shed loads at that frequency or below rather than persist with inadequate power delivery.

83. This combination is merely recognizing Lasseter's teachings with "well-known" load-shedding techniques described in Lopes, both of which relate to the same microsource technology. 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.

2. A POSITA would have found claims 1–6, 8, 13–15, 39–43, 61–62, and 65 obvious in view of the combination of Lasseter and Lopes.

[1.pre] A power system which provides A.C. power with a controlled A.C. frequency to assist in managing the loading thereof, the power system comprising:

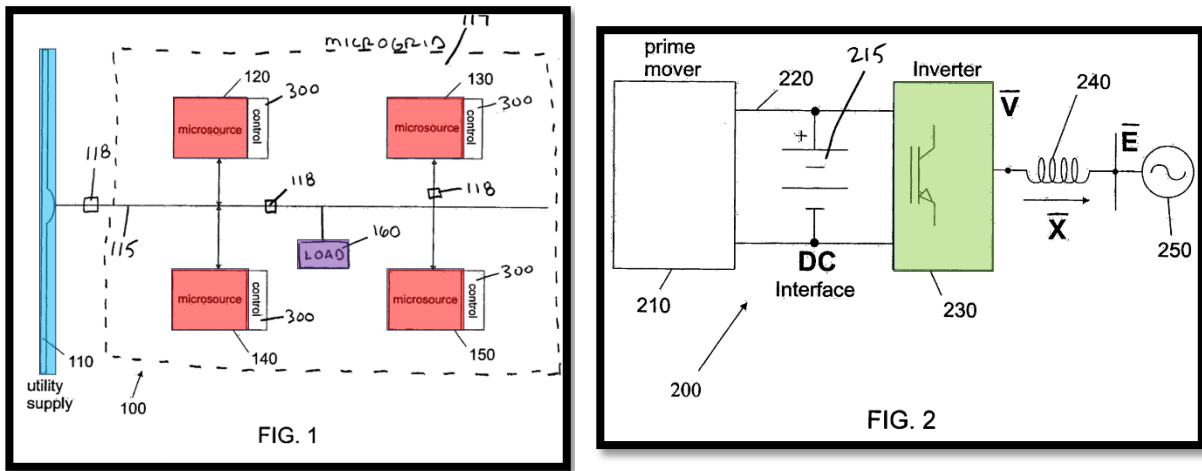
84. As Lasseter explains, its “distributed energy resource system,” or “DER,” is a *power system*. EX1005, Abstract, ¶¶[0063]-[0069], FIG. 1 (referring to DERs as a “microgrid”); EX1011, 1 (noting that “MG” stands for microgrid). According to Lasseter, DERs at least include a “microsource” that outputs “AC voltage or current at the required frequency.” EX1005, ¶¶[0010], [0015]-[0018]; [0071]-[0088]; FIG. 1.

85. Frequency is *controlled* given Lasseter’s discussion of “control schemes for controlling the instantaneous frequency...from one or more microsources.” *Id.*, ¶¶[0058], [0014]-[0018], [0142]. This control *assists in managing the* DER’s *loading*, for frequency is controlled “in response to events such as islanding or new loads.” *Id.*

[1.a] a non-utility type power source comprising an inverter which provides single or multiple phase output A.C. power to one or more of a plurality of loads, the power source having at least one maximum output power parameter which if exceeded causes an overload of the power source, the output A.C. power having an A.C. frequency, which frequency is controlled in response to the timely amount of the output A.C. power;

86. Because Lasseter distinguishes microsources (like those in Figure 1) from the utility grid throughout the specification, and because those microsources

are all depicted as having inverters (like in Figure 2)—Lasseter’s microsources are *non-utility type power sources comprising an inverter*. As seen below, Figure 1 distinguishes “microsources” 120-50 from “utility supply” 110. EX1005, FIG. 7, ¶¶[0150]-[0151], [0172]. “[M]icrosource 200...can be used in” Figure 1’s system, which “may include” a “voltage source inverter 230” (or “inverter 350”) *Id.*, ¶¶[0015]-[0018], [0069]-[0070], [0074], FIGS. 1-3.



87. The function of inverters is to invert the DC power from interface 220 to AC power in at least single or multiple phases. And so, the inverter 230/350 provides single or multiple phase output A.C. power to “one or more loads 160.” *Id.*, ¶¶[0015]-[0018], ¶[0063], ¶[0072]. Because “inverter 230 controls [the] phase of its output voltage,” it inverts the DC power from interface 220 to AC power—which “alternates” and has a frequency and phase—in at least single or multiple phases. *Id.*, ¶¶[0073]-[0074], FIGS. 1-3. All AC power is produced in one or more phases—that is, alternating voltage waveforms that vary in time—so when the

inverter outputs “AC power,” it must do so in at least one phase (single-phase) or several offset phases (multi-phase), since those are the only possible forms of AC.

88. All power sources necessarily have a maximum output power—this is an inherent feature of all microsources. Because no power source has unlimited output power, the microsources discussed in Lasseter have a ***maximum output power parameter*** that, if exceeded, would cause an overload, as defined by the ’857 patent, of the microsources.

89. Lasseter says this outright—it notes that microsources have a “maximum output power,” $P_{\max}$; they reach $P_{\max}$ “at the same time” as their “minimum operating frequency.” EX1005, ¶¶[0015], [0117]-[0118], [0130]. Lasseter explains that $P_{\max}$ is the maximum rated power of the microsource. EX1020, ¶[0112]. Because $P_{\max}$ is the maximum rated power of the microsource, $P_{\max}$ is a ***maximum output power parameter***.

90. $P_{\max}$ 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”). As a result, it is a parameter under the meaning that the ’857 patent gives to the term. $P_{\max}$ is exemplified in the ’857 Patent’s examples: “power...including maximums...instant, real time, near real time and timely.” EX1001, 10: 11-20.

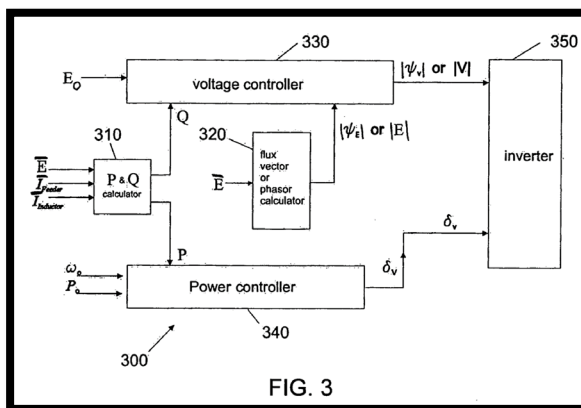
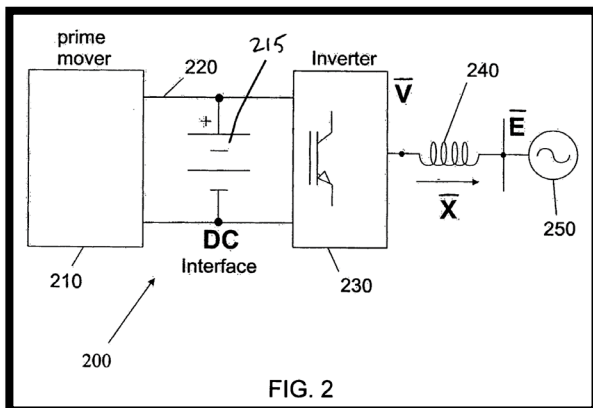
91. Lasseter's $P_{\max}$ is the threshold for an overload—*exceeding* Lasseter's microsources' $P_{\max}$ would cause an *overload of the power source* because a power source overloads when its combined load exceeds its maximum power capacity. EX1005, ¶¶[0119], [0130]; EX1008, 1:11-27, 2:14-24, 4:47-5:29; EX1011 4; EX1021 ¶¶[0021], [0026]-[0034]. This understanding aligns with the term as defined by the '857 patent, because power beyond $P_{\max}$, the rated maximum power, is “a departure from specifications for the power output from the power source” both in power and frequency.

92. Lastly, Lasseter teaches dynamically controlling inverter frequency in response to changing load conditions. It discloses “control schemes for controlling the instantaneous frequency...from one or more microsources.” EX1005, ¶¶[0057]-[0058], [0107], [0114]-[0115]. In Lasseter, frequency is controlled “in response to events such as islanding or new loads.” *Id.* The inverter's output power depends on the system's loads, which draw whatever power they require; as the total demand from those loads increases or decreases, the inverter must adjust its output accordingly. Because a system's loads determine the inverters' necessary output power, Lasseter's inverters' *frequency is controlled in response to the timely amount of the output A.C. power. Infra*, [1.b].

[1.b] a power sensing circuit which may be part of the power source or otherwise and is responsive to the timely amount of the output A.C. power, the power source operating in response to the power sensing circuit to control the frequency of the output A.C. power to have a first frequency when the

power source is not overloaded and a second frequency when the power source is overloaded or is near to being overloaded;

93. POSITA would recognize that controller **300** is a “*power-sensing circuit*” within the framework of the ’857 patent because controllers in microgrids and load management systems contain circuitry specifically designed to measure or calculate power, current, voltage, or frequency. EX1005, ¶¶[0074]-[0075]; EX1008 2:14-24, 4:47-64; EX1014, 3; EX1021, ¶¶[0027], [0075], [0090]; EX1027, 5:4-48. Controller **300** “can be used with a microsource such as that of FIG. 2,” making controller **300** is *part of the power source or otherwise*. EX1005, ¶¶[0074], ¶[0063].



94. Controller **300** is *responsive to the timely amount of the output A.C. power*. Its P&Q calculator **310** calculates *output A.C. power* “real power P being injected by the microsource” based on “instantaneous current and voltage measurements” at inverter **230**’s/**350**’s output. EX1005, ¶[0074]-[0077], FIGS. 3, 5 and 12. These measurements serve as inputs to power equations well-understood

by POSITAs of the time. EX1005, ¶¶[0072]; EX1013, 1. As one text (Scherz) describes it:

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

EX1022, 63-64.

95. Lasseter clarifies where these variables come from. “Exemplary inputs to the controller **300** can include...three measured states.” *Id.*, ¶¶[0075], [0077], [0086]. “[M]easured state variables can be 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.” *Id.*, ¶¶[0014], [0075].

96. POSITA would have understood that these “instantaneous” measurements result in a power computation for A.C. power that is “timely” because: (1) “instantaneous” data enables rapid (timely) control, EX1005, ¶¶[0074], [0104]; EX1016, 2-4; EX1020, ¶¶[0058], [0074]; (2) the system must respond in “real time” to state variations, EX1021, ¶¶[0022], [0025], [0097], [0100]; (3) the Lasseter-Lopes system identifies sources like fuel cells that respond slowly, and provides for “power storage” to quickly provide “energy balance when loads are added.” EX1005, ¶¶[0067], EX1020, ¶¶[0052]; EX1016, 2-4. POSITA understands that this quick response or balancing requires “timely” computation of

power demand. In this context, “instantaneous” means measured and used in real or near-real time. The ’857 patent defines “timely” as “instant, real time, close to real time or a suitable time.” EX1001, 25:60-66. Based on this definition, the calculated *output A.C. power* is *timely*—it is based on “instantaneous current and voltage measurements” and is used to control “the instantaneous operating frequency ω_i of the inverter” and so “instant, real time, close to real time or a suitable time.” EX1005, ¶[0075].

97. Further, when “reducing the operating frequency of the inverter to increase [their] unit output power,” Lasseter’s microsources *operate in response to* controller **300**. EX1005, Abstract, ¶¶[0015]-[0018], [0075], [0107], [0111]. Controller **300** includes “power controller **340** in FIG. 3,” which “uses...the measured power P_{meas} ,” *i.e.*, Real Power P , “to control the instantaneous operating frequency ω_i of the inverter.” *Id.*, ¶¶[0075], ¶[0105]-[0107]. As shown in Equation 8, when P_{meas} exceeds power-set point, P_0 , frequency decreases from its *first frequency* ω_0 .

98. As a clarifying note, Figure 3 depicts power controller **340** receiving the following inputs: ω_0 , P_0 , and Real Power P 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 FIG. 12 adds the “measured” subscript, Lasseter explains that Real Power P is calculated by P&Q calculator **310** based on measurements.

EX1005 ¶[0073], ¶[0077]. Real Power P and P_{meas} are the same thing. 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. FIG. 12 shows a controller for the system of FIG. 3 for maintaining inverter frequency as a function of commanded power P_0 :

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

99. Lasseter’s FIGS. 14-17 illustrate various approaches for commanding power and the associated operating frequency of the inverter or microsource. In every case, a “min” frequency is associated with a “max” power delivered by a microsource. When “in-between,” the microsource is illustrated as operating at a nominal operating frequency ω_0 .

100. Microsource operation at this *first frequency* ω_0 indicates a microsource is not overloaded (as defined by the ’857 patent). Instead, microsources operating at ω_0 are operating within their rated power specification—within P_{min} and P_{max} . EX1005, FIGS. 14-17. In other words, POSITA would have understood, or found obvious, that 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.”

101. Finally, when the microsource exceeds its “maximum power,” P_{max} , (i.e., where “load exceeds the aggregate power capacity of the units”), the

microsources decrease their frequency below their “minimum operating frequency.” EX1005, ¶¶[0118]-[0119], [0141], FIGS. 14-17; *see above* [1.a]. This constitutes an ***overload***, as defined by the ’857 patent, and the frequency below the minimum frequency is ***a second frequency***.

102. As I discuss above, microsources operating beyond $P_{\max}$ are overloaded. EX1011, 4, 5, 8 (overload). Lasseter similarly teaches when the microsource reaches $P_{\max}$, *i.e.*, ***near to being overloaded***, the frequency drops to the “minimum operating frequency,” *i.e.*, also ***a second frequency***. EX1005, ¶¶[0015], [0117]-[0118], [0130].

[1.c] a processor circuit comprising one or more processors responsive to the output A.C. power, the processor circuit operating in response to the occurrence of the second frequency to control the output A.C. power consumed by at least one load of the one or more loads thereby helping to prevent or alleviate an overload of the power source.

103. An algorithm for “shedding” loads is supplied by Lopes, which applies to “controllable loads” and operates “based on the amplitude of frequency deviation.” EX1011, 4-5. Load shedding ***controls the output A.C. power consumed by the load***, for load shedding “[a]llow[s] a temporary disconnection of less important loads.” *Id.* Shedding these loads can rectify an “high imbalance between local load and generation,” ***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.*

104. Lopes' load-shedding algorithm is triggered by (i.e., ***is responsive to***) "the amplitude of the frequency deviation," which is a function of changes in ***output A.C. power***. The magnitude of the frequency deviation specifies "a certain amount of load" to be "automatically shed through the activation of under-frequency load shedding relays" based on the "frequency deviation," i.e., ***the second frequency***. EX1011, 6. As I note above, POSITA would have been motivated to implement Lopes with specified frequency deviations that correspond to a given microsource's minimum frequency and below. *Id.*, 3, FIG. 4.

105. Lopes' load-shedding algorithm is implemented on "controllers located at loads or groups of loads [load controller (LC)]" and "under-frequency relays." EX1011, 1, 2, 4, 6, FIG.1. These constitute ***a processor circuit comprising one or more processors*** because they execute control logic—monitoring frequency and disconnecting loads when a certain threshold is met—using processing elements such as microcontrollers, logic circuits, or analog controls as would all be well-known to POSITA. EX1011, 1, 2, 4, 6, FIG.1. Regardless, processor circuits were well known and their benefits well understood, particularly in the context of loading shedding. EX1021, ¶[0025], EX1024, 2:8-14, 3:30-66, EX1025, 2:55-59, 3:60-4:23, 4:65-5:15, and EX1027, Abstract, 6:41-55, 7:1-10. It would also have been obvious to implement Lopes' load-shedding algorithm on a

processor circuit to benefit from the speed and convenience of modern computing and control systems.

[2.] A power system as claimed in claim 1 wherein when the one or more loads demand more power than the inverter can produce, the power source changes the A.C. power output frequency from the first frequency to the second frequency to signal the processor circuit to shed one or more of the plurality of loads to help the power source to recover from an overload.

106. My discussion above for element [1.a] is also applicable here—when *loads demand more power than the* microsource inverter’s maximum output power, the microsource drops to its minimum operating frequency or lower—*the second frequency*. In Lasseter-Lopes, the second frequency being at or below Lasseter’s minimum frequency signals the under-frequency relays to begin shedding loads. EX1011, 4. Shedding loads would “aid frequency restoration,” *helping the power source to recover from an overload*. EX1011, 6; EX1005, ¶[0099]. This would help recover from an overload because disconnecting some loads reduces the total power demand, allowing the power source to stabilize its output frequency and voltage.

[3.] A power system as claimed in claim 1 wherein the power source is used as a backup power source when utility power fails.

107. DERs’ microsources (from Lasseter) can operate as backup power sources given that they have “island” modes that allow them to operate when disconnected from the grid. EX1005, ¶[0065]. As Lasseter explains, DERs (or microgrids) “can provide more reliable power in critical applications, as a backup

to the primary electrical supply.” EX1005, ¶¶[0007]-[0008]. “[P]ower sources can...provide backup to their owners when the main power grid is unavailable.”

Id. POSITA would have understood that the DER is a backup power source because it can operate in islanding mode and provide power locally. EX1011, 1; EX1014, 7-8; EX1016, 1; EX1021, ¶¶[0004], [0016], [0023]; EX1028, 8-9; EX1029, 1-2. Because Lasseter’s DER architecture includes microsources capable of independent operation—through inverter-based control and islanding capability—POSITA would have understood that these same microsources can continue supplying local loads when the grid is disconnected, thereby functioning as backup power sources. *Id.*

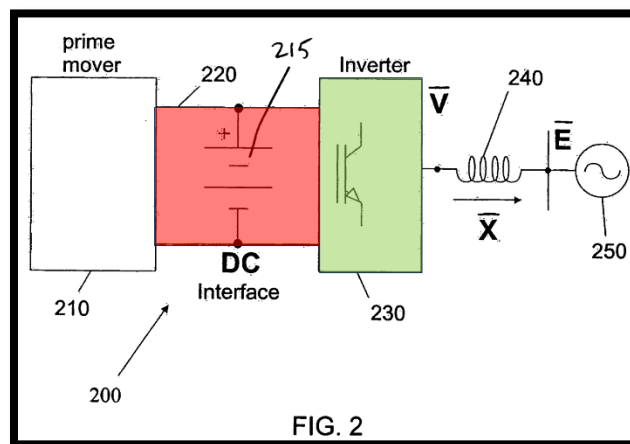
[4.] A power system as claimed in claim 1 wherein the inverter is responsive to power provided by a generator comprising an internal combustion engine to provide the output A.C. power.

108. “[M]icrosource control methods...can be used to control *inverter* interfaces found in...*internal combustion engines*.” EX1005, ¶¶[0069], [0064] (microturbine).

[5.] A power system as claimed in claim 1 wherein the inverter is responsive to at least one rechargeable battery to provide the output A.C. power.

109. Lasseter indicates that “microsource **200** may also include **power storage 215**, for example a **battery**.” EX1005, ¶¶[0070]-[0071], [0010], [0064]. POSITA would have understood or found it obvious that Lasseter’s batteries are *rechargeable*, given the battery’s position between the prime mover and inverter

suggesting the prime mover's power supplies or recharges the battery. EX1005, ¶[0070]-[0074], FIG. 2. Additionally, it would have been obvious to use a rechargeable battery in Lasseter's DER because they were often employed in similar systems. EX1001, 5:36-46 ("The control of battery charging current, especially in large battery arrays used with electric and hybrid vehicles and the like is well known in the art. For example U.S. Patent Application Publication 2010/0134073."); EX1007, 18, 31; EX1022, 100-103; EX11020, ¶[0014]-[0016] (implying that batteries serving as "storage" can hold charge generated by the system); EX1006 (same). Because **battery 215** is the "DC Interface" outputting power to the **inverter 230/350**, *the inverter is responsive to the battery* in generating AC power from the battery's DC power. *Id.*



110. Because **battery 215** is the "DC Interface" outputting power to the **inverter 230/350**, *the inverter is responsive to the battery* in generating AC power from the battery's DC power. *Id.*

[6.] A power system as claimed in claim 5 wherein the power system controls the charging of the at least one rechargeable battery.

111. POSITA would have understood that the controller **300** controls the amount of power flowing out of the prime mover **210** and through the inverter, and thus into and out of the battery **215** because the controller output governs the direction and magnitude of power exchange between the source and the battery. EX1005, ¶[0074] (voltage controller **330**, power controller **340**). The flow of power into and out of the battery affects charging—and so, POSITA would have understood or found it obvious that the power controller **300** *controls charging* of the *battery* in connection with its control of power to the inverter and its inverter control. EX1001, 5:36-46 (“The control of battery charging current, especially in large battery arrays used with electric and hybrid vehicles and the like is well known in the art. For example U.S. Patent Application Publication 2010/0134073.”); EX1007, 18, 31; EX1011, 5; EX1006, 5-6.

[8.] A power system as claimed in claim 6 wherein the power system controls the charging of the at least one rechargeable battery from at least one solar panel.

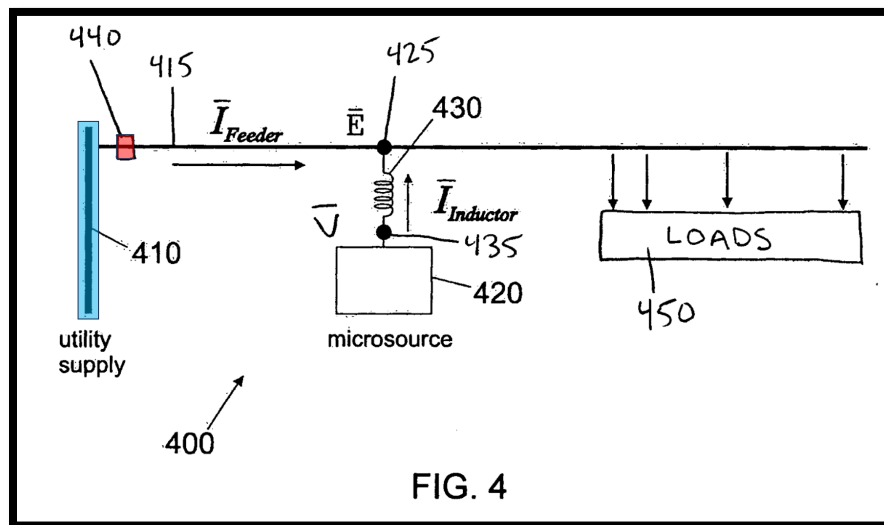
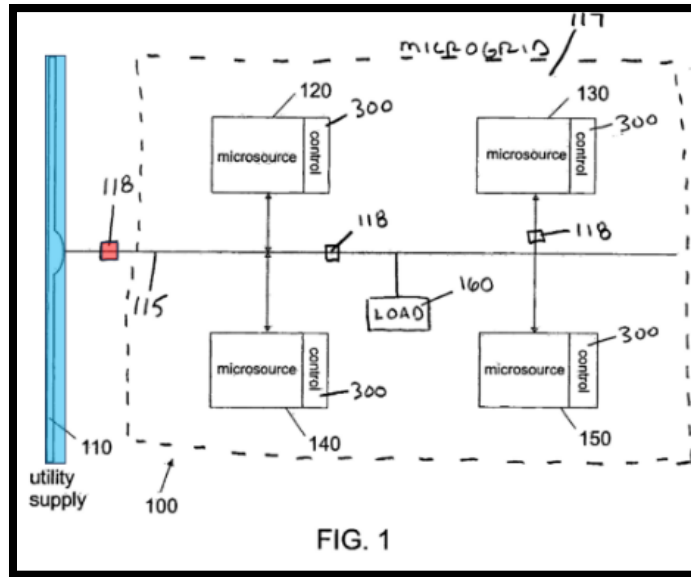
112. “The prime mover **210** can be...[a] PV.” *Id.* And as used in Lasseter, PV stands for “photovoltaic array.” EX1005, ¶[0064]. POSITA would have understood Lasseter’s reference to a “photovoltaic array” to be *solar panels*—the use of solar panels in photovoltaic arrays was ubiquitous at the time and the terms were often used interchangeably. EX1006, 10; EX1014, 5; EX1022, 142, 210, 224-

25. *See id.*, ¶[0064]; EX1001, 38:45-59 (“Solar panel **50** has a power output via connection **51** which is connected with the output of transfer switch **47** to provide power to the loads as is well known in the art, e.g. it is synchronized to and paralleled with the power from transfer switch **47**.”).

113. Controlling battery charging current was also well known in the art. EX1001, 5:36-46 (“The control of battery charging current, especially in large battery arrays used with electric and hybrid vehicles and the like is well known in the art. For example U.S. Patent Application Publication 2010/0134073.”). And so, the battery in Lasseter is charged from at least one solar panel. *Id.*

[13.] A power system as claimed in claim 1 further including a transfer switch which may select a power grid or the power source to provide power to the one or more of a plurality of loads, the transfer switch outputting power from the grid power meets acceptable parameters and to output power from the power source when the grid power does not meet acceptable standards.

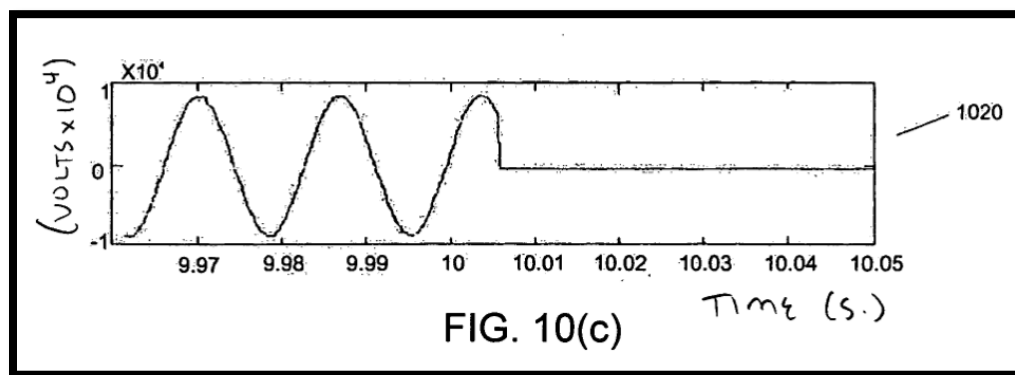
114. Lasseter’s “one or more **interface switches 118**” are the *transfer switches* that “can be positioned between the feeder line **115** and the **main utility supply 110** so that...microsource systems” **120-50** and “one or more loads **160**, can be isolated from the utility supply **110**.” EX1005, ¶¶[0065], [0066].



115. In the alternative, “FIG. 4 is a diagram of the state variables in an exemplary distributed energy resource system, such as that of FIG. 1.” EX1005, ¶[0023]. As Figure 4 shows, “switch 440 [transfer switch] that can be opened to isolate the microsource 420 and loads 450 from the utility supply 410.” EX1005, ¶[0084].

116. Looking at one of Lasseter’s examples (Figure 7) is instructive. This example “illustrate[s] the dynamics of the microsource controls described with reference to FIGS. 1-6.” EX1005, ¶[0091]. In Figure 7, Lasseter explains that systems 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*) switches from *meeting acceptable parameters* (supplying power at a constant voltage and frequency) to *not meeting acceptable parameters* (not doing so). *Id.*, ¶[0101].

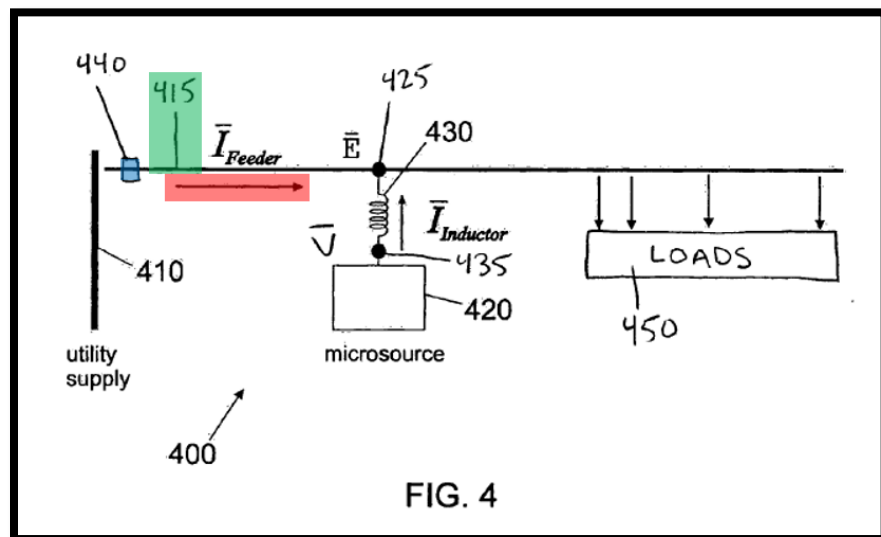
117. As the ’857 patent defines them, voltage and frequency are parameters—each is “a quantity of...[an] attribute” of the utility grid power, *i.e.*, the voltage or frequency, “which is treated as constant” throughout in Figure 10(c) until “loss of power.” EX1005, ¶[0029], [0100]-[0101], FIG. 10(c).



[14.] A power system as claimed in claim 1 further including a transfer switch which may select a power grid or the power source to provide power to the one or more of a plurality of loads, the transfer switch outputting power from the power grid when grid power meets acceptable standards and may output

power from the power source when the grid power does not meet acceptable standards, the power sensing circuit of b) comprising one or more current sensors electrically located to sense current output from the transfer switch.

118. My discussion above for claim [13] is also applicable here. Controller 300 (*power sensing circuit*) includes power controller 340. EX1005, FIG. 3. Power controller 340 is discussed above in connection with unit power control, but “power controller 340 in FIG. 3, can be classified into...a mixed system using both unit power control and zone power control,” too. EX1005, ¶[0105]. When operating the zone power control scheme in such a mixed configuration, I_{Feeder} would be used to calculate real power. EX1005 ¶¶[0075]-[0077]. I_{Feeder} “can be obtained from instantaneous voltage or current measurements that can be made locally.” EX1005, ¶[0075]. I_{Feeder} is the “time varying current in the feeder” 415 output from “switch 440.” EX1005, ¶[0075], ¶[0084], FIG. 4.

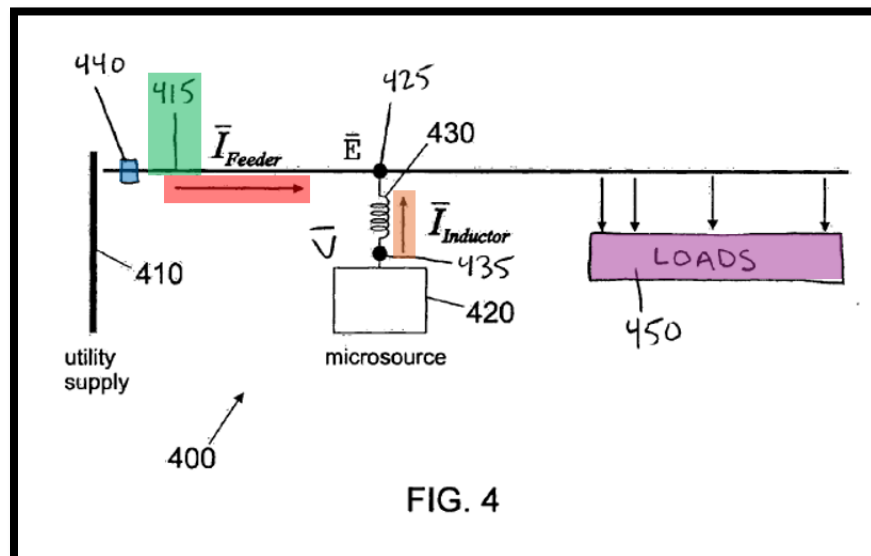


119. Lasseter's microsources or DERS are capable of "importing power from the grid" or "exporting power to the grid." EX1005, ¶¶[0111]-[0116], [0124], [0134]-[0136], [0139]-[0140], FIGS. 14-17. In a DER that is importing power, POSITA would have understood or found it obvious that controller **300 senses current I_{Feeder} output from switch 440** with *a current sensor* on the path through which current would flow into the DER because controllers in these systems measure "feeder" current (i.e., current entering from the switch). EX1005, ¶¶[0063]-[0066], [0075]-[0077]; EX1005, ¶¶[0056]-[0057], [0063]; EX1009, 3:33-55. As shown in FIG. 4, current I_{Feeder} flows through switch **440** and into the microgrid loads via the feeder line **415**. Placing a current sensor on this path provides a direct measurement of the current entering the system from the utility supply **410**. An additional current sensor is similarly provided in Lasseter for each microsource, sensing " $I_{Inductor}$ " as shown in the figure (the current flowing from the microsource(s)). Both sensed current measurements, i.e., measurements of I_{Feeder} and $I_{Inductor}$, are made available to the microsource power calculator and therefore to the power controller.

[15.] A power system as claimed in claim 1 further including a transfer switch which may select a power grid or the power source to provide power to the one or more of a plurality of loads, the transfer switch operating to select the power grid when grid power meets acceptable standards and to select the power source when the grid power does not meet acceptable standards, the power sensing circuit of b) comprising one or more current sensors electrically located to sense current output from the transfer switch and thereby are responsive to the amount of current being provided to the one or more of a

plurality of loads by the power grid when the transfer switch selects the power grid and to sense the amount of current being provided to the one or more of a plurality of loads by the power source when the transfer switch selects the power source.

120. My discussions above for claims [13] and [14] are also applicable here. The current I_{Feeder} from utility supply 410 (*power grid*) is *provided to loads 450* when *switch 440* is closed (*when power grid is selected*). EX1005, FIG. 4. When switch 440 is closed, it electrically connects the utility supply line 410 to the feeder line 415. As a result, the feeder current I_{Feeder} flows from the grid through the feeder 415 and along line 430 to the loads 450. The current sensor located to sense current output from *switch 440* is *responsive to the amount of current being provided to loads 450* because it measures said amount of I_{Feeder} passing through *switch 440*.



121. After opening **switch 440** (*when the transfer switch selects the power source*), controller **300** *senses the amount of current I_{Inductor} being provided to loads 450 by microsource 420*. POSITA would have understood or that controller **300** *senses current I_{Inductor}* with a second of the *one or more current sensors* on the path through which current in FIG. 4 would flow into **loads 450** because these types of current sensors were commonly used in applications where it would be advantageous to sense current for a controller. EX1021, ¶¶[0090], EX1007, 40-42, 49.

122. The transfer switch **440** effectively works to “select the power grid when the grid power meets acceptable standards and to select the power source when the grid power does not meet acceptable standards.” Disconnecting the connection to the power grid initiates power production commanded from the microsources, effectively transferring power from the grid to the microsources. Lasseter teaches that transfer switches like **440**, similarly shown as switch **118** in Lasseter FIG. 1, “can be positioned in other places, for example between portions of the microgrid **117**, or between a particular microsource and the feeder line **115**, thereby allowing a portion of the microgrid or a particular microsource to be operated in either island mode or grid mode.” EX1005, ¶[0066]. That is, Lasseter teaches that “interface” or transfer switches can be arranged in a variety of ways

well known to POSITA to transfer power delivery to the loads from the grid to the microsources or a combination thereof.

[39.pre] A power system which provides AC power with a controlled AC frequency to assist in managing the loading thereof, the power system comprising:

123. My discussion above for element [1.pre] is also applicable here.

[39.a] a non-utility type power source having one or more inverter which provides single or multiple phase output AC power to one or more of a plurality of loads, the power source having at least one power system parameter which if exceeded indicates an actual or potential overload of the power source, the output AC power having an AC frequency, which frequency is controlled in response to a timely amount of a parameter of the power source;

124. My discussion above for element [1.a] is also applicable here. The *power system parameter* is $P_{\max}$ and the *parameter of the power source* is P_{meas} . Both are parameters, as defined by the '857 patent, because each is “a quantity of...[an] attribute” of the microsources, *i.e.*, the maximum or measured rated power, “which is treated as constant” throughout Lasseter ($P_{\max}$) and in a given instant (P_{meas}); EX1020, ¶[0112] (“Pmax is the maximum rated power of the machine.”). Both are exemplified in the '857 Patent's examples: “power...including maximums...instant, real time, near real time and timely.” EX1001, 10: 11-20.

125. As I discuss above in reference to element [1.a], when $P_{\max}$ is exceeded, it causes an overload. Given the causal relationship, exceeding $P_{\max}$ also *indicates* an overload.

[39.b] a sensing circuit which may be part of the power source or otherwise and is responsive to the timely amount of at least one loading parameter of the power source, the power source operating in response to the sensing circuit and the at least one power system parameter 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 is near to being overloaded;

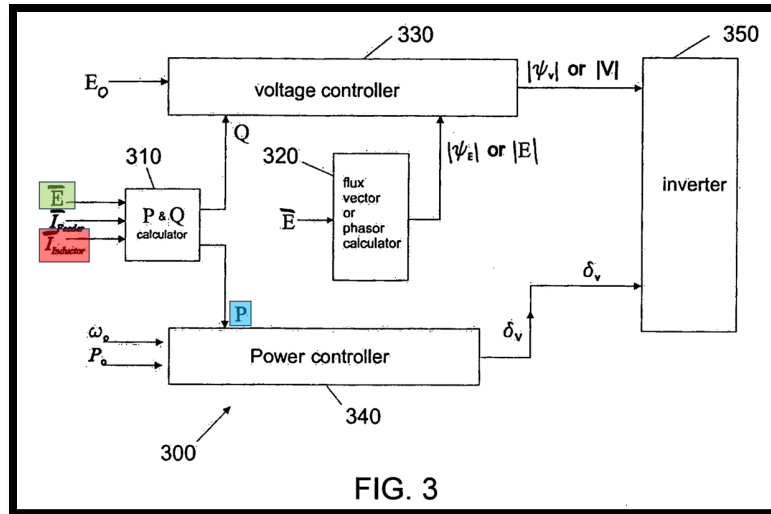
126. My discussions above for elements [1.b] and [39.a] are also applicable here.

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

127. My discussion above for element [1.c] is also applicable here.

[40.] A power system as claimed in claim 39 wherein in b) the at least one loading parameter is a voltage of the output AC power.

128. **System voltage E** is *a voltage of the output AC* to which controller **300** (*sensing circuit*) is responsive. “The P & Q calculator **310** can calculate...**real power** P_{meas} being injected by the microsource using the inductor current, $\bar{I}_{\text{inductor}}$.” EX1011, ¶[0077]. Figure 3 shows **system voltage E** as the voltage input to calculator **310** that calculates P_{meas} :



Based on calculator **310**'s available inputs, **system voltage E** is the *voltage of the output AC power* used with $\bar{I}_{\text{inductor}}$ to calculate P_{meas} (to which frequency control is responsive), where **system voltage E** would correspond to "V" in the textbook (EX1022) equation below. EX1005, ¶[0077], ¶[0190], FIGS. 1-4, 12.

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

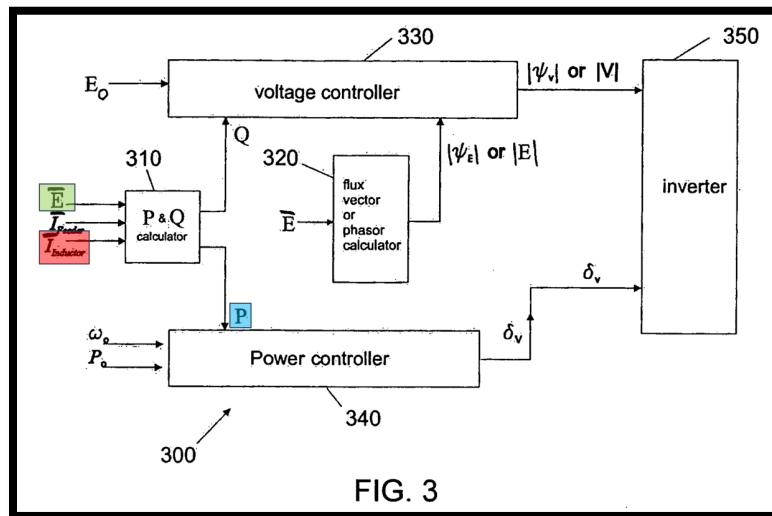
129. EX1022, 63-64. Because controller **300** operates in response to P_{meas} to change frequency, (as I discuss above for elements [39.a]-[39.b] and [1.b]), and because P_{meas} changes based on **system voltage E**, controller **300** is responsive to the *timely amount of voltage of the AC power system voltage E*.

130. As defined by the '857 patent, **system voltage E** is *timely*—it is determined via "instantaneous voltage measurements," *i.e.*, "instant, real time, close to real time or a suitable time." EX1005, ¶[0075].

[41.] A power system as claimed in claim 40 wherein in a) the at least one power system parameter is an amount of voltage and when in b) the voltage of the output AC power is less than the voltage amount the frequency of the output AC power is controlled to have the second frequency.

131. System voltage E (*the voltage of the output AC power*) is compared to *the power system parameter*, E_{P0} (E_{P0} *being the voltage amount* corresponding to P_0 at a given $\bar{I}_{inductor}$). EX1005, ¶[0075].

132. Calculator 310 is part of controller 300. EX1005, FIG. 3. And “calculator 310 can calculate...real power P being injected by the microsource using the inductor current, $\bar{I}_{inductor}$.” EX1011, ¶[0077]. Figure 3 shows system voltage E as the voltage input to calculator 310 that calculates P_{meas} :



133. Based on calculator 310’s available inputs it being the sole voltage measurement, POSITA would have understood or found obvious to use system voltage E as the *voltage of the output AC power* with $\bar{I}_{inductor}$ to calculate P_{meas} because the quantities are directly related using formulas that were commonly

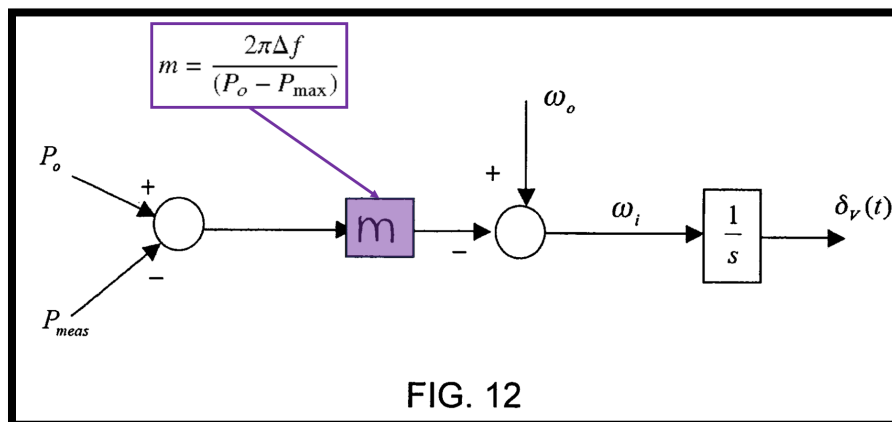
known. EX1005, ¶[0072], ¶[0077], ¶[0190], FIGS. 1-4, 12; EX1013, 1; EX1022, 63-64. For example, the author of Exhibit 1022 quotes the following equation that relates the three:

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

134. POSITA would have understood that P_0 and P_{max} *include voltage amounts* E_{P_0} or E_{max} —which are thus *power source parameters corresponding to the maximum output power*—for a given current $\bar{I}_{\text{inductor}}$ because power is a function of voltage and, as I explained above, the three quantities are related. *Id.*

135. Controller **300** compares P_{meas} , P_0 , and P - ω slope m (which is a function of P_{max} , EX1005, Eq. 9) to control frequency as shown in Equation 8 and Figure 12:

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



136. Lasseter ties maximum power delivery to minimum frequency, and a higher frequency at less than maximum power, e.g., in FIGS. 14-17. Voltage directly impacts the power delivery calculation. Hence, Lasseter's measurement of voltage sets the output power and therefore the output frequency. A change in operating or system voltage E will lead to operation at a second output frequency in Lasseter's microsources.

137. In the alternative, P_{meas} and P_0 (*power source parameter*) include *voltages* of the output AC power. P_{meas} and P_0 are compared. I explain this further in my discussion above for element [1.b].

[42.] A power system as claimed in claim 39 wherein in b) the at least one loading parameter is a current of the output AC power.

138. My discussion above for element [1.b] is also applicable here.

[43.] A power system as claimed in claim 42 wherein in a) the at least one power system parameter is an amount of current and when in b) the current of the output AC power is greater than the current amount the frequency of the output AC power is controlled to have the second frequency.

139. My discussion above for elements [1.b] and [40] are also applicable here. Although Lasseter describes P_{max} in terms of power, POSITA would have understood that it could be described in terms of voltage and/or current because, as I described in the above-mentioned elements, the three quantities are directly related following the below equation:

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

140. As a result, when (as in Lasseter) one knows $P_{\max}$ and the operating voltage, one also knows the maximum current that the microsource is injecting: $\bar{I}_{\text{inductor}}$ at $P_{\max}$. When Lasseter is controlling frequency, based on power, to be the second frequency, it is doing so when a current of the output AC power is greater than current of the power system parameter. EX1005, ¶[0016] (“Another embodiment of the invention relates to a method of controlling the output inverter of a microsource in a distributed energy resource system, using a unit power controller that reduces the operating frequency of the inverter to increase its unit output power, with the rate of change of frequency vs. power having at least two different values over the operating range of the inverter.”).

141. Lasseter ties maximum power delivery to minimum frequency, and a higher frequency at less than maximum power, e.g., in FIGS. 14-17. Current directly impacts the power delivery calculation. Hence, Lasseter’s measurement of current sets the output power and therefore the output frequency. A change in output current at a given system voltage E will lead to operation at a second output frequency in Lasseter’s microsources.

[61.pre] A power system which provides AC power with one or more controlled power parameters to assist in managing the loading thereof, the power system comprising:

142. My discussion above for element [1.pre] is also applicable here. Lasseter further describes “control schemes for controlling the instantaneous

frequency...from one or more microsources,” which frequency (ω_i) is a ***controlled power parameter***. EX1005, ¶[0058]. Frequency is a parameter, as defined by the '857 patent, because it is “a quantity of...[an] attribute” of the microsources, *i.e.*, the rate of oscillation of the sinusoidal AC waveform, “which is treated as constant” throughout Lasseter. Though microsources change their frequency, a “parameter may at times change or be adjusted.” EX1001, 10: 11-20.

[61.a] a non-utility type power source comprising an inverter which provides single or multiple phase output AC power to one or more of a plurality of loads, the power source having at least one maximum power source parameter which if exceeded for a specified period of time may cause a loss of output AC power or damage to the power source, the output AC power having one or more timely power parameter, including AC frequency, which may be changed;

143. My discussion above for element [1.a] is also applicable here. Lasseter’s “maximum output power,” $P_{\max}$, provides the ***maximum power source parameter*** because all power sources inherently have a maximum power parameter that ***if exceeded for a period of time*** may cause a ***loss of power or damage*** the power source. POSITA would have understood that to be Lasseter’s $P_{\max}$ or would have found it obvious to set $P_{\max}$ to that value because Lasseter seeks to avoid exceeding $P_{\max}$, which would avoid damage to the power source. EX1005, ¶¶[0119], [0130]; EX1008, 1:11-27, 2:14-24, 4:47-5:29; EX1011 4; EX1021 ¶¶[0021], [0026]-[0034]. As I discussed above with respect to element [1.a], $P_{\max}$ is a parameter.

144. Lopes deploys load shedding when “generation” is exceeded due to “high imbalance between local load and generation” for longer than a ***specified period of time***, or as Lopes calls it, a “certain time interval” because power sources could otherwise be ***damaged***. EX1011; 11, 4.

145. As the ’857 patent defines it, the frequency power parameter identified in my discussion of element [61.pre] is ***timely***, given that it is the “instantaneous frequency,” *i.e.*, “instant, real time, close to real time or a suitable time.” EX1005, ¶[0058]. Because said frequency is “controlled,” it ***may be changed***. *Id.*

146. The microsource’s power output itself is another ***power parameter***, calculated from “instantaneous voltage [and] current measurements” (P_{meas}). EX1022, 64.

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

147. Because it is calculated from “instantaneous” measurements, it is ***timely*** as the ’857 patent defines the term, *i.e.*, “instant, real time, close to real time or a suitable time.” EX1005, ¶[0075]; also see above [1.a]-[1.b], [39.a]-[39.b]. In Lasserter, the power output ***may be changed***. *Id.* Power output (P_{meas}) is a function of output frequency, so it ***includes AC frequency***. (“ $P=VI^* \cos \phi$ ”).

148. Another *power parameter* includes “ I_{inductor} , the time varying current injected by the microsource.” EX1005, ¶[0075]. I_{inductor} is a parameter as defined by the ’857 Patent because it is “a quantity of” an output power “which is treated as a constant” throughout Lasseter within its calculations. Timely current is one of the ’857 Patent’s express example of a parameter. EX1001, 10:11-20. I_{inductor} is *timely* as defined in the patent because measurements for it are “instant, real time, close to real time or a suitable time,” *id.*, given that they are based on “instantaneous current and voltage measurements” at inverter 230’s/350’s output. *Id.*, ¶[0074]-[0077], FIGS. 3, 5 and 12.

[61.b] a power sensing circuit which may be part of the power source or otherwise and is responsive to the timely power parameter, the power source operating in response to the power sensing circuit and the maximum output power parameter to control the frequency of the output AC power to indicate the loading of the power source;

149. My discussion above for element [1.b] and [39.b] is also applicable here. Microsource (the *power source*) *operates in response to* its controller 300 (*power sensing circuit*) to “reduce[] the operating frequency of the inverter to increase its unit output power” (*to control the frequency of the output AC power*). EX1005, ¶[0015]; *See above* [1.b]. In so doing, the microsource *indicates* the power output by the microsource (*the loading of the power source*) by changing frequency to reflect the power load, *e.g.*, “maximum output power” with “minimum operating frequency.” EX1005, ¶[0015]; *See above* [1.b].

150. As I discuss above in the context of element [61.a], controller **300** (*power sensing circuit*) is responsive to *timely power parameters* I_{inductor} , P_{meas} , and frequency. In particular, calculator **310** of controller **300** calculates P_{meas} using, among other things, $\bar{E}$ and I_{inductor} , and determines the output frequency of the inverter (ω_i) based on P_{meas} . *See above* [1.b]. P_{meas} is also a function of the output power's frequency. EX1005, Eq. 8. The power controller **340** of controller **300** changes frequency (ω_i) based on P_{meas} and the P- ω slope m , according to Equation 8:

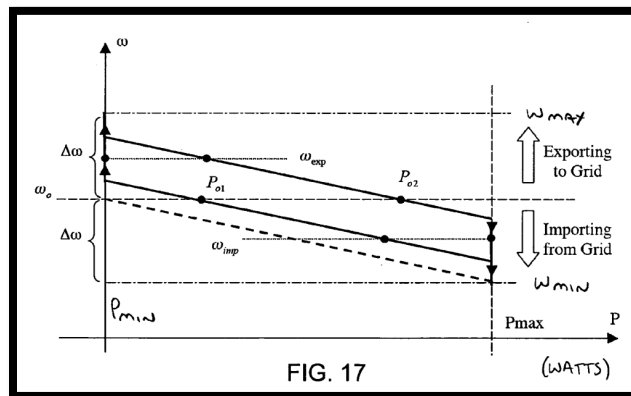
$$\omega_i = \omega_0 - m(P_0 - P_{\text{meas}}) \quad [\text{Eq. 8}]$$

151. P_{max} is also a *maximum output parameter* to which controller **300** is responsive. The P- ω slope m “is a function of...the maximum power output, P_{max} ,” (*maximum output power parameter*) and frequency (f), EX1005, ¶[0112], according to Equation 9:

$$m = \frac{2\pi\Delta f}{(P_o - P_{\text{max}})} \quad [\text{Eq. 9}]$$

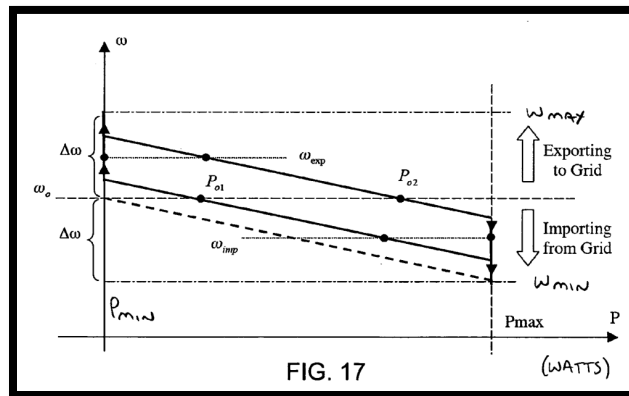
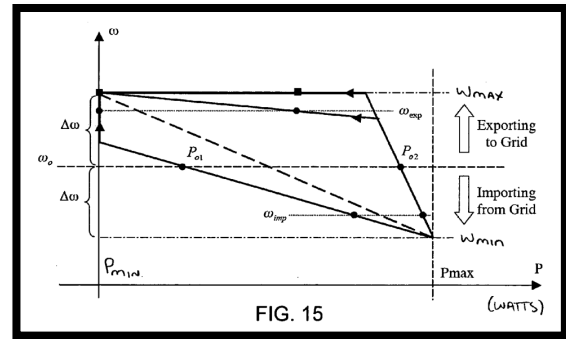
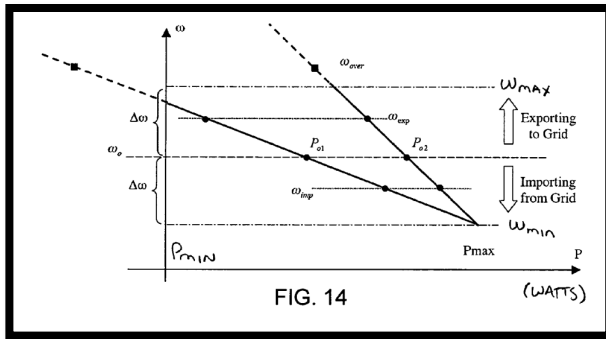
152. When P_{meas} reaches P_{max} in of Figures 14-17, controller **300**'s power controller **340** responds by setting the inverter to the minimum frequency. As a result, power controller **340** of controller **300** (*power sensing circuit*) also *operates in response* to the P_{max} (*the maximum output parameter*).

153. The relationships of Equations 8 and 9 hold in the unit control scheme of FIG. 17 until reaching $P_{\max}$. At this point, the “slope $[P-\omega]$ switches to vertical.” EX1005, ¶[0140], ¶¶[0138]-[0141]. That being so, power controller **340** of EX1005, ¶[0140], ¶¶[0138]-[0141]. That being so, power controller **340** of controller **300** (*power sensing circuit*)—when employing FIG. 17—additionally *operates in response* to $P_{\max}$ (*the maximum output parameter*) to switch the slope to vertical. The microsource (*power source*) *operates in response* to controller **300** (*power sensing circuit*) *to control the frequency of the output AC power*, which in turn operates in response to the *maximum output parameter*.



154. The microsource (*power source*) *operates in response* to controller **300** (*power sensing circuit*) *to control the frequency of the output AC power*, which in turn operates in response to the *maximum output parameter*.

155. As depicted in Figures 14, 15, and 17, changes in output frequency ω_i *indicate the loading of the power source*. EX1005, ¶¶[0033]-[0036], ¶[0110], ¶¶[0114]-[0115], ¶¶[0121]-[0129], ¶¶[0128]-[0140].



156. Given that Lasseter teaches changing frequency to address changes in loading, POSITA would have understood or found obvious that this change in frequency *indicates* loading. One need only look to Lopes for proof—Lopes' under-frequency relays function on the premise that frequency droops indicate an overload at certain thresholds. EX1011, 4, 6. This relationship was well-understood at the time of the invention. EX1009, 1:25-39; EX1024, 1:6-29; EX1006, 5; EX1014, 6.

[61.c] a processor circuit comprising one or more processors responsive to the frequency of the output AC power to control the coupling of power to at least

one load of the one or more loads thereby helping to prevent or alleviate an overload of the power source.

157. My discussion above for element [1.c] is also applicable here. Given that they “shed[]” loads “based on the amplitude of frequency deviation” of the microsources (*power sources*), the under-frequency relays in Lopes (*processor circuits*) are *responsive to the frequency of the output AC power*. EX1011, 4-5.

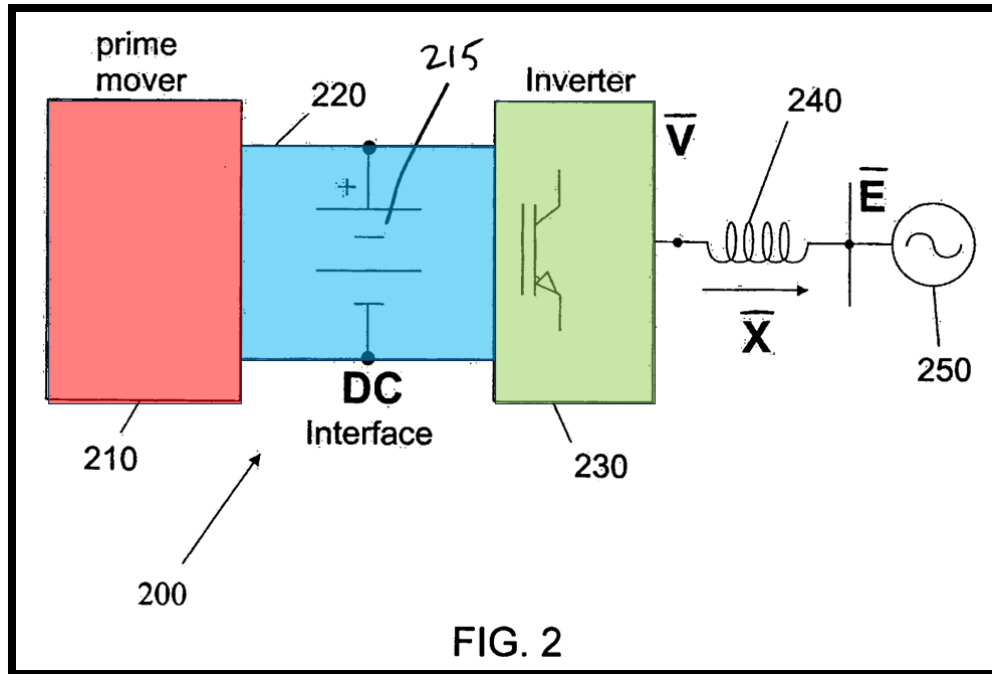
[62.] A power system as claimed in claim 61 wherein the processor circuit of c) is a physically distinct device contained in its own enclosure and not physically part of the power source of a), the processor circuit c) being physically wired to the power source output to receive the output AC power, and physically wired to the at least one load of the one or more loads, the processor circuit operating to controllably couple power from the power source output to the at least one load.

158. My discussion above for claim [2] is also applicable here. Because they are located at the loads themselves, the LCs and under-frequency relays from Lopes (*processor circuits*) are *physically distinct*. EX1011, 2-4, 6, FIG. 1. Given the basic function of relays and load shedding generally POSITA would have understood or found obvious that the LCs and under-frequency relays are *physically wired* between the microsources (*power sources*) and the loads because they “make” or “break” the electrical connection in a wire to permit or prohibit the flow of current from a power source to a load. EX1008, 2:1-6, 8:1-14; EX1021, ¶[0094]; EX1001, 6:3-7 (“Load shedding is well known in the prior art, for example a system is described in the Rodgers et al. U.S. Patent Application Publication 2005/0116814.”). Additionally, POSITA would have known the LCs

and under-frequency relays are physically wired because it was well-known that these types of relays are wired or coupled to sources and loads. EX1021, ¶¶[0084]-[0089]; EX1008, 7:1-19;

[65.] A power system as claimed in claim 61 wherein in a) the one or more inverter is a DC to AC inverter and receives DC power from one or more of: i) a power grid; ii) a rechargeable power storage system; iii) a solar PV system; iv) another green renewable power system; v) an internal combustion power generator.

159. As I discussed above in reference to claims 5 and 6, *DC-to-AC inverter 230/350* receives DC power from either “*power storage 215...a battery*” (*rechargeable power storage system*). EX1001, 5:36-46 (“The control of battery charging current, especially in large battery arrays used with electric and hybrid vehicles and the like is well known in the art. For example U.S. Patent Application Publication 2010/0134073.”). Alternatively, it receives DC power from “prime mover **210**.” EX1005, ¶[0070], FIG. 2. Prime mover **210** can include a “**PV**” (*solar PV system*) or a “*wind turbine*” (*an other green renewable power system*). EX1005, ¶[0070], FIG. 2. The inverter can also receive DC power from an *internal combustion power generator*, *See above* [4], which is an AC source that is “typically used to provide an intermediate DC voltage, that may...[be] produced indirectly from AC sources, for example by rectification.” EX1005, ¶[0010]. “*Power storage* for a microsource during island operation can come” from “use of local traditional generation” like the utility grid. EX1005, ¶[0068].



B. GROUND 1B: The Lasseter-Lopes-Miller Combination

1. The Lasseter, Lopes, Miller Combination would have been obvious to a POSITA.

160. Combining Miller with Lasseter-Lopes would have been obvious because POSITA would have recognized the benefit of the combination. As I discussed above, Lasseter discloses a method of controlling microsource output frequency to alter its output power in response to changing loads, and Lopes adds a responsive under-frequency load-shedding scheme to maintain balance between generation and load. *See above* Part VII.A. While Lasseter-Lopes addresses conditions where microsourses can meet demand through local frequency control and selective disconnection of loads, *id.*, it does not describe how to coordinate that distributed control with broader energy management functions—such as the

selection of a particular power source for charging and discharging batteries in the DER. For the reasons I explain below, it would have been obvious to configure a microsource on Lasseter-Lopes' DER with an arrangement similar to Miller's "integrated control device" that "manages the supply of energy from various sources," EX1026, 1:53-62, and its associated rechargeable batteries **105** and **106**, that coordinates selective deployment of grid, renewable, and backup power to manage battery charging and discharging. Lasseter (by the reference it incorporated in EX1005, ¶[0056]) discloses such a battery microsource. EX1020, ¶[0016] ("[T]here are two basic classes of microsources: DC sources, such as...battery storage.").

161. **First**, while Lasseter discusses using a battery as a microsource, *See above* Lasseter-Lopes [6]; EX1020, ¶[0016], Lasseter relies on the common knowledge of POSITA to know that "battery storage" (EX1020, 16) must be charged. POSITA would have looked to Miller's solution, its "integrated control device," that coordinates and manages battery charging because of the importance of batteries to the microgrid. EX1015, 2 ("Storage technologies such as batteries, ultracapacitors and flywheel play an important role. Combining storage with micro-sources provide peak power and ride-through capabilities during disturbances."); EX1016, 4 ("Sources need a fast-response energy storage module to minimize the impacts of source dynamics on the microgrid operation.").

Providing a rechargeable battery microsource on Lasseter-Lopes' DER with an arrangement similar to Miller's "integrated control device" would simply have been "a combination of familiar elements according to known methods," *i.e.*, a rechargeable battery and control device used for its intended purpose of supplying battery power to the DER and managing battery charging and discharging, to "yield predictable results," *i.e.*, ensuring the rechargeable battery is charged and able to supply power to the DER. *KSR Intern. Co. v. Teleflex Inc.*, 550 U.S. 398, 401 (2007); EX1001, 5:36-46 ("The control of battery charging current, especially in large battery arrays used with electric and hybrid vehicles and the like is well known in the art. For example U.S. Patent Application Publication 2010/0134073.").

162. **Second**, POSITA looking to maximize the use of multiple microsources (including microsources without a dedicated battery) would have been motivated to incorporate a rechargeable-battery microsource with a controller like Miller's controller **104** to maximize the system's utility by enabling battery-charging participation across all microsources, "deliver[ing] power in the most efficient way." EX1026, 5:9–18, 7:25-37.

163. **Third**, POSITA seeking to maximize efficiency would have been motivated to add a rechargeable-battery microsource with Miller's controller **104** to allow other microsources to charge a battery. As I discussed above,

microsources enjoy “better efficiencies...at this higher operating points.” EX1005, ¶[0132]. Using Miller’s controller **104** with a rechargeable-battery microsource would allow the system to employ otherwise underutilized microsources for charging, improving their efficiency under low-load conditions while storing energy for future demand.

164. **Fourth**, POSITA would have wanted to incorporate a rechargeable-battery and a controller, similar to Miller’s controller **104** with “optimization algorithm,” in Lasseter’s DERs to ensure cost-effective battery charging. EX1026, 1:53-62. Cost concerns were something POSITA considered in designing power generation systems. EX1015, 5 (“Another possibility is that each micro-source or cluster of micro-sources are dispatched locally, based on incentives such as cost of grid power, capacity charges or load management agreements.”). Miller addresses cost-effective battery charging strategies—e.g., deferring recharging until “later in the day from the power grid, when electrical costs are lower.” EX1026, 5:43-58. Combining Miller with Lasseter–Lopes ensures the system maintains frequency stability and minimizes purchased-energy cost—a recognized design objective for microgrids subject to time-of-use pricing. Miller offers additional cost advantages that would have motivated a POSITA to combine its teachings with Lasseter by enabling selective charging from renewable sources, such as wind or solar, when such power is available. POSITA would have recognized the benefits of charging

batteries only with inexpensive solar and wind energy, and of controlling charging so that grid power is not used when more costly.

165. ***Fifth***, POSITA would have been additionally motivated to incorporate Miller’s teaching of rechargeable batteries in Lasseter-Lopes’ DERs. POSITA would have looked to Miller to obtain the benefits of rechargeable batteries that can be used for many cycles. Miller teaches an exemplary list of “***storage batteries*** for storing electrical energy” for which “power from one or more of the power sources can be used to charge.” EX1026, 2:54-61, 4:4-12. POSITA would have been motivated to incorporate rechargeable batteries rather than single-use batteries, as doing so would eliminate the need for continual battery replacement. Lopes specifically acknowledges that “storage devices are absolutely essential to control strategies for MG operation in islanded mode,” EX1011, 8, so a POSITA would have recognized the importance of replenishing battery charge to prolong battery operation beyond a single useful charge. In EX1020, incorporated by reference in Lasseter EX1005, Lasseter describes “storage technologies such as batteries, ultracapacitors, and flywheels.” All of these are “refuellable” or “rechargeable,” i.e., by spinning up a flywheel, charging an ultracapacitor, or recharging a battery. POSITA would have understood that Lasseter’s “batteries” are primarily practical when they are rechargeable, as is the case for all of his cited “storage” technologies.

166. Moreover, POSITA would have reasonably expected to succeed in combining the references. The combination merely applies Miller’s supervisory “integrated control device” that “manages the supply of energy from various sources,” EX1026, 1:53-62, to known microsource configurations with various sources as in Lasseter-Lopes. Each element—e.g., controllers and rechargeable batteries—was well known and widely used in systems before the priority date. Implementing Miller’s supervisory control in Lasseter-Lopes’ distributed system would simply involve exchanging control signals between known interfaces and using known techniques to dispatch sources for charging, yielding predictable and reliable operation.

167. Miller does not substantively modify the operating principle of Lasseter-Lopes—Miller actually augments it. During normal operation, the Lasseter-Lopes system would continue managing local power balance through frequency and load control, and Miller would coordinate recharging of batteries in parallel as dictated by its algorithm. During surplus generation, Miller would recharge storage or export power to the grid—functions expressly contemplated by Lasseter and Lopes. EX1005, ¶¶[0110]-[0115] (export), ¶[0010], ¶¶[0064]-[0070] (battery); EX1011, 7-8. And so, integrating Miller’s source-management and charging logic with Lasseter-Lopes’ frequency-based control is “a combination of

familiar elements according to known methods” to “yield predictable results.”
KSR, 550 U.S. at 416.

168. POSITA combining Lasseter-Lopes with Miller would have needed to do nothing beyond integrating well-known battery management techniques described in Miller (e.g., charging and power source coordination) with the distributed microsource and load-shedding control already described in Lasseter-Lopes. Because all the references address the same power-system technology—power systems that integrate with a utility grid.—the fundamental aspects of Lasseter’s frequency-manipulated microsources, strengthened by Lopes’ load-shedding and Miller’s centralized hybrid-source coordination, would have resulted in a reasonable expectation of success.

169. Finally, it would have also been obvious for the batteries in Lasseter-Lopes’ microsources, EX1005, ¶[0064], to be rechargeable as taught by Miller, EX1026, 4:4-12.

2. A POSITA would have found claims 5-12, 16 obvious in view of the combination of Lasseter, Lopes, and Miller.

[5.] A power system as claimed in claim 1 wherein the inverter is responsive to at least one rechargeable battery to provide the output A.C. power.

170. My above discussion in the following is also relevant here: [5]. Miller discloses storage units 105 and 106. EX1026, 2:54-61. “[A]pparatus 101 includes...an internal storage device 105,” which “may

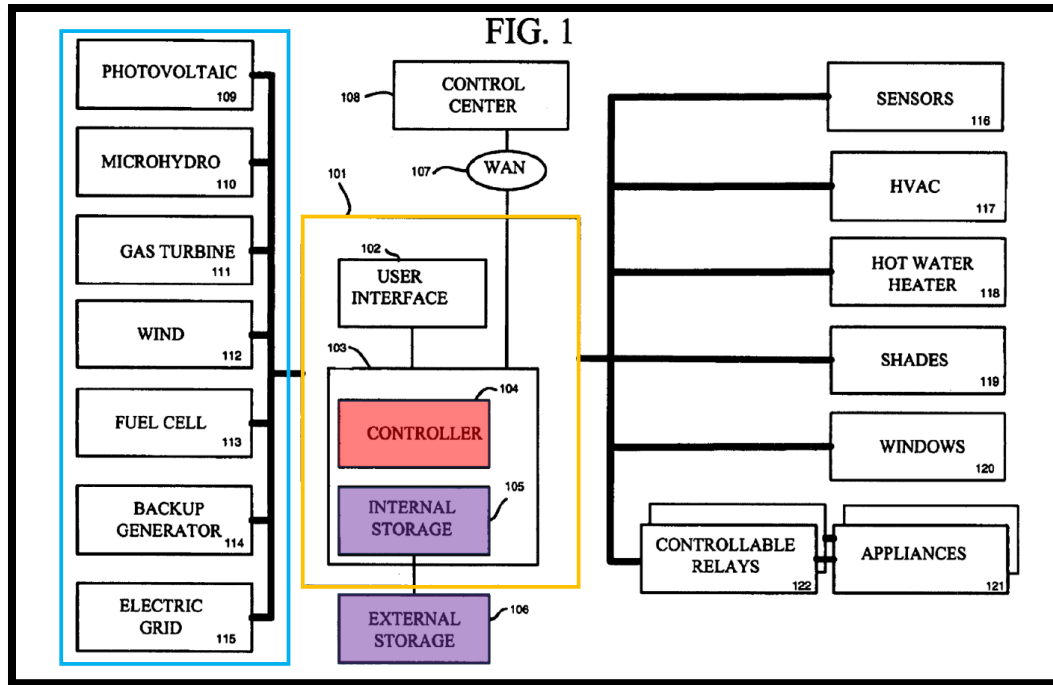
comprise, for example, a plurality of lead-acid or nickel-metal-hydride *storage batteries* for storing electrical energy.” EX1026, 2:54-61. These are examples of the “storage technologies” to which Lasseter refers in citing “batteries” in EX1020 ¶[0014]. “During normal operation, power from one or more of the power sources can be used to *charge storage units 105 and 106*.” EX1026, 4:4-12. EX1001, 5:36-46 (“The control of battery charging current, especially in large battery arrays used with electric and hybrid vehicles and the like is well known in the art. For example U.S. Patent Application Publication 2010/0134073.”); EX1007, 18, 31; EX1022, 100-103; EX11020, ¶¶[0014]-[0016] (implying that batteries serving as “storage” can hold charge generated by the system); EX1006 (same).

171. I also understand that Lasseter’s “microsource **200** may also include *power storage 215*, for example a *battery*.” EX1005, ¶¶[0070]-[0071], [0010], [0064]. When employing Miller’s rechargeable-battery teachings with the batteries in Lasseter, Lasseter’s *inverter is responsive to the rechargeable batteries* in producing AC power from the battery’s DC power because Miller’s rechargeable batteries would be the “DC Interface” outputting power to the *inverter 230/350*. *Id.*; EX1026, 3:18-21; EX1005, ¶[0010]; *See above* [5].

[6.] A power system as claimed in claim 5 wherein the power system controls the charging of the at least one rechargeable battery.

172. My above discussion in the following is also relevant here: [5] (Miller’s *apparatus 101* has *rechargeable batteries 105* and *106*). *Controller 104*

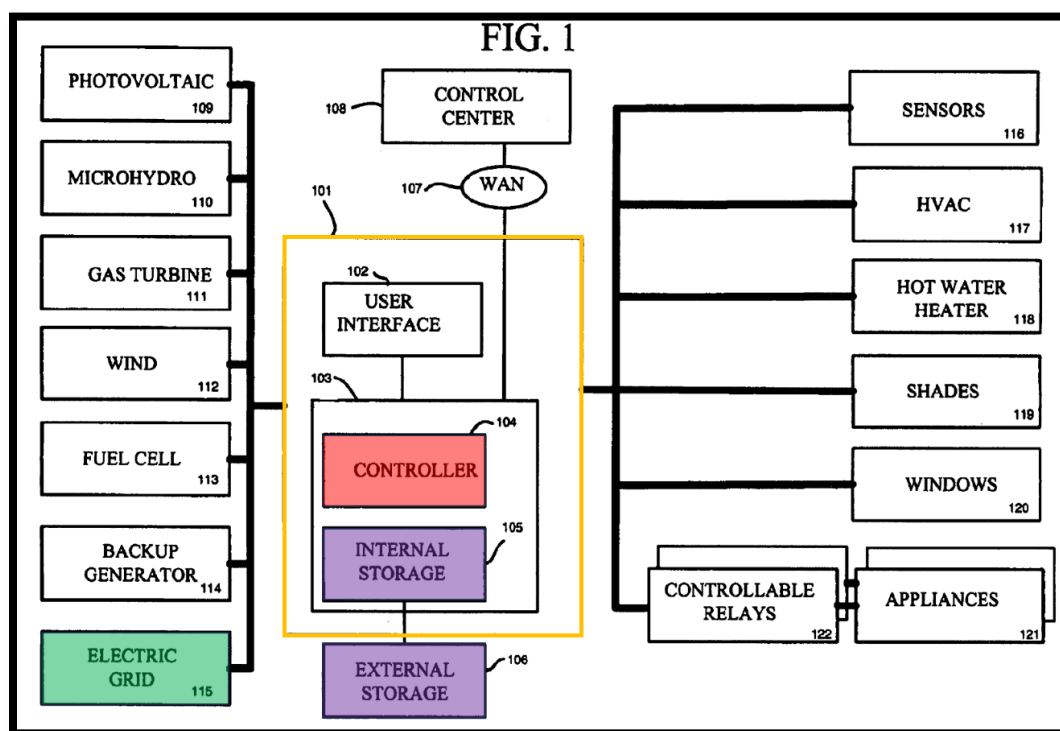
“*control[s]* the operation of **apparatus 101** to *receive electrical power* from **power sources 109** through **115**.” EX1026, 3:22-28. “During normal operation, power from one or more of the **power sources** *can be used to charge storage units 105 and 106*.” EX1026, 4:4-12. And so, when deploying Miller’s **apparatus 101** as a rechargeable-battery microsource with Miller’s **controller 104**, **controller 104** *controls the charging of rechargeable batteries 105 and 106*. Controlling the charging would have been obvious to a POSITA because doing so was well known at the time. EX1001, 5:36-46 (“The control of battery charging current, especially in large battery arrays used with electric and hybrid vehicles and the like is well known in the art. For example U.S. Patent Application Publication 2010/0134073.”); EX1007, 18, 31; EX1022, 100-103; EX11020, ¶¶[0014]-[0016] (implying that batteries serving as “storage” can hold charge generated by the system); EX1006 (same).



[7.] A power system as claimed in claim 6 wherein the power system controls the charging of the at least one rechargeable battery from a power grid.

173. My above discussion in the following is also relevant here: [6] (controller 104 controls battery 105/106 charging). The controller 104 “control[s] the operation of apparatus 101 to *receive electrical power* from power sources 109 through 115.” EX1026, 3:22-28. “During normal operation, power from one or more of the power sources can be used to charge storage units 105 and 106 and/or to meet demand in addition to electric grid 115.” EX1026, 4:4-12. Because “[t]he bold lines shown in FIG. 1 indicate electrical distribution paths,” and electric grid 115 is connected by a bold line to apparatus 101 (containing batteries 105 and 106) POSITA would have understood that controller 104 *controls the charging from a power grid* because the grid supplies power through apparatus 101’s

controlled distribution path as depicted in Figure 1. EX1015, 5 (“For grid connected micro-sources the controls need to provide despatched power and local voltage regulation.”).



[8.] A power system as claimed in claim 6 wherein the power system controls the charging of the at least one rechargeable battery from at least one solar panel.

174. My above discussion in the following is also relevant here: Lasseter-Lopes [8] (solar panels); Lasseter-Lopes-Miller [6] (controller **104 controls battery 105/106 charging**). In Figure 1, the controller **104** is compatible with and can control “alternative energy sources **109** through **113**” to “provide electrical power to the apparatus.” EX1026, 3:56-4:3, FIG. 1. The alternative energy sources “include *photovoltaic (PV) cells 109.*” *Id.* See also EX1001, 38:45-59 (“Solar

panel **50** has a power output via connection **51** which is connected with the output of transfer switch **47** to provide power to the loads as is well known in the art, e.g. it is synchronized to and paralleled with the power from transfer switch **47**.”).

[9.] A power system as claimed in claim 6 wherein the power system controls the charging of the at least one rechargeable battery from a non-grid internal combustion powered electrical power source.

175. My above discussion in the following is also relevant here: Lasseter-Lopes [4] (*internal combustion* powered electrical *power source*); Lasseter-Lopes-Miller [6] (controller **104** *controls battery 105/106 charging*). Miller also teaches that a gas turbine **111** that can charge batteries **105/106** is available and compatible with controller **104**. EX1026, 4:4-12, FIG. 1. Miller teaches the same for a backup generator **114** that is available to charge batteries **105/106**, which POSITA would have found obvious to deploy as an internal combustion microsource as disclosed in Lasseter given their ubiquitous use as backup power sources. EX1026, FIG. 1.

[10.] A power system as claimed in claim 6 wherein a power grid and at least one solar panel are available to charge the battery and the power system controls the selection of at least one of the power grid and the at least one solar panel to charge the at least one rechargeable battery.

176. My above discussion in the following is also relevant here: [6] (controller **104** controls battery **105/106** charging); [7] (electric grid **115**); [8] (photovoltaic **109**).

[11.] A power system as claimed in claim 6 wherein a power grid and a non-grid internal combustion powered electrical power source are available to charge the at least one rechargeable battery and the power system controls the selection of at least one of the power grid and the non-grid internal combustion powered electrical power source to charge the at least one rechargeable battery.

177. My above discussion in the following is also relevant here: [6] (controller **104** controls battery **105/106** charging); [7] (electric grid **115**); [9] (gas turbine **111** and backup generator **114**).

[12.] A power system as claimed in claim 6 wherein a power grid, a solar panel array and a non-grid internal combustion powered electrical power source are available to charge the at least one rechargeable battery and the power system controls the selection of one or more of the power grid, the solar panel array and the non-grid internal combustion powered electrical power source to charge the at least one rechargeable battery.

178. My above discussion in the following is also relevant here: [6] (controller **104** controls battery **105/106** charging); [7] (electric grid **115**); [8] (photovoltaic **109**); [9] (gas turbine **111** and backup generator **114**).

[16.] A power system as claimed in claim 5 further including a transfer switch which may output power from a power grid or from the power source to provide power to the one or more of a plurality of loads, the power system operating to charge the at least one rechargeable battery from the power grid via the transfer switch output when the transfer switch outputs grid power, with the power system stopping the charging of the at least one rechargeable battery via the output of the transfer switch when the transfer switch outputs power from the power source to provide power to the one or more of a plurality of loads.

179. My above discussion in the following is also relevant here: [5]-[6]; Lasseter-Lopes [13]-[15].

C. GROUND 1C: The Lasseter-Lopes-Baldassarre Combination

180. Because POSITA would have recognized the benefits of combining Lasseter and Lopes with Baldassarre it would have been obvious to a POSITA, and doing so would have rendered claims of the '857 patent obvious.

1. The Lasseter-Lopes-Baldassarre Combination would have been obvious to a POSITA.

181. As I discussed above for Ground 1A, Lasseter and Lopes together show how one would implement a microsource-based power system that varies its output frequency in response to different states to manage distributed loads and perform automatic load shedding. *See above* Part VII.A. Lopes contemplates that it would be beneficial to shed loads based on the loads' relative importance (by recommending shedding different amounts of loads "based on the amplitude of frequency deviation") and later gradually reconnecting previously-shed loads. EX1011, 3-6. Baldassarre supplements Lopes, specifically 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, ¶[0058], ¶[0090], FIGS. 1-2. 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 freedom in user selection of load-shedding critical and non-critical loads per Lopes. EX1021, ¶¶[0025]-[0027],

[0063]-[0075] (a user's needs and environment are dynamic); EX1008, 2:1-40 (adjustable priority saves the user from needing to rewire the transfer switch controller). Lopes' load shedding control could be augmented with Baldassarre's load-management control, or implemented as Baldassarre's load-management control with nominal further adjustments to accommodate the system of Lasseter-Lopes.

182. **First**, the frequency deviation and load-shedding thresholds of Lasseter-Lopes could form the basis of control logic, but the Lasseter-Lopes combination alone does not describe how a user would specify the order for loads to shed or how the system could coordinate load disconnection and reconnection. POSITA would have looked to Baldassarre's control system, including its user interface and load-priority programming, as an obvious solution, because it provides the hardware and software structure for assigning and updating load priorities, implementing time-based reconnection, and restoring power in a predetermined or user-defined sequence. EX1021, ¶¶[0056]-[0058], [0061]-[0065], [0083]-[0089], [0093]-[0109], [0121]-[0127], FIGS. 1, 5-7. Integrating Baldassarre's user interface with Lasseter-Lopes' distributed controllers would yield a system that not only sheds loads automatically when frequency drops, but does so according to priorities that the user can define and modify in real time—a desirable improvement for any microgrid or backup-power environment. *Id.*,

¶¶[0058]-[0071]. Incorporating these aspects of Baldassarre into Lasseter-Lopes would simply be “a combination of familiar elements according to known methods,” which means applying a feature-rich load control system with a user interface, to “yield predictable results,” *i.e.*, a load shedding system with the flexibility of user-definable priorities. *KSR Intern. Co. v. Teleflex Inc.*, 550 U.S. 398, 401 (2007).

183. **Second**, POSITA would have been motivated to combine Lasseter-Lopes with Baldassarre because Baldassarre permits users to “continuously update the priorities of particular electrical loads in real time” and “select in real-time which loads are essential.” EX1021, ¶¶[0007], [0016], [0021], [0106]. By combining Lasseter-Lopes’ automatic frequency-responsive control with Baldassarre’s real-time, user-configurable interface, responsive load-shedding schemes could adapt dynamically as the user’s operational needs change—avoiding the rigidity of fixed preprogrammed thresholds and improving system usability, efficiency, and safety.

184. **Third**, it would have been straightforward and predictable to implement Baldassarre’s control system 114 with the LCs and under-frequency relays discussed in Lasseter and Lopes. Lopes’ LCs and under-frequency relays would function as frequency-responsive devices that open upon a predetermined frequency deviation, but a control system like Baldassarre’s would provide a user-

programmable means for managing and coordinating those relays. EX1021, ¶¶[0094]-[0104], [0110]-[0119]. Baldassarre's processor-based controller and user interactive device allow the user to define load priorities, specify the conditions under which particular loads are shed, and restore loads automatically or manually in a selected order. EX1021, ¶¶[0021], [0027], [0032], [0034], [0056], [0090], [0095]. POSITA would have recognized that 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 because the controller can select which loads to shed. EX1021, ¶¶[0020], [0035]; EX1008, 2:1-40 (adjustable priority saves the user from needing to rewire the transfer switch controller). In the alternative, POSITA would have found it obvious to implement Baldassarre's centralized, user-programmable control functions as additional logic within the load controllers (LCs) and under-frequency relays disclosed in Lopes, because the case LCs already monitor power parameters and disconnect/reconnect loads. EX1011, 2-4. Either approach would have been a predictable combination of known microprocessor-based control systems to achieve improved coordination, configurability, and user accessibility in managing frequency-responsive load shedding. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007).

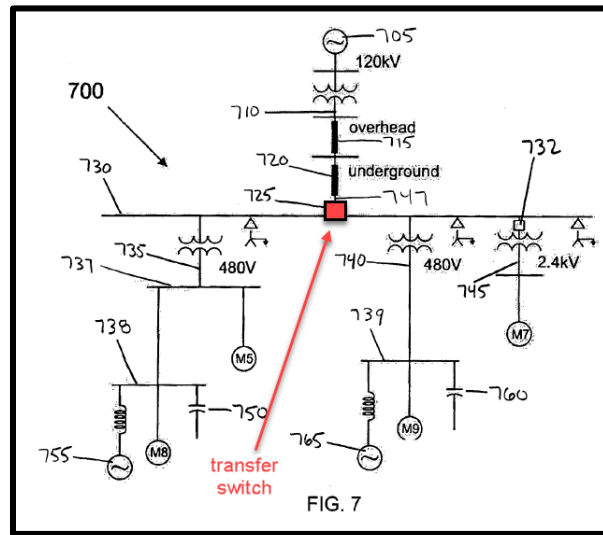
185. **Fourth**, POSITA would have been motivated to combine Baldassarre for its additional benefits, which include: (1) real-time adjustment of load priorities through a user interface; (2) reduced generator or microsource size by maintaining total load demand below the source’s maximum capacity; (3) prevention of overload and overheating damage; (4) load optimization and improved fuel efficiency by maintaining output “at or just below the maximum capacity of the auxiliary power source;” and (5) reduce peak demand on utility providers. EX1021, ¶¶[0016], [0030], [0053], [0081], [0103]. These are the same operational goals Lasseter and Lopes pursue—balancing supply and demand, avoiding overload, and maintaining system stability—but implemented with user-driven, processor-based hardware that offers real-world flexibility and customizability. EX1011, 2; EX1005, ¶¶[0006]-[0008].

186. POSITA would have reasonably expected success in combining the three systems because all three references address the same problem—managing distributed or backup power sources to maintain stable operation when loads vary and operate within the same technological domain of AC power control systems. EX1005, Abstract; EX1009, 1; EX1021, Abstract. Lopes contemplates “adopt[ing] standard protocols and open technologies...using of-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; 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 have predictably yielded improved functionality: dynamic, user-configurable, frequency-responsive load management in distributed or islanded microgrids.

187. POSITA also would have found it obvious to add Baldassarre's teaching of a multi-terminal transfer switch to the Lasseter-Lopes system to enable switching between the utility supply and the two legs of the power bus. EX1021, ¶¶[0023]-[0024]; [0113]-[0116]. For example, POSITA would have seen the advantage of the connection between the utility supply feeder and the two legs of the power bus (utility supply feeder 710 and power bus 730 of Figure 7), because it permits the connection utility supply and power bus with a transfer switch. *Id.* The configuration would allow manual disconnection/reconnection of one leg of the bus at the switch, for example, to disconnect one leg for maintenance or during its construction while maintaining the connection between the utility supply and the other leg of the bus. POSITA would have had a reasonable expectation of success in the combination because it is simply "a combination of familiar elements according to known methods," *i.e.*, applying a multi-terminal switch

between multiple power paths, to “yield predictable results,” *i.e.*, a switch that operates to switch the multiple power paths. *KSR Intern. Co. v. Teleflex Inc.*, 550 U.S. 398, 401 (2007).



EX1005, FIG. 7 (annotated)

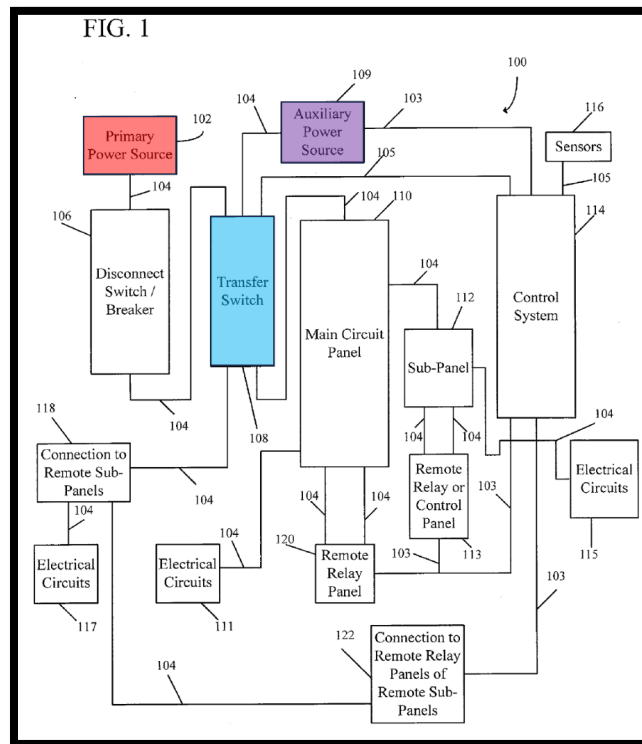
188. Baldassarre also provides details on the hardware connection of current interrupters, as I discuss in more detail below.

2. A POSITA would have found claims 13, 44, 63-64 obvious in view of the combination of Lasseter, Lopes, and Baldassarre.

[13.] A power system as claimed in claim 1 further including a transfer switch which may select a power grid or the power source to provide power to the one or more of a plurality of loads, the transfer switch outputting power from

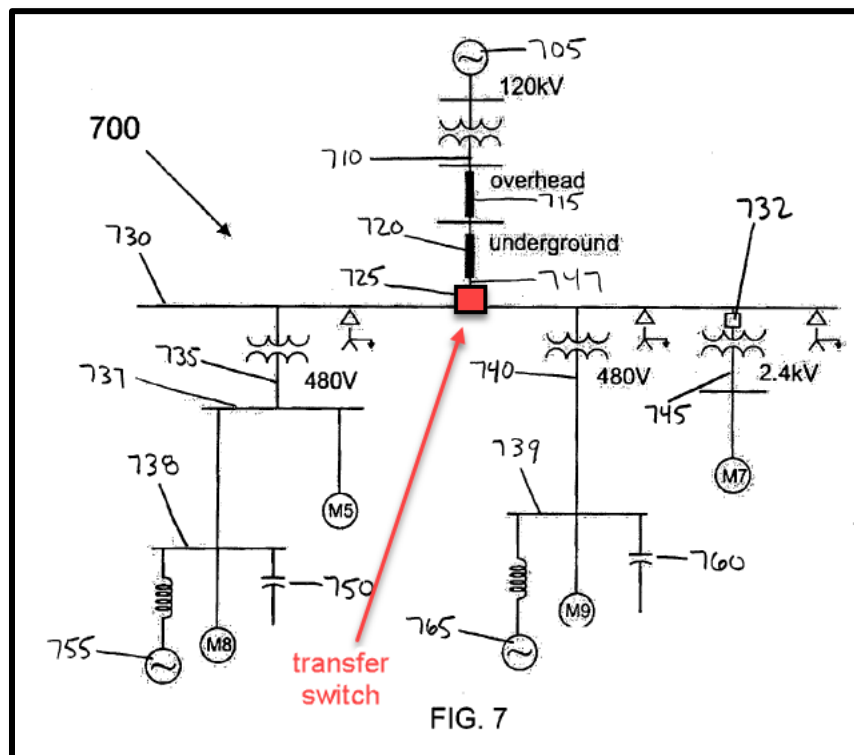
the grid power meets acceptable parameters and to output power from the power source when the grid power does not meet acceptable standards.

189. My above discussion in [13] is relevant here as well. POSITA looking to implement a transfer switch would have looked to Baldassarre.. Baldassarre explains “automatic *transfer switches* are controlled using relay logic, programmable logic controllers (PLCs), [and] embedded controllers” to select between a **primary power source 102** and an **auxiliary power source 109**. EX1021, ¶[0011], [0024], [0088]; FIG. 1. Baldassarre’s transfer switch is able to selectively connect multiple terminals, as shown in Figure 1 below. *Id.*



190. A transfer switch like Baldassarre’s (with multiple terminals) connected between a utility supply (for example, in Figure 7 below, utility supply

feeder line 710) and the two legs of the power bus (in Figure 7, power bus 730) and operating per Lasseter's instruction (as I discussed in [13]) would ***output power from the grid power when it meets acceptable parameters*** (e.g., power from the utility supply to power bus) and ***output power from the power source when the grid power does not meet acceptable standards*** (e.g., power from the left leg of the power bus to loads on the right leg).

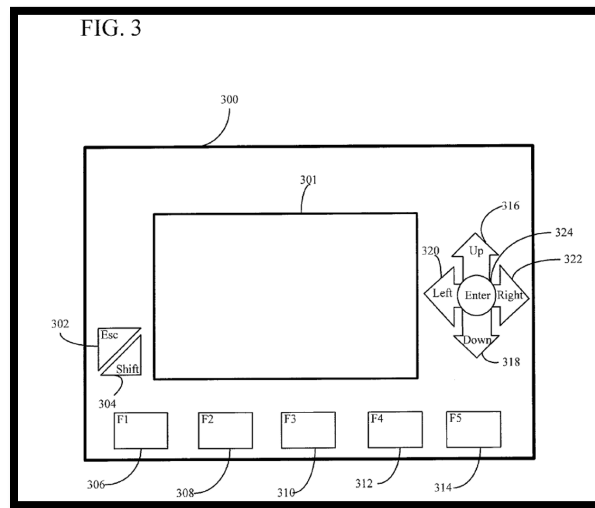


EX1005, FIG. 7 (annotated)

[44.] A power system as claimed in claim 39 wherein in c) the processor circuit operates to disconnect output AC power from the at least one or more loads

for at least a time period which is responsive to a load priority which is selected via a user interface.

191. As I discussed above in [1.c]-[2], Lopes provides LCs and under-frequency relays (*processor circuits*) that *disconnect output AC power* from *loads*. POSITA would have been motivated to employ a user programmable, sequenced load disconnect/reconnect strategy, such as Baldassarre’s control system **114** and user interactive device **300**, to help control the operating parameters of Lopes’ LCs or under-frequency relays. Baldassarre’s “user interactive device **300** is a graphical *user interface*.” EX1021, ¶[0097].



192. The “user interactive device **300** is used for controlling control system **114**.” EX1021, ¶[0076], ¶¶[0082]-[0083], FIGS. 1-3. After a *time period* during which the “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 the sequence selected via user interactive device **300**, loads are disconnected for *a time period which is responsive to a load priority*.

[63.pre] A power system as claimed in claim 61 wherein the processor circuit of c) is a physically distinct device contained in its own enclosure and not physically part of the power source of a), the enclosure containing:

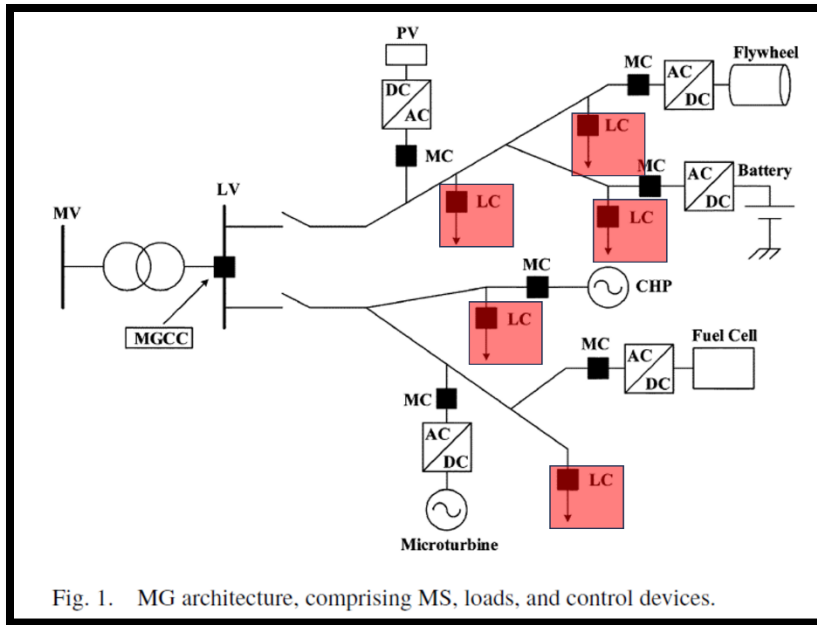
193. My above discussion in [62] is relevant here as well.

[63.d] a printed circuit assembly on which at least the one or more processor and supporting circuitry is mounted;

194. POSITA would have understood, or at least found obvious—because the '857 patent does not discuss PCBs or printed circuit assemblies—that Lopes' under-frequency relays, LCs, and Baldassarre's various controllers (*processors*) and their *supporting circuits* are conveniently *mounted* on *printed circuit assemblies*, and in their *own enclosures*, as standard microcontroller-based control systems are ordinarily realized on PCBs and PCBs are typically provided within enclosures to protect them. EX1022; EX1011, 4, 6; EX1021, ¶[0025], ¶[0090], ¶[0085], ¶¶[0096]-[0103], ¶[0108]. This understanding is bolstered by Lopes, which contemplates “adopt[ing] standard protocols and open technologies...using of-the-shelf, low-cost, widely available, and fully-supported hardware and software components” into its load-control system. EX1011, 2.

[63.e] at least one electrically controlled electro-mechanical switch, relay or contactor with one or more input electrical terminals via which it may be physically wired to the power source output to receive the output AC power, and one or more load electrical terminals via which it may be physically wired to the at least one load of the one or more loads and at least one control electrical terminal which is connected to the printed circuit assembly in order that the one or more processor can control connecting the output AC power to the at least one load via the input electrical terminals and the load electrical terminals;

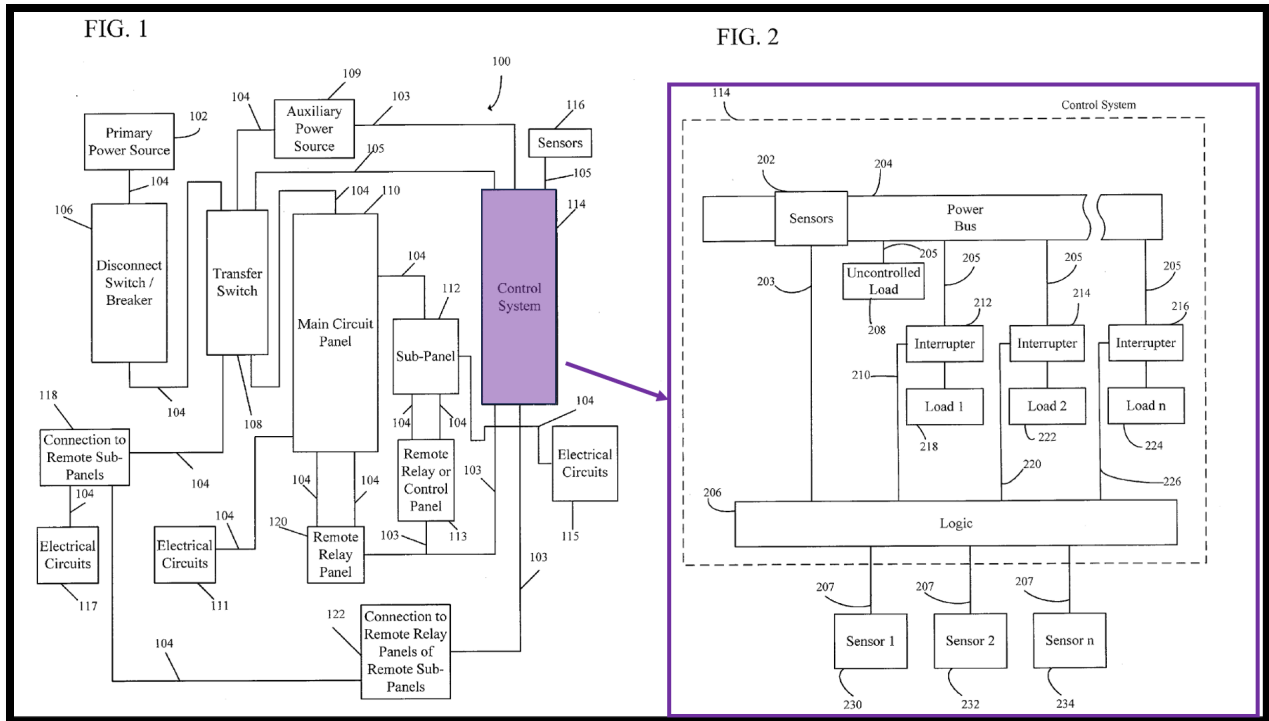
195. Lopes shows its LCs in line with loads. EX1011, 2, FIG. 1. Because “LC[s] serve as interfaces to control loads through the application of an interruptibility concept,” EX1011, 2, POSITA would have understood, or found obvious that, LCs control switches, relays or contactors of some sort that can break the connection between the power source and load. Lopes’ under-frequency relays also allow for “temporary disconnection” of loads. EX1011, 4. POSITA would have understood that the ability to “disconnect” or “interrupt[.]” indicates (or POSITA would at least have found it obvious) that the switches, relays or contactors have *input electrical terminals physically wired* to the microsource outputs to receive AC power and *load electrical terminals physically wired to loads*. For example, as the LCs are depicted in Figure 1, power flowing through these physically wired terminals is what is disconnected when loads are shed.



196. Finally, POSITA would have understood or found obvious that the *printed circuit assemblies* in Lopes' LCs and under-frequency relays have *control electrical terminals* to allow the LCs and relays to *control connecting the output AC power to the loads*. LCs are "controllers located at loads" that Lopes depicts on distribution lines—it is costly to install such cable and delivering power over these long distances results in losses. EX1011, 2. Relays are also electrically actuated switches that are activated via electricity, which POSITA would have understood or found obvious is delivered via the line which they disconnect. EX1022, 108-12.

197. POSITA would have found it obvious to implement Baldassarre's current interrupters as Lopes' relays or to implement Lopes' relays in a similar manner to Baldassarre's current interrupters in a load shedding system. EX1001,

6:3-7 (“Load shedding is well known in the prior art, for example a system is described in the Rodgers et al. U.S. Patent Application Publication 2005/0116814.”). POSITA would find motivation in Baldassarre as an example having “[d]etailed illustrative embodiments” and with stated advantages. EX1021, ¶[0046], [0052]-[0056]. Figure 2 in Baldassarre depicts control system **114**, which includes *electrically controlled electro-mechanical relays* that it calls “current interrupters **212**, **214**, and **216**” or “relays.” EX1021, ¶[0090], ¶[0091], ¶[0086]. The interrupters/relays have *input electrical terminals* connecting to a power source output and *load electrical terminals* for delivering output power to loads **218**, **222** and **224**—“power bus **214** supplies power to interrupters **212**, **214**, and **216** via electrical wires **205**,” and interrupters **212**, **214**, and **216** “are in series electrical connection with loads **218**, **222** and **224**.” *Id.* POSITA would have understood or found obvious that a relay or interrupter connected in series between a power source output and a load has input and load terminals.



198. The “control system 114 may be coupled to...at least one sub-panel via electrical wires 104” (*control electrical terminal*). EX1021, ¶[0089]. POSITA would have understood or found obvious that these wires connect the relays to the processor-based control circuitry to enable the controller to actuate the relays while minimizing wiring complexity. Indeed, via this terminal, control system 114 “may manage the controlled loads, which may be located in circuit panels, sub-panels, and/or remote sub-panels via relays.” EX1021, ¶[0091], ¶[0086]. When shedding loads, “control system 114 sends a signal,” and relays start “breaking the connection from the auxiliary power source to the load,” which means deactivating the load. EX1021, ¶[0094].

[63.f] a power supply receiving the output AC power of d) and providing DC power for the one or more processors, the power supply circuit being partially or totally mounted on the printed circuit board or otherwise;

199. Lopes and Baldassarre both teach control systems that use processors (LCs/under-frequency relays and interrupters/relays of **114**, respectively) to manage relays and loads. EX1011, 4, 6; EX1021, ¶¶[0086], [0090]–[0094]. POSITA would have understood or found obvious that these control systems necessarily require a regulated DC supply to power its processor and logic circuitry, because microprocessors cannot operate on AC mains. It would have been obvious to implement a conventional AC/DC conversion circuit receiving the output AC power already supplied to the control system because this provides a simple, reliable source of DC power without requiring a separate auxiliary feed. *Id.*

200. Moreover, it was routine to mount power supply components (rectifiers, regulators, or switching modules) directly on the printed circuit assembly containing the processor, either in whole or in part. For example, the system in EX1022 demonstrates this setup. EX1022 450-51. Off-the-shelf PCB-mount AC/DC converters were widely available, and it would have been an obvious design choice to integrate such components partially or totally on the control system PCB to minimize wiring and improve reliability. *Id.*

[63.g] a user interface circuit being partially or totally mounted on the printed circuit or otherwise, the user interface providing information to a user or

installer and providing the capability to enter a priority for the at least one load of e).

201. My above discussion in [44] is relevant here as well. Baldassarre's user interactive system **300 provides information to a user**, because it can "contain a display (e.g. screen) for interaction with a user and visually displaying the current demand of at least one load within the system." EX1021, ¶[0108]. POSITA would have understood the system 300 to be a circuit.

[64.pre] A power system as claimed in claim 61 wherein there are a plurality of processor circuits of c) the power system comprising: a plurality of processor circuits of c) each being a physically distinct device contained in its own enclosure and not physically part of the power source of a) or other processor circuits c), each enclosure containing:

202. My above discussion in [62] is relevant here as well. Lopes discloses a plurality of *processor circuits* ("under-frequency relays" and LCs). EX1011, 4, 6.

[64.d)] a printed circuit assembly on which at least the one or more processor and supporting circuitry is mounted;

203. My above discussion in [63.d] is relevant here as well

[64.e)] at least one electrically controlled electro-mechanical switch, relay or contactor with one or more input electrical terminals via which it may be physically wired to the power source output to receive the output AC power, and one or more load electrical terminals via which it may be physically wired to the at least one load of the one or more loads and at least one control electrical terminal which is connected to the printed circuit assembly in order that the one or more processor can control connecting the output AC power to the at least one load via the input electrical terminals and the load electrical terminals;

204. My above discussion in [63.e] is relevant here as well.

[64.f)] a power supply receiving the output AC power of d) and providing DC power for the one or more processors, the power supply circuit being partially or totally mounted on the printed circuit board or otherwise;

205. My above discussion in [63.f] is relevant here as well.

[64.g)] a user interface circuit being partially or totally mounted on the printed circuit or otherwise, the user interface providing information to a user or installer and providing the capability to enter a priority for the at least one load of e).

206. My above discussion in [64.g] is relevant here as well.

D. GROUND 1D: The Lasseter-Lopes-Baldassarre-Miller Combination.

1. The Lasseter-Lopes-Baldassarre-Miller Combination would have been obvious to a POSITA.

207. The same motivations that I discussed above for combining Baldassarre and Miller individually with Lasseter-Lopes apply equally when the four references are combined collectively. As I discussed, Baldassarre contributes the hardware and operational framework of a transfer switch capable of routing power either from the utility grid or from an auxiliary source to a plurality of loads. *See above* Part VII.C. Miller provides an “integrated control device” that “manages the supply of energy from various sources” like the grid. EX1026, 1:53-62, FIG. 1. “[P]ower from one or more of the power sources can be used to charge storage units **105** and **106**.” EX1026, 4:4-12. POSITA would have recognized that these features are complementary: Baldassarre’s transfer switch determines which source (grid or auxiliary) supplies the load, while Miller’s controller determines

when and how the system charges the connected batteries. *Id.*; EX1021, [0113]-[0116]; EX1009, 38; EX1008, 2:1-5, 3:35-46. Integrating these two teachings in the Lasseter-Lopes system would predictably allow the batteries to charge from the grid when grid power is available and to cease charging when the transfer switch isolates the grid and connects the auxiliary power source—thereby conserving backup power for supplying the loads..

208. POSITA would have appreciated that this combined operation does not substantively alter the underlying principles of the Lasseter-Lopes combination, yet still improves system reliability and efficiency because it would facilitate the combination of the systems. Baldassarre’s transfer switch already provides the physical mechanism for selecting between grid and auxiliary power outputs, and Miller’s charging control already governs when charging should occur depending on system state. *Id.* By linking Miller’s charging logic to Baldassarre’s switching condition—which involves charging when the switch outputs grid power, and stopping charging when it outputs auxiliary power—the system ensures that stored energy is preserved during grid outages and that grid energy is utilized for charging where possible. This coordination merely applies familiar battery-management control to an existing grid-transfer topology, yielding a straightforward, desirable result: automatic, condition-based control of charging

consistent with practical backup power system design principles. *KSR*, 550 U.S. at 401.

209. POSITA would have had a reasonable expectation of success combining the references as I described because both Miller and Baldassarre disclose components commonly used in power systems—controllers, transfer switches, and chargeable batteries—and both operate within the same technical field of power management. EX1026, Abstract, 2:54-3:7; EX1021, Abstract, ¶[0057]. Integrating Miller’s control logic with Baldassarre’s switch would have required only routine engineering to exchange control signals indicating the switch’s position to enable or disable charging accordingly. The resulting combination would predictably yield a system that automatically stops charging when disconnected from the grid and resumes charging when grid power returns.

2. A POSITA would have found claims 16 obvious in view of the combination of Lasseter-Lopes-Baldassarre-Miller.

[16.] A power system as claimed in claim 5 further including a transfer switch which may output power from a power grid or from the power source to provide power to the one or more of a plurality of loads, the power system operating to charge the at least one rechargeable battery from the power grid via the transfer switch output when the transfer switch outputs grid power, with the power system stopping the charging of the at least one rechargeable battery via the output of the transfer switch when the transfer switch outputs power from the power source to provide power to the one or more of a plurality of loads.

210. My above discussion in Lasseter-Lopes-Baldassarre [13] and Lasseter-Lopes-Miller [5]-[6] is relevant here as well. The transfer switch

disclosed in Baldassarre may output power from a power grid or other power source to provide power to the one or more load in a plurality of loads. And Miller discloses charging at least one rechargeable battery from the power grid. “During normal operation, power from one or more of the power sources can be used to charge storage units 105 and 106 and/or to meet demand in addition to electric grid 115.” EX1026, 4:4-7. “During power outages or brownouts from grid 115...storage units 105 and 106[] can be used to meet energy demand.” EX1026, 5:7-9. POSITA would have found it obvious to not charge the batteries during a power outage when incorporating Baldassarre’s transfer switch transitions to its auxiliary power source because the grid supply would be disconnected and conserving auxiliary-source power for load support, rather than battery charging, would have been a predictable and desirable design choice.

VIII. PETITION 2

A. GROUND 1A: The Lasseter-Lopes Combination

1. The Lasseter-Lopes Combination would have been obvious to a POSITA.

211. The same motivations to combine Lasseter and Lopes discussed in reference to Petition 1 apply here..

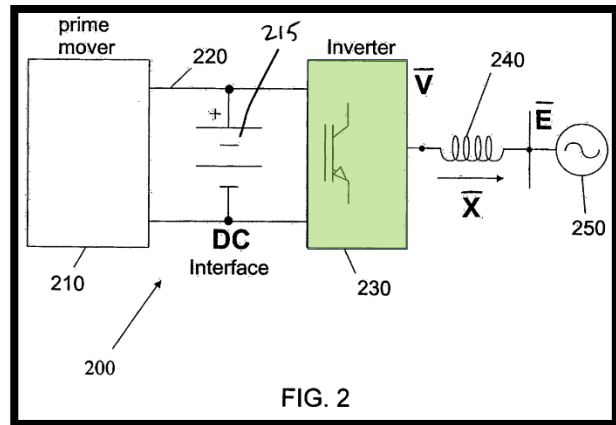
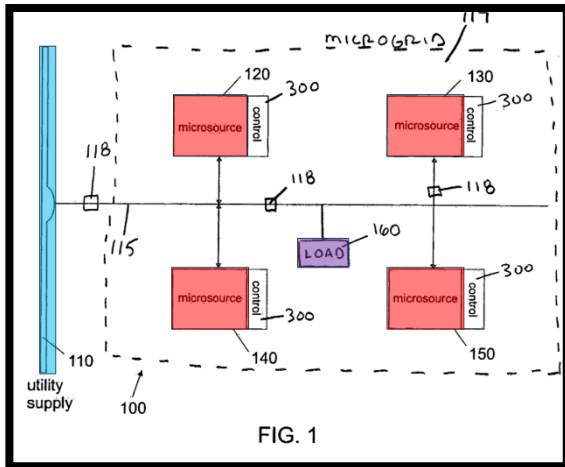
2. A POSITA would have found claims 17-23, 25, 27-38 obvious in view of the combination of Lasseter and Lopes.

[17.pre] A power system which provides AC power with a changeably controlled AC frequency to assist in managing the loading thereof, the power system comprising:

212. Lasseter’s “distributed energy resource system” (DER) to be a *power system* as claimed in the ’857 patent. EX1005, Abstract, ¶[0063]. DERs comprise at least one “microsource” power source, and output *AC power*’s “AC voltage or current at the required frequency.” EX1005, ¶¶[0008]-[0011]. I also understand that the frequency is *controlled* because Lasseter discloses “control schemes for controlling the instantaneous frequency...from one or more microsources.” *Id.*, ¶[0058]. This control must then *assist in managing the DER’s loading*, because frequency is controlled “in response to events such as islanding or new loads.” *Id.*

[17.a] a power source comprising one or more DC to AC inverter which provides output AC power to one or more of a plurality of loads, the power source having a known at least one power source parameter corresponding to the maximum output power capability of the power source;

213. Lasseter also demonstrates that a microsource is *a power source comprising an inverter*. The patent explains that microsources “may include” a DC/AC “*inverter 230*” / “inverter 350,” as shown in FIG. 2. EX1005, ¶[0070], [0074], FIGS. 1-3.



214. Additionally, inverter 230/350 in Lasseter must *provide output AC power* to the “*one or more loads 160*” of the microgrid. EX1005, ¶[0063]. “[I]nverter 230 controls [the] phase of its output voltage,” which means that 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, ¶[0010]. This means that inverter 230/350 is a *DC to AC inverter*..

215. Lasseter’s microsources also have a *known power source parameter*. The patent explains that microsources have “a set point unit power flow P_0 .” EX1005, ¶[0107]. POSITA creating a microsource system would have known the set points, as defined by the ’857 patent, are *known* because they are inputs to controller 300 that the controller 300 stores and uses in subsequent operations. EX1005, ¶¶[0075], [0107]-[0113]. POSITA would have understood or found it obvious that P_0 is stored in a memory of the controller 300, given POSITA’s

understanding that controllers store values in memory. EX1021, ¶¶[0092], EX1009, 6: 4-18, 7: 7-17; EX1027, Abstract; EX1027: 6, 41-55.

216. Set points are a *parameter*, as defined by the '857 patent, because they are “a quantity of one or more property or attribute” and “treated as a constant” within Lasseter (although they “may at times change”).

217. The power P_0 , is the set point or commanded operating power for Lasseter's microsource power controller, as shown for example in FIG. 3. This set point is an operating “parameter” of the power source in Lasseter, a parameter that could correspond to maximum power delivery at $P_{\max}$ or lower power levels.

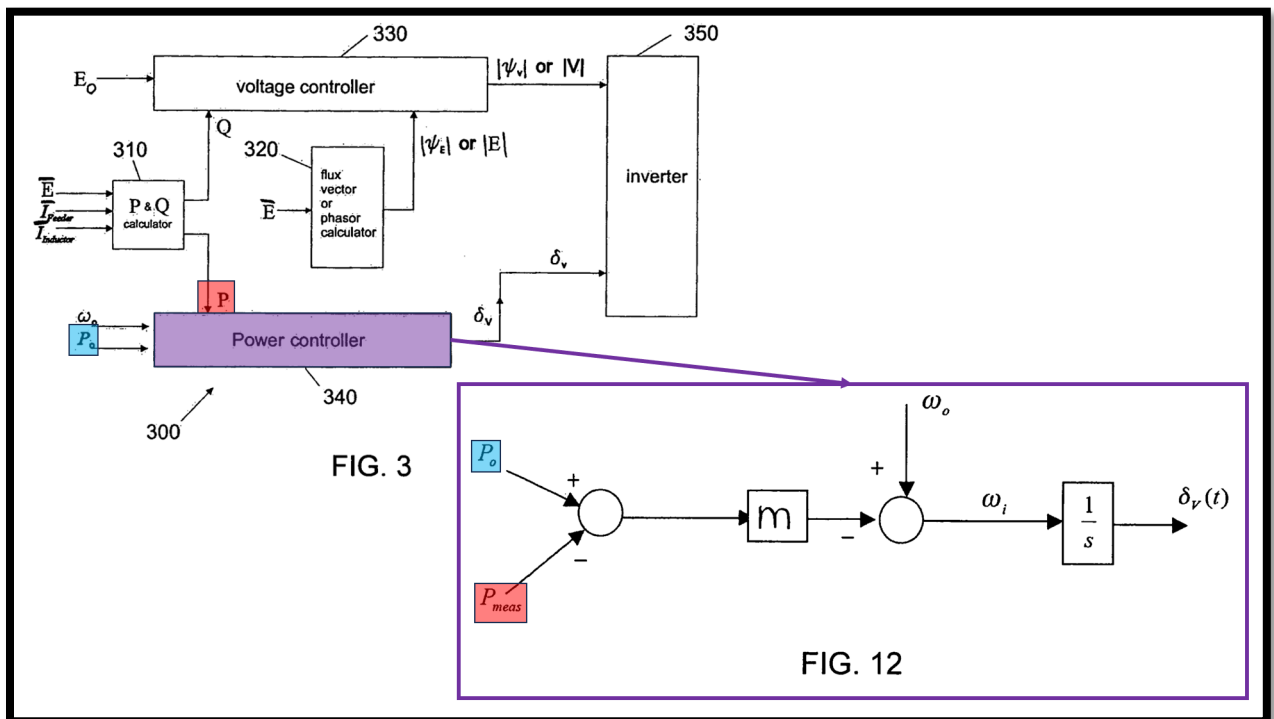
[17.b] the output AC power having one or more timely power parameter which is sensed and compared to at least one corresponding power source parameter by a power source monitor which may be part of the power source or otherwise, the power source operating in response to the power source monitor to control the frequency of the output AC power to have at least a first frequency when the power source is not overloaded and a second frequency when the power source is overloaded including by supplying an excessive current for a period of time which if continued may risk damage or loss of power;

218. Controller **300** in Lasseter-Lopes is microsource's *power-source monitor*. EX1005, ¶[0074]. Controller **300** *senses* inductor current, $\bar{I}_{\text{inductor}}$ via “instantaneous voltage or current measurements” of *timely power parameter*, measured power P_{meas} . EX1005, ¶¶[0075]-[0077]. The controller uses calculator

310 to calculate the P_{meas} “being injected by the microsource using the inductor current, $\bar{I}_{\text{inductor}}$.” *Id.*, ¶[0077]; EX1022, 63-64.

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

219. Within the ‘857 patent, $\bar{I}_{\text{inductor}}$ and P_{meas} are *timely*, because they are both based on “instantaneous current and voltage measurements.” *Id.* ¶[0075]. Thus, they are both “instant, real time, close to real time or a suitable time.” *Id.* $\bar{I}_{\text{inductor}}$ and P_{meas} are both parameters, as defined by the ‘857 patent, because they are “a quantity of...[an] attribute” of the microsources, *i.e.*, the instantaneous current and the output power, “which is treated as constant” throughout Lasseter (although it “may at times change”).



220. Controller **300** *compares* P_{meas} to a *corresponding power source parameter* (“set point unit power flow P_0 ”), which is demonstrated both by Figure 12 and Equation 8. *Id.*, ¶¶[00106]-[0109], [0112], [0122].

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

[Eq. 8]

221. As a result, Lasseter’s microsources *operate in response to* controller **300**. They do so *to control the frequency of the output AC power* when “reducing the operating frequency of the inverter to increase [their] unit output power.” EX1005, Abstract. Controller **300** has a “power controller **340** in FIG. 3,” which “uses...the measured power P_{meas} ,” i.e., Real Power P , “to control the instantaneous operating frequency ω_i of the inverter.” *Id.*, ¶¶[0105]-[0113]. As shown in Equation 8, when P_{meas} exceeds power-set point, P_0 , frequency decreases from its *first frequency* ω_0 . *Id.*

222. A Lasseter microsource will exceed its “minimum operating frequency” when the “load exceeds the aggregate power capacity of the units” because “maximum power is reached at minimum frequency in all units.” EX1005, ¶¶[0113]-[0119], [0130], [0015]; FIGS. 14-17. POSITA would have understood or found obvious that microsources operating above the minimum frequency are operating below P_{max} and so the sources are *not overloaded* because minimum frequency occurs at maximum power. *Id.*

223. 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. In other words, POSITA would have understood, or find obvious, that 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” because the source is designed to operate within that range. EX1005, ¶¶[0017], [0058]; EX1021 ¶¶[0021], [0026]-[0034]; EX1023, Abstract, [0003] (“predetermined range”).

224. A system operating at or below the minimum frequency (a ***second frequency***) would be operating at or above $P_{\max}$, which is associated with an ***overload*** of the power source because exceeding maximum power is an overload. EX1005, ¶¶[0119], [0130]; EX1008, 1:11-27, 2:14-24, 4:47-5:29; EX1011 4; EX1021 ¶¶[0021], [0026]-[0034]. POSITA would also understand or find obvious that operating at or below this frequency, beyond $P_{\max}$, for longer than a “certain time interval” (as taught by Lopes, EX1011, 4) could cause “[i]nverter overcurrents,” resulting in damage to the power source because excessive current is supplied being supplied during an overload. *Id.*; EX1011, 4; *see also* EX1017, 6; EX1021, ¶[0057] (“limiting the total instantaneous consumption of electrical energy”). Because P_{meas} is a function of I_{inductor} (as discussed in [17a]), when P_{meas}

exceeds $P_{\max}$, then the value of I_{inductor} is an ***excessive current***. Operating below the minimum frequency and beyond $P_{\max}$ would constitute an overload for the power source as defined by the '857 patent. *Id.*

225. Microsources in this state would “balance generation and consumption inside the MG” by increasing power output with “proportional...frequency deviation.” EX1011, 3. When there is a “high imbalance between local load and generation,” the system sheds loads through “under-frequency relays” to ***alleviate*** this overload. *Id.*, 4.

[17.c] a processor circuit comprising one or more processors responsive to the output AC power and operating in response to the occurrence of the second frequency 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.

226. Lopes explains an algorithm used for “shedding” “controllable loads” “based on the amplitude of frequency deviation.” EX1011, 4-5. Load shedding ***controls the coupling of A.C. power to the load***, because load shedding “[a]llow[s] a temporary disconnection of less important loads.” *Id.* Shedding these loads can rectify an “high imbalance between local load and generation,” ***helping to prevent 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.*

227. When the system undergoes “frequency deviation” to a “***second frequency***,” Lopes’ load-shedding algorithm ***responds to*** “the amplitude of the frequency deviation” (which indicates the A.C. output power’s changes) by “automatically shed[ding]” a certain amount of loads “through the activation of under-frequency load shedding relays.” EX1011, 6. As I have discussed, POSITA would have been motivated to implement Lopes with specified frequency deviations corresponding to below a given microsource’s minimum frequency because that implementation would avoid unnecessary load shedding while also preventing overloading. *Id.*, 2-4, FIG. 4.

228. Lopes’ load-shedding algorithm would be executed using “controllers located at loads or groups of loads [load controller (LC)]” and “under-frequency relays.” EX1011, 1, 2, 4, 6, FIG.1. POSITA would have understood that the “controllers” and “relays” constitute ***processor circuits comprising one or more processors*** because they execute tasks typically reserved for processors. EX1011, 2-5 (receive information and carry out automatic tasks); EX1005, ¶¶[0074]-[0078], (perform calculations). Even if POSITA would not have understood the LCs to refer to processor circuits, processor circuits were well known and their benefits well understood, particularly in the context of loading shedding. EX1021, EX1024, EX1025, and EX1027. It would also have been obvious to implement Lopes’ load-

shedding algorithm on a processor circuit to benefit from the speed and convenience of modern computing and control systems.

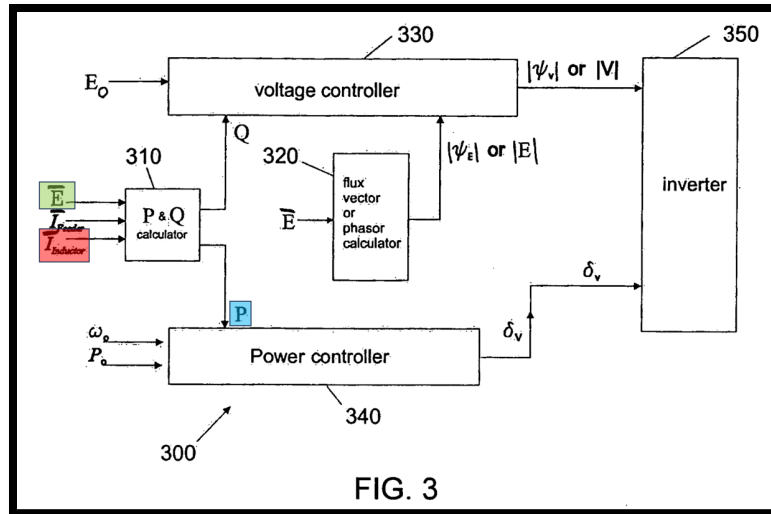
[18.] A power system as claimed in claim 17 wherein the at least one power source parameter of a) corresponds to at least one of the power source not being overloaded or being overloaded.

229. The “set point unit power flow P_0 ” (a *power source parameter*, as I explained above) in Lasseter is less than $P_{\max}$ when not in an overload state and greater than $P_{\max}$ when in an overloaded state. *Id.*, ¶[0107].

[19.] A power system as claimed in claim 17 wherein in b) the one or more timely power parameter includes at least a voltage of the output AC power and is compared to the at least one power source parameter of a) which includes at least a voltage amount.

230. The system voltage E to be a voltage of the output AC power and E_{P0} to be a voltage amount corresponding to P_0 at a given $\bar{I}_{\text{inductor}}$ in the Lasseter-Lopes combination. System voltage E is a *timely power parameter* that is compared to E_{P0} , which is in this context a *power source parameter*. EX1005, ¶[0075]. System voltage E is *timely* as defined by the '857 patent, for it is determined via “instantaneous voltage measurements,” *i.e.*, “instant, real time, close to real time or a suitable time.” EX1005, ¶[0075].

231. Controller 300 is a *power source monitor* that has a calculator 310. EX1005, FIG. 3. “[C]alculator 310 can calculate...real power P being injected by the microsource using the inductor current, $\bar{I}_{\text{inductor}}$.” EX1011, ¶[0077]. Figure 3 shows system voltage E as the voltage input to calculator 310 that calculates P_{meas} :



232. As demonstrated by the below equation, P_{meas} can be calculated using the **system voltage** E (which is the *voltage of the output AC power*) and $\bar{I}_{\text{inductor}}$. EX1005, ¶[0077], [0190], FIGS. 1-4, 12; EX1022, 63-64.

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

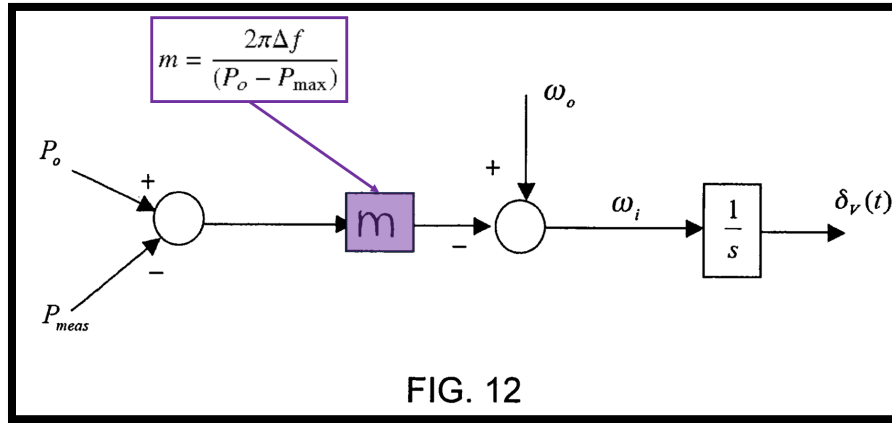
233. Because P_0 and P_{max} depend on *voltage amounts* E_{P0} or E_{max} for a given current $\bar{I}_{\text{inductor}}$ (as I explained above), E_{P0} or E_{max} are *power source parameters corresponding to the maximum output power*. EX1005, ¶[0072]; EX1013, 1; EX1022, 63-64

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

234. Controller **300** changes frequency through comparisons of P_{meas} , P_0 , and **P- ω slope m**. EX1005, Eq. 8, FIG. 12. I also understand that **P- ω slope m** is a function of P_{max} . EX1005, Eq. 9.

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

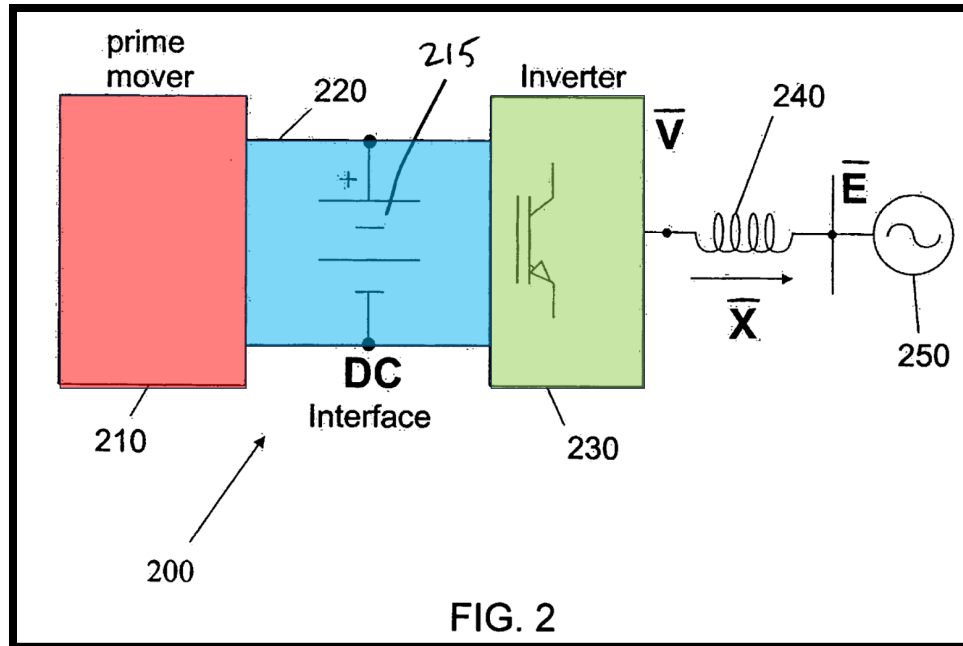
[Eq. 8]



235. In the alternative, *timely power parameter* P_{meas} and *power source parameter* P_0 both *include voltages* of the output AC power, and P_{meas} and P_0 are compared as I explained above in [17.b].

[20.] A power system as claimed in claim 17 wherein in b) the one or more timely power parameter includes at least a current of the output AC power and is compared the at least one power source parameter of a) which includes at least a current amount.

236. $\bar{I}_{\text{inductor}}$ in the Lasseter-Lopes combination is a *timely power parameter* that represents the *output AC power current*. See above, [17b]. $\bar{I}_{\text{inductor}}$ is used to calculate P_{meas} , and P_{meas} is *compared to the power source parameter* P_0 . *Id.* P_0 also *includes a current amount*, because power is a function of current, as I explained above (“ $P=VI \cdot \cos \phi$ ”). And, where P_{meas} operates at P_0 , $\bar{I}_{\text{inductor}}$ is the current associated with this power level at the output voltage $\bar{E}$. And so, the claimed



[21.b] a power source monitor circuit which may be part of the power source or otherwise operating in response to the operating condition of the power source to control the AC power frequency to be one of a plurality of frequencies including at least a first frequency which represents when the power source is being operated with loading that does not create an overload and a second frequency which represents when the power source is being operated with loading that if continued will risk damage to or loss of power by the power source;

239. My discussion in [17.b] is applicable here as well. The controller 300 responds to a power source operating condition to control the frequency of the AC power, because it compares P_{meas} (a measured power, which is an operating condition of the power source) to a “set point unit power flow P_0 ” to determine ω_i (the instantaneous operating frequency, which could be the “first” or “second” frequency of the patent). EX1005, ¶¶[00106]-[0109], [Eq. 8], [0112], [0122], FIG. 12.

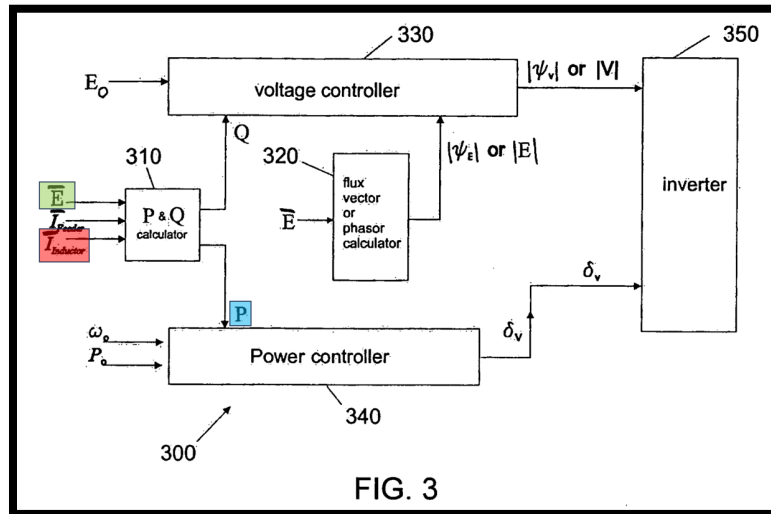
[21.c] the power system further comprising a coupling circuit for controllably coupling at least some of the AC power from the power source to at least a first load of one or more loads, the coupling being responsive to the frequency of the output AC power in a manner such that it performs at one or more of helping to prevent overloading; helping to mitigate overloading or helping to not increase the overloading of the power source.

240. My discussion above for element [17.c] is also applicable here. The “under-frequency relays” in a Lasseter-Lopes combination would be *coupling circuits for controllably coupling at least some of the AC power from the power source to at least a first load*. Because they actively shed loads in response to certain frequency deviations of the microsources, Lopes’ under-frequency relays *respond to the frequency of the output AC power*. EX1011, 4, 6. Based on this responsiveness, under-frequency relays disconnect “less important loads” to correct an “imbalance between local load and generation” capabilities of the power source, which helps *prevent overloading, mitigate overloading, or not increase overloading of the power source* because it reduces the power demanded of the source. EX1011, 4.

[22.] A power system as claimed in claim 21 wherein in b) the power source monitor circuit is responsive to the operating condition of the power source which is a voltage of the AC power to control the AC power frequency.

241. The controller 300 is a *power source monitor circuit* that responds to *system voltage E*. “The P & Q calculator 310 can calculate...*real power P* being injected by the microsource using the inductor current, $\bar{I}_{\text{inductor}}$.” EX1011, ¶[0077].

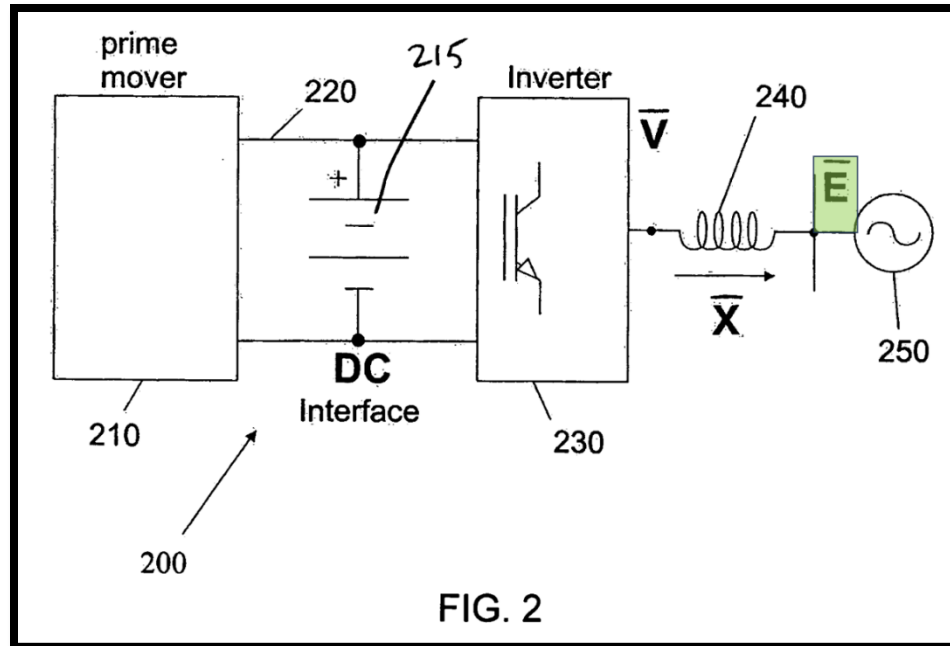
Figure 3 shows **system voltage E** as the voltage input to calculator **310** that calculates P_{meas} .



242. As I explained above in [19], **system voltage E** is the *voltage of the AC power*. As I explained at length above, POSITA would have known or found it obvious to use **system voltage E** and $I_{inductor}$ to calculate P_{meas} (which frequency control responds to) because the parameters are directly related by well-known equations. EX1005, ¶[0077], [0190], FIGS. 1-4, 12; EX1022, 63-64; *See above* [19], [21.b].

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

243. My discussion above for element [19] is also applicable here. Because controller **300** changes frequency in response to P_{meas} , and because P_{meas} changes based on **system voltage E**, the controller **300** itself responds to the AC power's voltage.



[23.] A power system as claimed in claim 21 wherein in b) the power source monitor circuit is responsive to a voltage of the AC power dropping below a known voltage to control the AC power frequency to be the second frequency.

244. My discussion of the controller 300 in [22] is applicable here as well.

Because the controller 300 measures the AC output's current and voltage, the controller 300 is responsive to *voltage*. Assuming the power source provides a substantially constant current $\bar{I}_{\text{inductor}}$, when the output *system voltage E* drops—such as from large circulating reactive currents caused by loads attached to the system—the measured real power $P_{\text{meas}} = E \times \bar{I}_{\text{inductor}} \cos(\phi)$ correspondingly decreases. And so, even without a change in current, controller 300 remains responsive to the *voltage of the AC power*, and as *system voltage E* drops below a known voltage E_0 , frequency would change proportionately to the second frequency. POSITA would have understood or found obvious that large voltage

drops can damage power sources if not corrected promptly because they drive the power source outside of its operational range, and so POSITA would have been motivated to implement such voltage-responsive frequency control. EX1005, ¶¶[0017], [0058]; EX1021 ¶¶[0021], [0026]-[0034]; EX1023, Abstract, [0003] (“predetermined range”).

[25.] A power system as claimed in claim 21 wherein in b) the power source monitor circuit is responsive to a wattage of the AC power rising above a known wattage to control the AC power frequency to be the second frequency.

245. POSITA who wished to implement a Lasseter-Lopes combination would have understood or found it obvious that P_{meas} and P_0 are *wattages* because power is commonly measured in watts. EX1014, 3; EX1007, 15; EX1022, 138. The controller **300** is a *power source monitor* that compares the *wattage of the AC power* (P_{meas}) to a *known wattage*: “set point unit power flow P_0 .” EX1005, ¶[0107]; *See above* [21.b], [17.a] (P_0 is “known”).

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

[Eq. 8]

246. Controller **300** would use “ P_0 and... P_{meas} to control the instantaneous operating frequency ω_i of the inverter.” EX1005, ¶[0107], FIGS. 3, 12. My discussion above for element [17.a] is also applicable here. When P_{meas} *rises above known wattage* P_0 (in this instance, P_{max}), controller **300 responds** by decreasing

inverter frequency ω_i *to be the second frequency* according to Equation 8. EX1005,

¶¶[0105]-[0108]; *See above* [21.b].

[27.pre] An electronic power system which provides AC power, the power system comprising at least:

My discussion above for element [17.pre] is also applicable here.

[27.a] an AC power source having one or more DC to AC inverter which converts DC power to AC power having a changeably controlled frequency, the AC power source having at least one timely operating parameter from which an overload of the AC power source may be determined;

247. My discussions above are also relevant here for the following elements: power source, [17.a], changeable frequency, timely operating parameter [17.b].

[27.b] a power source monitor, which may be part of the power source or otherwise, operating in response to the at least one timely operating parameter to control the AC power frequency to have a timely one of a plurality of frequencies including least a first frequency when there is no overload and a second frequency when there is an overload;

248. My discussions above for elements [17.b] and [21.b] are also applicable here. The determined frequency would be characterized as an “instantaneous frequency” in the framework of the ’857 patent, because it is “instant, real time, close to real time or a suitable time.” EX1005, ¶[0075].

[27.c] the power system further comprising a coupling circuit for controllably coupling the AC power to at least a first load of the one or more loads, the first coupling being responsive to the loading of the AC power source in a

manner that it performs at least one of helping to prevent, or helping to mitigate, overloading of the power source.

249. My discussions above for elements [17.c] and [21.c] are also applicable here. Because the frequency varies based on loading, The under-frequency relays are *responsive to the loading of the AC power source*.

[28.] A power system as claimed in claim 27 wherein in b) the power source monitor is responsive to the at least one timely operating parameter which is a voltage of the AC power to control the AC power frequency.

250. My above discussion of the following is also relevant here: [22].

[29.] A power system as claimed in claim 28 wherein in b) when a voltage of the AC power drops below a known voltage the AC power frequency is controlled to be the second frequency.

251. My above discussion of the following is also relevant here: [23].

[30.] A power system as claimed in claim 27 wherein in b) the power source monitor is responsive to the at least one timely operating parameter which is a current of the AC power to control the AC power frequency.

252. My above discussion of the following is also relevant here: [17.b], [20].

[31.] A power system as claimed in claim 30 wherein in b) when a current of the AC power increases above a known current the AC power frequency is controlled to be the second frequency.

253. My above discussion of the following is also relevant here: [17.b], [20]. As I discussed above, while Lasseter describes $P_{\max}$, POSITA would have understood that power and current are directly related at a given operating voltage

because they are proportional according to well-known equations, like the one reproduced below. EX1005, ¶[0072]; EX1013, 1; EX1022, 63-64.

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

254. So, POSITA who knows P_{max} and the operating voltage also knows or can readily determine the corresponding maximum current, $\bar{I}_{\text{inductor}}$ injects. *Id.*; EX1005, ¶[0075]. This means that when Lasseter controls the AC power frequency to a second frequency based on power, it is simultaneously controlling the frequency when a current of the AC power increases above a known current..

[32.] A power system as claimed in claim 27 wherein in b) the power source monitor circuit is responsive to the at least one timely operating parameter which is a wattage of the AC power.

255. My above discussion of the following is also relevant here: [25].

[33.] A power system as claimed in claim 32 wherein in b) when a wattage of the AC power increases above a known wattage the AC power frequency is controlled to be the second frequency.

256. My above discussion of the following is also relevant here: [25].

[34.pre] An electronic power system which provides AC power to one or more loads, the power system comprising at least:

257. My above discussion of the following is also relevant here: [17.pre].

[34.a] an AC power source having one or more DC to AC inverter which converts DC power to AC power which may be controlled to change to different known frequencies, the AC power source having at least one timely

operating parameter from which an overload of the AC power source may be determined;

258. My above discussion of the following is also relevant here: [17.a] (power source), [17.b] (changeable frequency, timely operating parameter).

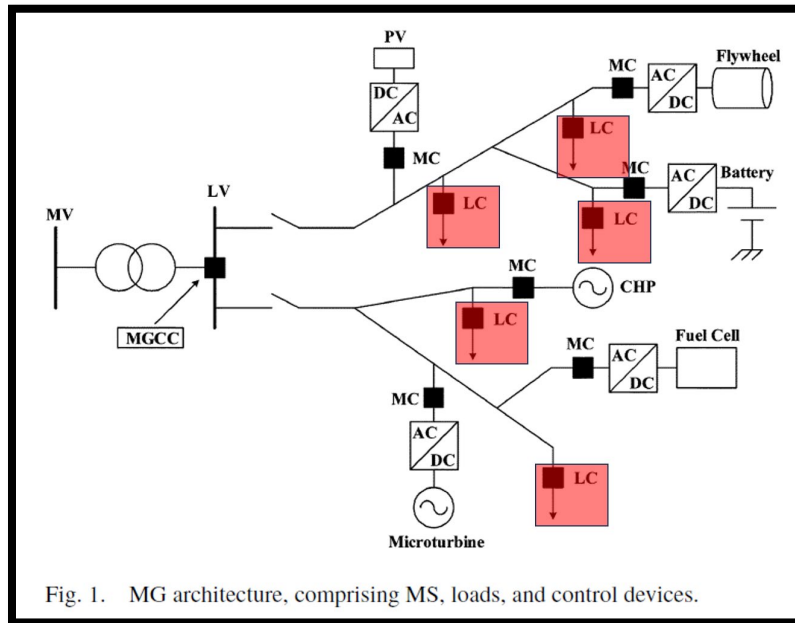
[34.b] a power source monitor operating in response to the at least one timely AC power source operating parameter to control the AC power frequency to have a timely one of a plurality of frequencies including least a first frequency when there is no overload and a second frequency when there is an overload;

259. My above discussion of the following is also relevant here: [17.b], [21.b] (operating in response).

[34.c] the power system further comprising a first coupling circuit for controllably coupling the AC power to at least a first load of the one or more loads in a manner to mitigate overloading of the power source after the AC power takes on the second frequency; and

260. Lopes implements the load-shedding algorithm using “controllers located at loads or groups of loads [load controller (LC)].” EX1011, 2, FIG.1. LCs operate “controllable loads” via the load “shedding” algorithm “based on the amplitude of frequency deviation.” EX1011, 4-5. “[C]ontrollable loads” can shed and reconnect via the LCs that “serve as interfaces,” (*a first coupling circuit*), “to *control* loads through the application of an interpretability concept.” EX1011, 2. POSITA would have understood this “interpretability concept” as referring to decoupling or found it obvious to disconnect the loads via coupling, because a POSITA would have understood or found obvious to implement LCs with the

under-frequency relays that they control. EX1008, 2:1-6, 8:1-14; EX1021, ¶[0094]; EX1024, 1:21-36.



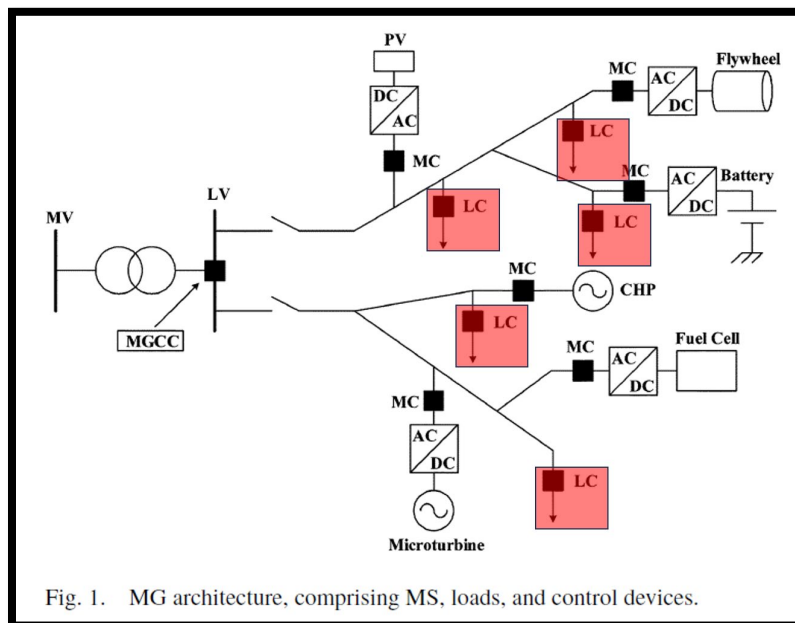
261. In the alternative, Lopes uses “under-frequency relays,” (*a first coupling circuit*) to *control the coupling of* loads. These under-frequency relays *couple output AC power to loads* and shed loads to *mitigate* “frequency deviations and transient *overload[s]*.” EX1011, 2, 4, 6, FIG. 1.

262. These under-frequency relays (which could be considered to include both LCs and relays) respond based on “the amplitude of the frequency deviation”—indicative of varying AC power output. EX1011, 5. The under-frequency relays specify “a certain amount of load” to be “automatically shed” based on the “frequency deviation.” EX1011, 6. As I have discussed above, POSITA would have been motivated to implement Lopes with known frequency

deviations corresponding to (or below) a given microsource's minimum frequency (the *second frequency*). *Id.*, 3, FIG. 4.

[34.d] further comprising a second coupling circuit for controllably coupling the AC power to at least a second load of the one or more loads, the second coupling circuit being responsive to at least one AC power source timely operating parameter, which may be the same as or different than the at least one timely operating parameter of b) to perform at least one of i) prevent an overload, ii) alleviate an overload or iii) prevent further overload if the power source is already overloaded.

263. Lopes discusses using multiple “under-frequency load shedding relays” and LC load “controllers located at loads.” EX1011, 2, 6, FIG. 1. For example, Figure 1 depicts five such controllers:



264. My discussion above for [34.c] is applicable here as well. Because the relays/LCs discussed in Lopes perform the same load control functions as the first load coupling circuit,, the relays/LCs are five distinct *coupling circuits for*

controllably coupling the AC power to at least a second load of the one or more loads. Based on the same *operating parameter* as the first coupling circuit (frequency), these under-frequency relays/LCs *prevent an overload, ii) alleviate an overload or iii) prevent further overload if the power source is already overloaded.* See above [21.c].

[35.] An electronic power system as claimed in claim 34 wherein in d) the second coupling circuit is responsive to the at least one AC power source timely operating parameter which is a voltage of the AC power.

265. As I discussed above in [19], voltage is an *AC power source timely operating parameter*. And, as discussed above for [22]-[23], controller 300 changes frequency by responding to system voltage E, *a voltage of the AC power*. Within the framework of the '857 Patent, system voltage E is *timely*, as I discussed above in [19]. Because Lopes' under-frequency relays (which includes the *first* and *second coupling circuits*) are responsive to frequency deviations, as I discussed in [34.c]-[34.d], and because the frequency deviations are responsive to system voltage E, per my discussion in [22]—Lopes' under-frequency relays are responsive to *the at least one AC power source timely operating parameter which is a voltage of the AC power*.

[36.] An electronic power system as claimed in claim 35 wherein in d) the second coupling circuit is responsive to a voltage of the AC power increasing above a known value.

266. My above discussion of the following is also relevant here: [22]-[23], [35]. Because real power is a function of voltage and current ($P_{\text{meas}} = E \times \bar{I}_{\text{inductor}} \cos(\phi)$), if a power source is providing a current $\bar{I}_{\text{inductor}}$ and the output **system voltage E** increases, the measured real power will also increase. This means even if the current remains fixed, the controller **300** is still responsive to the **voltage of the AC power** because as the **system voltage E** increases above a known voltage E_0 , frequency decreases to the second frequency. And so, Lopes' under-frequency relays are *responsive to a voltage of the AC power increasing above a known value*.

[37.] An electronic power system as claimed in claim 34 wherein in d) the second coupling circuit is responsive to the at least one AC power source timely operating parameter which is a current of the AC power.

267. My above discussion of the following is also relevant here: [17.b], [20].

[38.] An electronic power system as claimed in claim 35 wherein in d) the second coupling circuit is responsive to a current of the AC power increasing above a known value.

268. My above discussion of the following is also relevant here: [31].

B. GROUND 1B: The Lasseter-Lopes-Baldassarre-Miller Combination.

1. The Lasseter-Lopes-Baldassarre Combination would have been obvious to a POSITA.

269. The same reasons to combine Lasseter, Lopes, and Baldassarre I discussed above in reference to Petition 1 apply here as well.

270. POSITA attempting to improve the Lasseter-Lopes system's ability to detect overload would have found it obvious to incorporate Baldassarre's technique to detect overloads by monitoring distortion in the AC output's sine wave because, as explained by Baldassarre, a "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]; *see also* EX1007, 39; EX1019, 2. 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, which increases the reliability of overload detection because it provides an alternative means to diagnose an overload state. EX1021, ¶¶[0057]-[0059]. 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 had 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.

2. A POSITA would have found claims 24 and 26 obvious in view of the combination of Lasseter-Lopes-Baldassarre.

[24.] A power system as claimed in claim 21 wherein the AC power has a sine wave distortion parameter and in c) the coupling circuit is additionally responsive to the AC power sine wave distortion to performs at one or more of helping to prevent overloading; helping to mitigate overloading or helping to not increase the overloading of the power source.

271. AC or “grid” power is usually transmitted in “sinusoidal” waves. EX1005, ¶[0101], FIGS. 10(a)-(b). POSITA would have understood, or at least found it obvious to anticipate, that sinusoidal AC power will experience *sine wave distortion* because no AC power transmission is perfectly sinusoidal.

272. Baldassarre teaches a way for its “control system” to “sense the power through other means as well:

[0059] While the control system of the present invention may sense the current of the loads of the auxiliary power source, the control system may sense the power through other means as well, such as, power and frequency monitors, 60 Hertz cycles, sine waves, etc. to determine when the auxiliary power source is overloaded.

EX1021, ¶[0059]. POSITA would have understood or found obvious that such

monitoring entails detecting *distortion* in the AC waveform—i.e., deviations from an ideal sinusoid—as a standard indicator of poor power quality or overloading. Because monitoring power quality metrics was well known to POSITA, EX1007, 27 (“What is the power quality of the utility source?”), Baldassarre’s teaching of sensing the system’s “sine waves” would have led a POSITA to measure waveform distortion to identify overload conditions. Without affecting the operating principle of Lopes’ LCs or Lopes’ under-frequency relays, Baldassarre’s technique could determine whether the DER’s microsources are overloaded by evaluating the sine waves of the system’s AC power, EX1021, ¶[0059], and delay reconnection of low-priority loads to help *prevent, mitigate, or not increase the overloading of the power source.*

[26.] A power system as claimed in claim 21 wherein in c) the coupling circuit comprises a contactor having input terminals for electrically connecting to the power source and output terminals for electrically connecting to the first load and providing AC power thereto when the contactor is closed, the coupling circuit further comprising a user interface whereby the user may configure the manner in which the coupling circuit responds to the frequency of the AC power to open the contactor thereby disconnecting the AC power from the first load.

273. My above discussion in Lasseter-Lopes [17.c] is relevant here as well. Lopes shows LCs (which are or are part of *coupling circuits*) in line with loads, for example, in Figure 1. EX1011, 2, FIG. 1. Because “LC serve as interfaces to control loads through the application of an interruptibility concept,” EX1011, 2, POSITA would have understood or found obvious that LCs control a switch, relay,

contactor, or equivalent to break the connection between the power source and load. Lopes' under-frequency relays (which are or are part of *coupling circuits*) also allow for "temporary disconnection" of loads. EX1011, 4. POSITA would have understood that the ability to "disconnect" or "interrupt[]" indicates (or POSITA would have at least found it obvious) that the switches, relays, or contactors have *input terminals for electrically connecting* the microsource and *output terminals for electrically connecting* to the loads, providing AC power when the contactor is closed. For example, as is depicted in Figure 1, the power flowing through the physically wired LC terminals is what is being disconnected or interrupted.

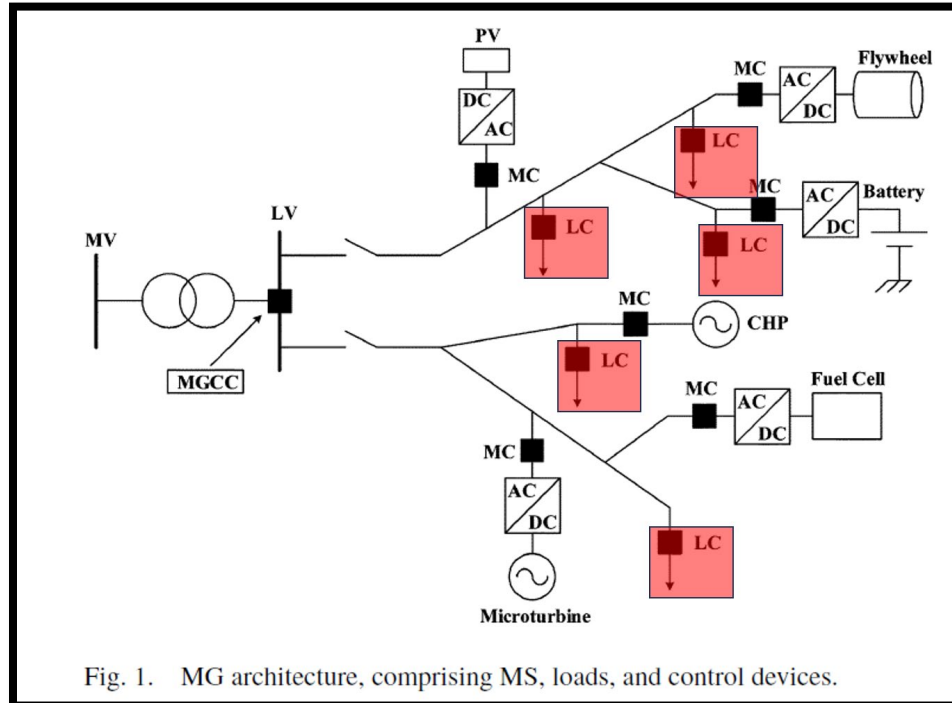
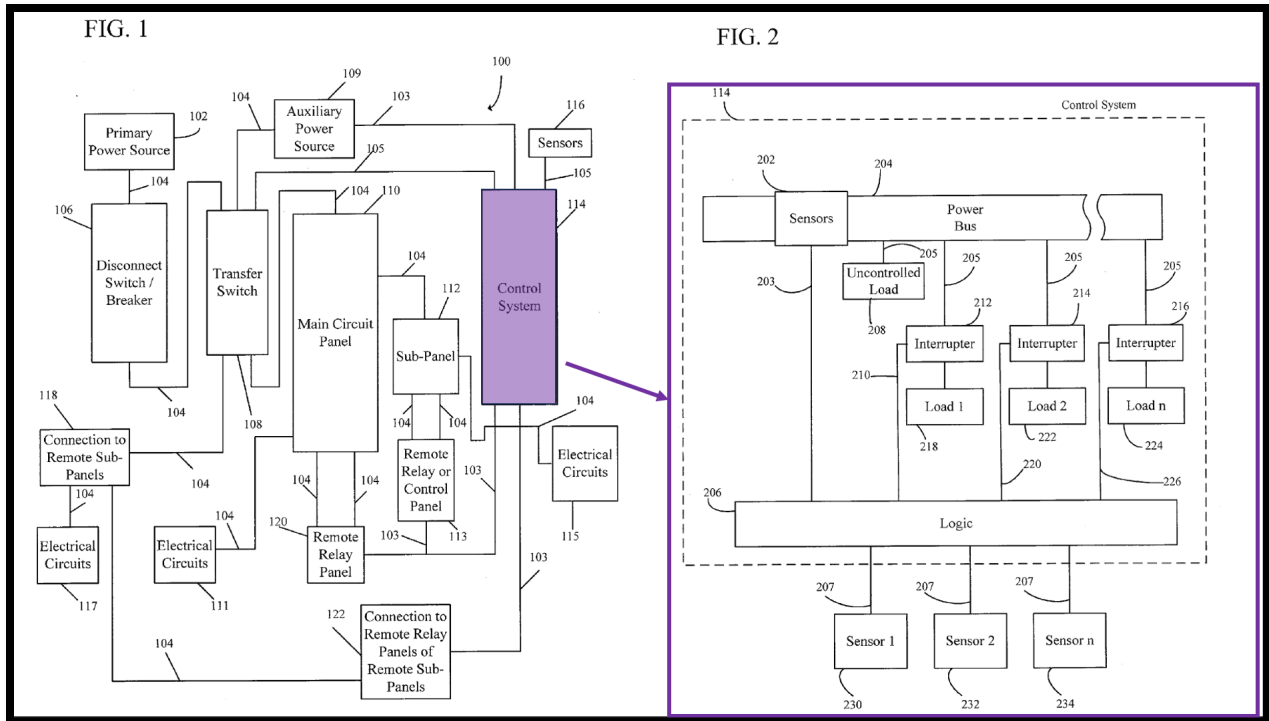


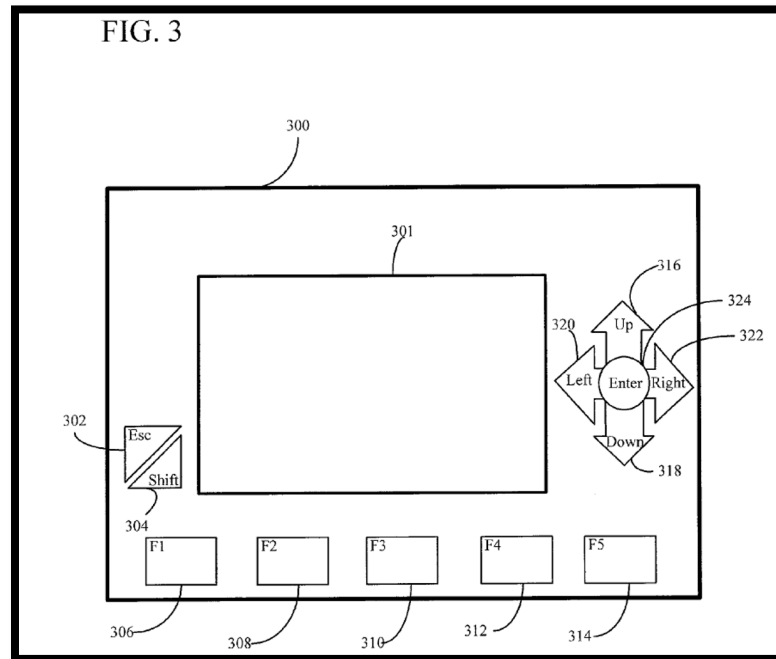
Fig. 1. MG architecture, comprising MS, loads, and control devices.

274. POSITA would have also looked to Baldassarre and found it obvious to either use Baldassarre's current interrupters as Lopes' relays or, conversely, to use Lopes' relays like Baldassarre's current interrupters. POSITA would have been motivated by Baldassarre as an example having "[d]etailed illustrative embodiments" and stated advantages. EX1021, ¶[0046], [0052]-[0056]. Baldassarre's Figure 2 depicts control system **114**, including *contactors* that it calls "current interrupters **212**, **214**, and **216**" or "relays." EX1021, ¶[0090], ¶[0091], ¶[0086]. The interrupters/relays have *input terminals for electrically connecting* to a power source output and *output terminals for electrically connecting* output power to loads **218**, **222** and **224**—"power bus **214** supplies power to interrupters **212**, **214**, and **216** via electrical wires **205**," and interrupters **212**, **214**, and **216** "are in series electrical connection with loads **218**, **222** and **224**." *Id.* POSITA would have understood or found obvious that a relay or interrupter connected in series between a power source output and a load has both input and load terminals.



275. I also understand that “control system 114 may be coupled to...at least one sub-panel via electrical wires 104” (*control electrical terminal*). EX1021, ¶[0089]. POSITA would have understood or found obvious that these wires connect the relays to the processor-based control circuitry, enabling the controller to actuate the relays while minimizing wiring complexity. Through this terminal, control system 114 “may manage the controlled loads, which may be located in circuit panels, sub-panels, and/or remote sub-panels via relays.” EX1021, ¶[0091], ¶[0086]. When shedding loads, “control system 114 sends a signal,” and relays start “breaking (e.g., deactivating the load) the connection from the auxiliary power source to the load.” EX1021, ¶[0094].

276. As I discussed above, POSITA would have been motivated to control Lopes' under-frequency relays' operating parameters using Baldassarre's control system **114** and user interactive device **300**. Baldassarre's "user interactive device **300** is a graphical *user interface*." EX1021, ¶[0097].



277. The "user interactive device **300** is used for controlling control system **114**." EX1021, ¶[0076], ¶¶[0082]-[0083], FIGS. 1-3. "Control system **114** controls electrical circuits **111**, **115**, and **117** based on a predetermined priority list established by a user." EX1021, ¶[0086]. "Upon installation of the system, the user can program the microprocessor to shed and restore the various controlled loads in any desired sequence, according to the user's priorities." EX1021, ¶[0095]. By changing the order in which loads are shed, *the user may configure the manner in which the coupling circuit responds* to changes in loading, which are

communicated to Lopes' LCs and under-frequency relays as changes in *frequency of the AC power*. EX1011, 4, 6. Lasseter's microsources all maintain constant frequency. EX1005, ¶[0113], ¶[0119], FIGS. 14-15, 17, 27. As I discussed above, POSITA would have found it obvious to use Baldassarre's user interface to set different system frequencies at which each load is shed by opening the respective relay, *disconnecting the AC power from the first load*.

C. GROUND 1C: The Lasseter-Lopes-Tsukida Combination.

1. The Lasseter-Lopes-Tsukida Combination would have been obvious to a POSITA.

278. POSITA would have been motivated to incorporate Tsukida's algorithm for load-shedding into a Lasseter-Lopes system to improve the way the system selectively sheds loads in response to deviations in frequency. EX1023, Abstract. As I explained above in [66.c], the LC and under-frequency relays in the Lasseter-Lopes combination shed loads in response to frequency. Lopes also indicates that there is a time "required for load shedding application." EX1011, 4. Of course Lopes expects POSITA to already have known the basic options and configurations when operating a relay. Even still, POSITA that were looking for more concrete instruction as to the particular algorithm by which those LCs and relays operate would turn to Tsukida. Thus, POSITA would have found it obvious to use Tsukida's load-shedding algorithm to carry out those operations.

279. **First**, Lopes generally discusses its load-shedding algorithm when it teaches LC and under-frequency relays for load shedding at certain thresholds. EX1011, 4-5. Tsukida supplements Lopes by teaching a specific algorithm for underfrequency load shedding and the associated logic for executing the algorithm. EX1023, ¶¶[0029]-[0042], ¶¶[0046]-[0050], ¶¶[0054]-[0057], ¶¶[0060]-[0068], ¶¶[0075]-[0080], ¶¶[0082]-[0090]. POSITA implementing a Lasseter-Lopes system would have looked to Tsukida to determine the appropriate logic operations to perform on Lopes' under-frequency relays. Applying Tsukida's load shedding algorithm in a Lasseter-Lopes load shedding system would simply be "a combination of familiar elements according to known methods," i.e., applying a load shedding algorithm for its intended purpose of controlling a load shedding system, to "yield predictable results," i.e., load shedding based on frequency and time. *KSR Intern. Co. v. Teleflex Inc.*, 550 U.S. 398, 401 (2007).

280. **Second**, POSITA would have wanted to incorporate Tsukida's algorithm because it would help the Lasseter-Lopes system avoid false-positive errors in load shedding. Similar to Lopes' load-shedding logic—requiring frequency deviations persist for a certain time interval, EX1011, 4—Tsukida's logic distinguishes overload conditions from tolerable transients ("out of step" conditions) and sheds loads only in the former case. EX1023, ¶¶[0038]-[0039], ¶¶[0064]-[0065]; also see EX1005, FIG. 25A. Lopes discusses shedding loads

based on frequency deviations at certain thresholds, EX1011, 4-5. While POSITA would have known of ways of avoiding false-positive errors in load shedding, EX1011, 4; EX1005, FIG. 25(a), POSITA would have incorporated Tsukida's algorithm. Tsukida's algorithm would improve Lasseter-Lopes by preventing false-positive sheds resulting from out-of-step conditions and ensuring load shedding occurs only under true overload conditions.

281. **Third**, POSITA would have been motivated to use Tsukida's algorithm because it staggers when loads are shed based on adaptive time intervals. 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 what time intervals would lead to successful microgrid systems. Tsukida supplies this information and gives exemplary timing schemes. EX1023, ¶[0037], ¶¶[0047]-[0049]. For example, Tsukida provides the below table 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]. And so, Tsukida supplies concrete implementation guidance that would enhance the performance of the Lasseter-Lopes system.

282. POSITA would have reasonably expected success when combining Tsukida with Lasseter-Lopes. Lopes already discloses using processors to execute a load-shedding strategy. Tsukida provides the logic algorithm used by processors in determining to shed loads and teaches several additional advantages. And so, the result of the Lasseter-Lopes-Tsukida combination would have been predictable to POSITA, and POSITA would have expected it to work.

2. A POSITA would have found claims 35 and 36 obvious in view of the combination of Lasseter-Lopes-Tsukida.

[35.] An electronic power system as claimed in claim 34 wherein in d) the second coupling circuit is responsive to the at least one AC power source timely operating parameter which is a voltage of the AC power.

283. My discussion in [34.c] is applicable here as well. Lasseter-Lopes has a plurality of coupling circuits. Tsukida's "underfrequency load shedding protection system 11a comprises an input processing unit 19a that receives the voltage V1a detected by the voltage transformer 38a" (*timely operating parameter which is voltage of the AC power*). EX1023, ¶[0028]. The system can "judge[] the underfrequency level" from the voltage and "output[] a load shedding command"—and so the system is *responsive to the voltage*. *Id.*

284. In the alternative, the "input processing unit 19a" in Tsukida "receives the voltage V1a...and at the same time, obtains a voltage value Va and outputs it to the underfrequency level detection unit." *Id.*, ¶[0029]. The detection unit *responds to the voltage of AC power* by "output[ting] the logical value '1' when the voltage value Va of the voltage V1a is equal to or less than a predetermined value." The value is incorporated 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]. The system 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].

285. In the alternative, I also understand Tsukida to disclose a “V/F relay that operates when the ratio (V/F) of the generator terminal voltage to the power system frequency exceeds a predetermined value.” *Id.*, ¶[0093]. When the “voltage rises in a state in which the power system frequency f has dropped,” the V/F relay “parallel[s]” the generator “off the power system” to create a “power generation shortage of the entire power system.” *Id.* POSITA would have understood that the V/F relay must detect voltage independent of frequency to determine the V/F ratio. POSITA would also have understood that the V/F relay decouples loads from the source when it “parallel[s] the generator” to “short[] the entire power system.” EX1023, ¶[0093].

[36.] An electronic power system as claimed in claim 35 wherein in d) the second coupling circuit is responsive to a voltage of the AC power increasing above a known value.

286. Tsukida’s system is equipped with “undervoltage relay 33a” which “outputs the logical value ‘1’ when the voltage...is equal to or less than a determined value.” EX1023, ¶[0033], ¶[0064]. If not less than a determined value (*above a known value*), the “undervoltage relay[] 33a” has “not detected any undervoltage”. *Id.*, ¶[0035], ¶[0061], ¶[0071], ¶[0090]. Tsukida’s system

determines that loads should not be shed when the undervoltage relay 33a has not detected an undervoltage, and so the system is *responsive to the voltage of AC power*. *Id.*, ¶¶[0064]-[0068], ¶¶[0071]-[0072], ¶¶[0084]-[0091].

287. In the alternative, as I discussed above, Lopes already discloses that load shedding is caused by “frequency/active power droop.” EX1011, 5-6. Lopes uses under frequency relays (LCs) to respond to “the amplitude of the frequency deviation”—disconnecting loads when voltage is low and reconnecting when power is restored. EX1011, 2, 4, 5; *See above* [19], [22]. POSITA would have known or found it obvious that loads in Lopes are reconnected when voltage returns above a known value, meaning the circuit is *responsive to a voltage increasing above a known value*.

IX. PETITION 3

A. GROUND 1A: The Lasseter-Lopes Combination

1. The Lasseter-Lopes Combination would have been obvious to a POSITA.

288. The same motivations to combine Lasseter and Lopes discussed in reference to Petition 1 apply here.

2. A POSITA would have found claims 45-47, 49-54, 58-60, 66-69 obvious in view of the combination of Lasseter and Lopes.

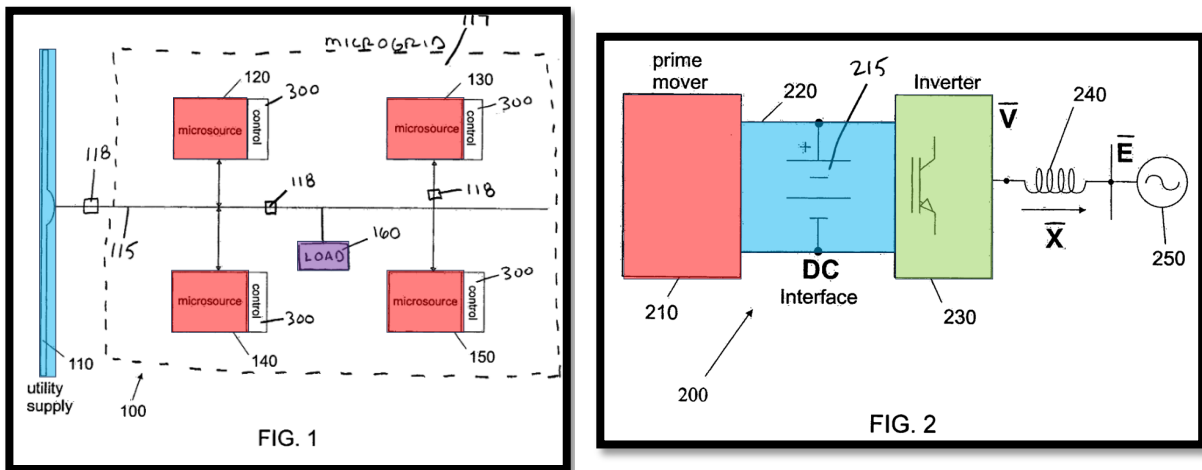
[45.pre] A power system which provides AC power to one or more loads, the AC power frequency being changeably controlled to assist managing the loading of the power system at least when not sending power to a grid, the power system comprising:

289. Even if the preamble is limiting, Lasseter's DERs comprise *power systems*. EX1005, Abstract, ¶[0063], FIG. 1. DERs comprise at least one "microsource" power source, and output *AC power*'s "AC voltage or current at the required frequency." EX1005, ¶¶[0008]-[0011]. 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.*. 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;

290. The microsources described in Lasseter 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” a “*voltage source inverter 230*”/ “*inverter 350*.” *Id.*, ¶¶[0070], [0074], FIGS. 1-3.



291. DC interface 220 connects to *inverter 230/350* and “*power storage 215...a battery*.” EX1005, ¶¶[0070]-[0071], FIG. 2. Lasseter’s *batteries* are a *rechargeable power storage system*, which POSITA would have understood or found obvious because the *battery*’s position between the *prime mover* and *inverter* suggests the *prime mover*’s power supplies the *battery*. *Id.*; EX1007, 18, 31;

EX1022, 100-103; EX11020, ¶¶[0014]-[0016] (implying that batteries serving as “storage” can hold charge generated by the system); EX1006 (same). POSITA would have understood that *inverter 230 receives power* flowing through the *battery 215* because of the functionality and description of the system, for instance, as depicted in Figure 2. *Id.* EX1005, ¶[0070]-[0074].

292. “[P]rime mover 210,” including prime movers like a “PV” (*solar PV system*) can also deliver power to *inverter 230/350*. EX1005, ¶[0069], ¶[0064], ¶[0070], FIG. 2. PV stands for “photovoltaic array,” which POSITA would have understood or found obvious to be *solar PV system*, given the ubiquity of solar panels in photovoltaic arrays. *Id.*, ¶[0064]; EX1006, 10; EX1014, 5; EX1022, 142, 210, 224-25. Other *green renewable power system* would include Lasseter’s “fuel cell...or wind turbine.” EX1005, ¶[0070].

293. As Lasseter explains, “microsource control methods...can be used to control *inverter* interfaces found in...*internal combustion engines*.” EX1005, ¶[0069]. Similar AC sources are “typically used to provide an intermediate DC voltage, that may... [be] produced indirectly from AC sources, for example by rectification.” EX1005, ¶[0010]. POSITA would have understood or found obvious that the inverter receives power from the internal combustion engine’s associated generator after it has been rectified because Lasseter had extensively taught that power from high-frequency AC sources such as generators and turbines

needed to be rectified EX1005, ¶[0010]; EX1020, ¶[0016], [17]; EX1015, 2. Lasseter also provides a “microturbine” (another type of *internal combustion power generator*) as an example microsource. EX1005, ¶[0064].

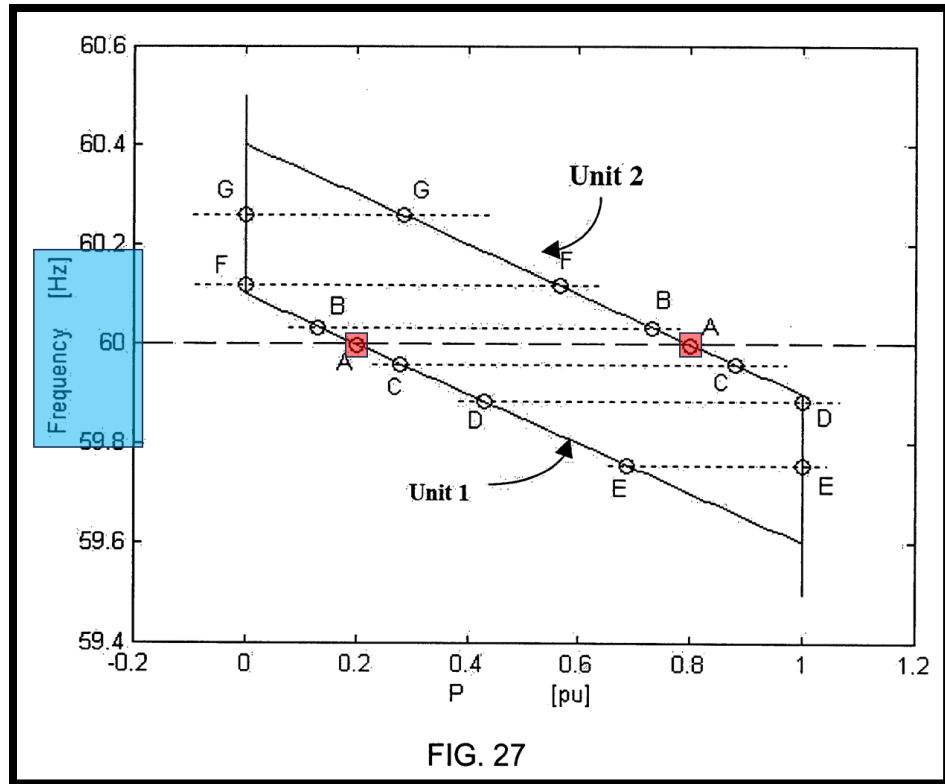
[45.a.2] the power source providing single or multiple phase output AC power to one or more loads which may include the power grid, the output AC power having one or more controlled parameter, including the AC frequency which frequency is controlled by the power source in response to the power grid frequency 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;

294. The microsource inverter **230/350** of Lasseter *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,” which means that 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. Given the situations disclosed by Lasseter where microsources are “exporting power to the grid,” the loads *may include the power grid*. EX1005, ¶[0111]; ¶[0115], ¶[0116], ¶[0124].

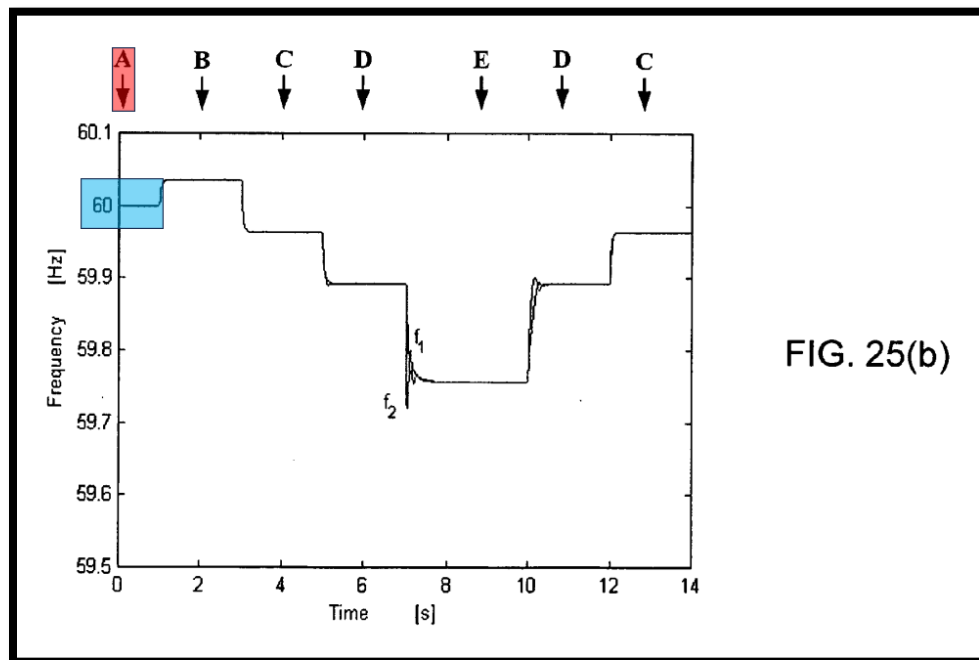
295. As discussed at length above, the *output AC power* of Lasseter’s microsources’ *have one or more controlled parameter*, which *includes the AC frequency*. Lasseter discloses “control schemes for controlling the instantaneous frequency...from one or more microsources.” *Id.*, ¶[0058]. Frequency is a parameter, as defined by the ’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 they “may at times change”).

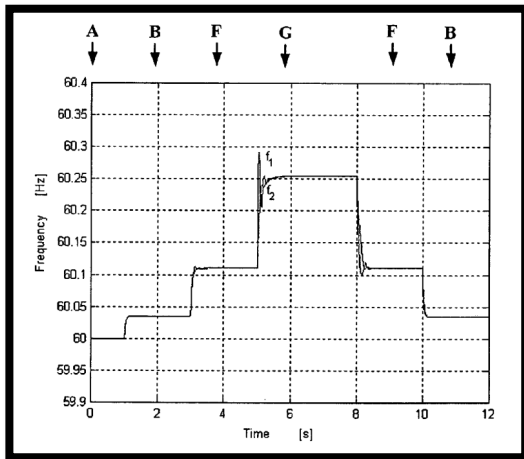
296. When operating in what Lasseter calls “grid mode,” microsources are *synchronized* to the utility grid’s frequency and “operate at the same nominal frequency” which is “system frequency, ω_o .” EX1005, ¶[0111], ¶[0113], ¶[0139], FIGS. 14-17, 27. Power is held steady because each microsource “holds its injection to a set point P_0 .” EX1005, ¶[0109], ¶[0111]. In other words, power and frequency are held constant when Lasseter is in grid mode. Consistently, Figure 27 (and 25(b)) depicts “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].



297. Figure 25(b) is similar; it depicts a 60Hz “grid connected” frequency at time A until a “transfer to island” occurs at time B (EX1005, ¶[0164]):



298. Lasseter's Figure 26(b) provides another example, showing the grid-connected frequency remaining 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

299. When a microsource imports power from or exports power to a utility grid, POSITA would have understood or found obvious that the microsources would have the utility grid's frequency imposed on it if the connection is maintained because the microgrid matches the utility grid. EX1005, ¶[0113], ¶[0139]; EX1011, 3-5. The microsources would need to match their operating frequency to the grid's to avoid system disturbances, and potential instability. EX1023, ¶[0038]-[0039], ¶[0064]-[0065] (describing the "out of step").

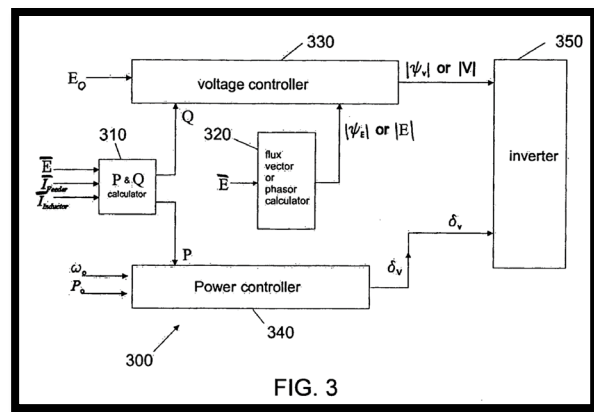
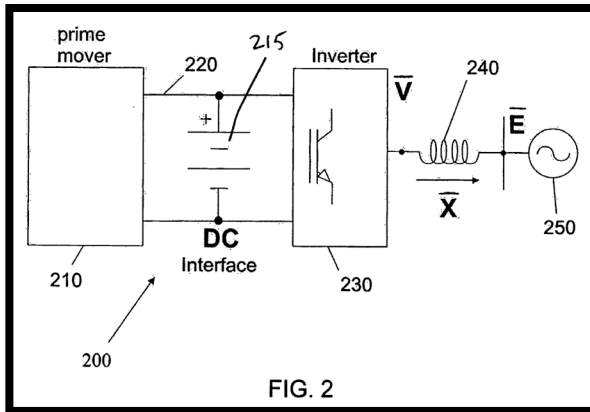
300. ***Synchronization is not desired*** "when the system islands," given that the microsources are no longer connected to the utility grid. Rather than being synchronized, "microsources" that "were importing power from the grid before islanding" must "increase their power outputs when the system islands, 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*, for 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].

[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;

301. Controller **300** of Lasseter’s microsource is a *control circuit*.

302. Controller **300** “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*.



303. Because controller **300** includes P&Q calculator **310** that calculates “real power P [P_{meas}] being injected by the microsource,” controller **300** is *responsive to one or more power source operating parameter*, P_{meas} . EX1005, ¶[0077]. P&Q calculator **310** calculates “real power P [P_{meas}] being injected by the microsource” based on timely instantaneous current and voltage measurements at inverter **230**’s/**350**’s output. EX1005, ¶[0077], ¶[0073]; EX1022, 63-64.

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

304. “Exemplary inputs to the controller **300** can include...three measured states.” *Id.*, ¶[0075]. “[M]easured state variables can be 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.” *Id.* P_{meas} is a parameter, as defined by the ’857 patent, because it is “a quantity of...[an] attribute” of the microsources, *i.e.*, the output power, “which is treated as constant” throughout Lasseter (although

it “may at times change”). Indeed, “power” is expressly listed by the ’857 patent as an example parameter. EX1001, 10:11-20.

305. Given that P_{meas} represents a microsource’s loading, it *affects the power source operation*. If P_{meas} exceeds the maximum operating power, P_{max} , the microsource can be overloaded (as discussed below).

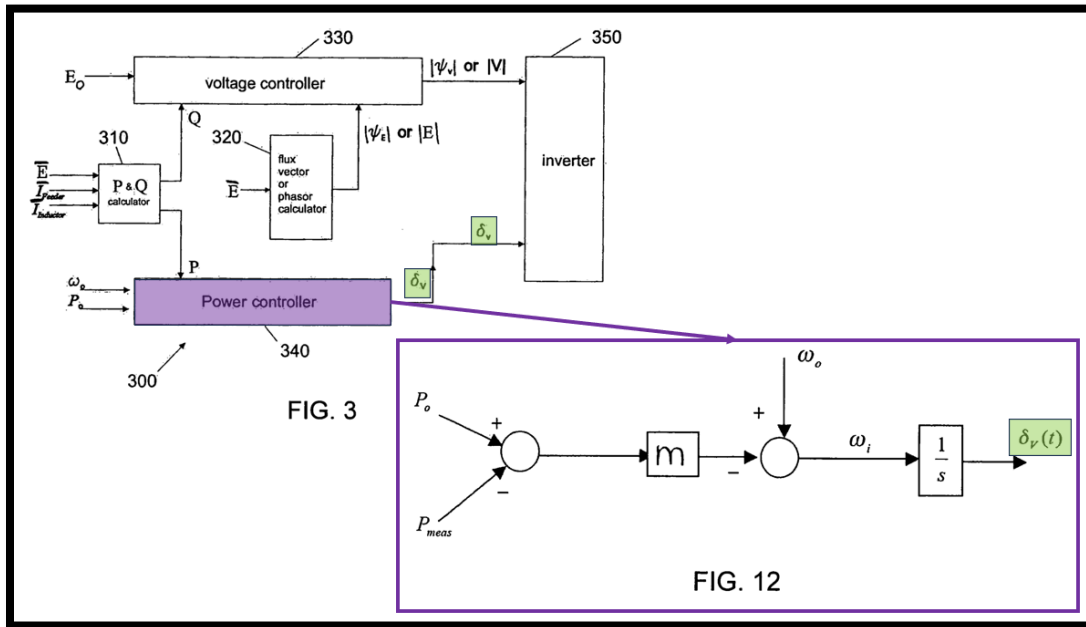
306. Controller **300** (the *control circuit* in Lasseter) “uses...the measured power P_{meas} to control the instantaneous operating frequency ω_i of the inverter.” *Id.*, ¶[0107]. Via controller **300**, changes in P_{meas} also affect the operation of the power source by causing the control circuit to change the instantaneous frequency, ω_i , of the power output by the microsource. *Id.*.

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

[Eq. 8]

307. As I discuss above in element [45.a.2]’s discussion of “island mode,” controller **300** *operates at least when the output AC power is not synchronized to the power grid or another device*. Controller **300** *operates to control one or more parameter of the output AC power*, including both “the instantaneous operating frequency ω_i of the inverter” and “the operating phase angle of the inverter $\delta_v(t)$.” EX1005, ¶[0107], Abstract, ¶¶[0105]-[0106]. Because the inverter’s phase angle sets voltage alignment of the *output AC power*, it is also a *parameter*, as defined by the ’857 patent.

308. It is “a quantity of...[an] attribute” of the microsources, i.e., the phase angle of the output power, “which is treated as constant” throughout Lasseter (although it “may at times change”).



309. Controller 300 “control[s] the instantaneous operating frequency ω_i of the inverter” when it “chang[es] the operating phase angle of the inverter $\delta_v(t)$.” 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 .

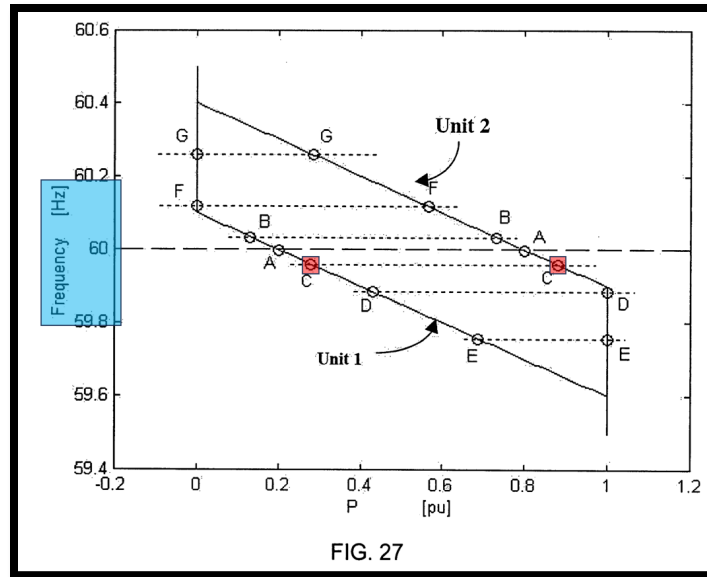
$$\omega_i = \omega_0 - m(P_0 - P_{meas}) \quad [\text{Eq. 8}]$$

310. Under the '857 patent's definition of overload, microsources are *not overloaded* when they operate at the *first frequency* ω_0 —they instead are operating within their rated power specification, between P_{min} and P_{max} . FIGS. 14-17. In other

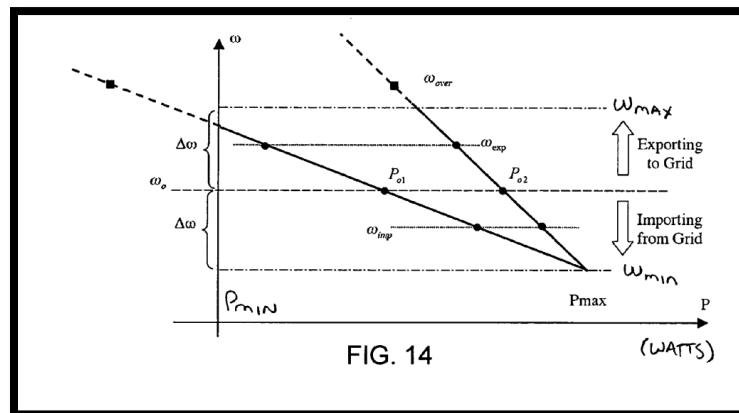
words, POSITA would have understood, or find obvious, that a load on a microsource between the minimum power, $P_{\min}$, and maximum rated power, $P_{\max}$, will not “cause a departure from specifications for the power output from the power source” because the source is designed to operate within that range. EX1005, ¶¶[0017], [0058]; EX1021 ¶¶[0021], [0026]-[0034]; EX1023, Abstract, [0003] (“predetermined range”).

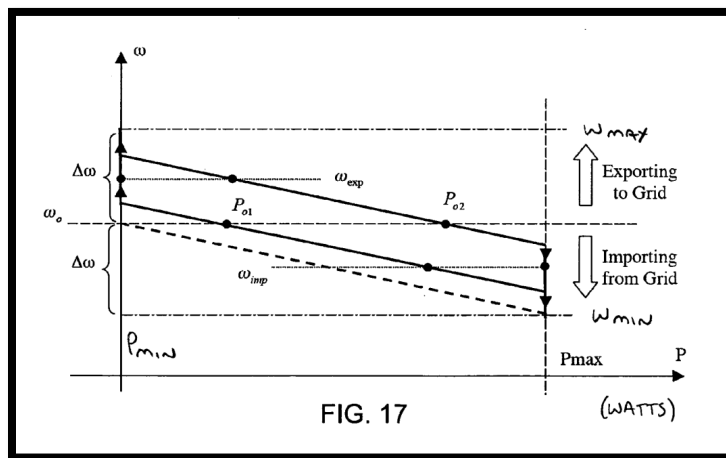
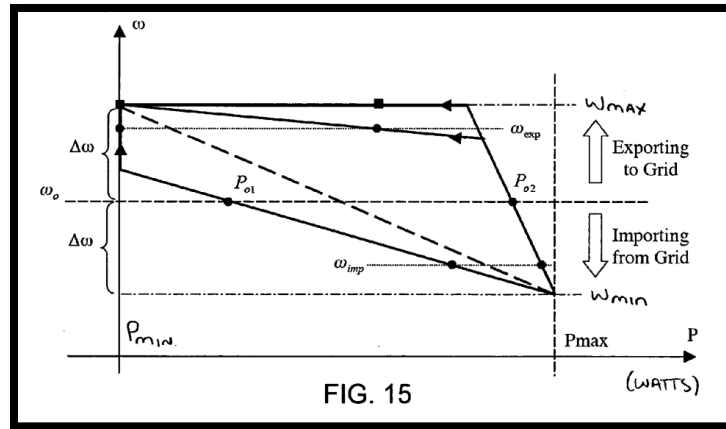
311. *When supplying excessive current*² beyond that provided at its steady-state “power set point” within its power specification (P_0 or Point A depicted in FIG. 27). The microsource *can handle* this *excessive current*, as shown by its reaching other “steady states,” e.g., Point C, in FIG. 27, within its power specification *which the AC power source can handle*. EX1005, ¶[0161].

² The claimed “excessive current” does not explain what the current is excessive in relation to; thus, any current could be an “excessive” current relative to another reference.



312. Figures 14, 15, and 17 also demonstrate this capability, with ω_0 being the system frequency. POSITA would have understood, or found obvious, the system frequency would match the grid frequency when connected to the utility supply because it would have been advantageous to ensure synchronization of the power. EX1005, ¶[0113], ¶[0139]; EX1011, 3-5; *see also* EX1023, ¶¶[0038],-[0039]; ¶¶[0064]-[0065].





313. In Lasseter-Lopes, where “load exceeds the aggregate power capacity of the units,” and the microsource also exceeds its “maximum power” ($P_{\max}$), the microsources also drop below “minimum operating frequency.” EX1005, ¶¶[0118]-[0119], ¶[0141], FIGS. 14-17. This constitutes an **overload**, as defined by the '857 patent, and the frequency below the minimum frequency is **a second frequency**. 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*).

[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.

314. Lopes describes “controllable loads” and a process (or 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 these loads can rectify an “high imbalance between local load and generation,” *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.*

315. Lopes’ load-shedding algorithm *responds to* “the amplitude of the frequency deviation” by determining “a certain amount of load” to be “shed through the activation of under-frequency load shedding relays” based on that “frequency deviation,” (here, a *second frequency*). EX1011, 6. The frequency deviation is a *parameter* reflecting changes in *output A.C. power*. As discussed, POSITA would have been motivated to implement Lopes with specified frequency

deviations corresponding to a given microsource's minimum frequency and below.

Id., 3, FIG. 4.

316. I also understand that Lopes discusses “controllers located at loads or groups of loads [load controller (LC)]” and “under-frequency relays,” which separately or together form *a processor circuit comprising one or more processors* that implement Lopes' load-shedding algorithm. EX1011, 1, 2, 4, 6, FIG.1. Even if POSITA would not have understood the LCs to refer to processor circuits, processor circuits were well known and their benefits well understood, particularly in the context of loading shedding. EX1021, EX1024, EX1025, and EX1027. It would also have been obvious to implement Lopes' load-shedding algorithm on a processor circuit to benefit from the speed and convenience of modern computing and control systems.

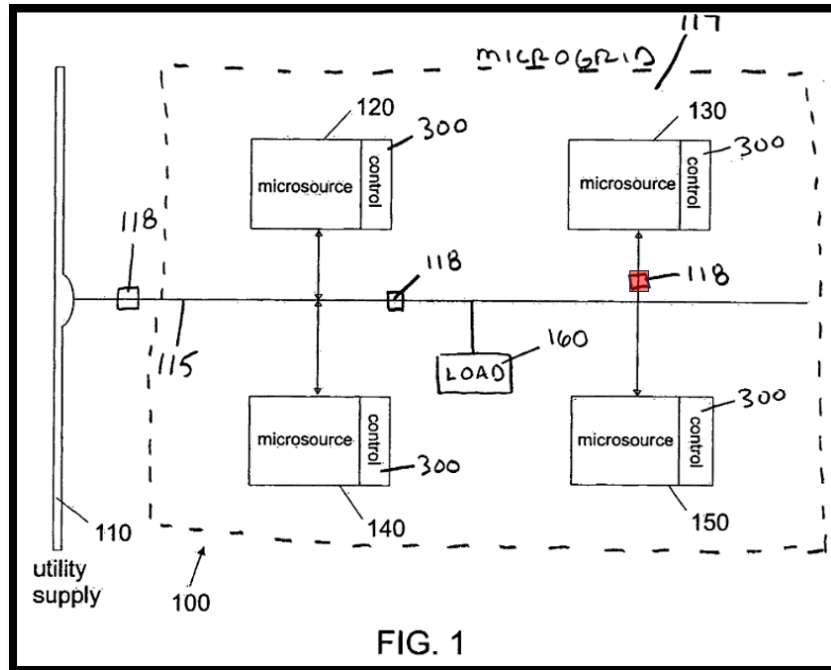
[46.] A power system as claimed in claim 45 which provides renewable and backup power in addition to grid power, wherein the power source provides output AC power which is coupled via one or more contactor or transfer switch to the one or more loads which without the output AC power would normally be 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.

317. 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]. “[P]ower sources can...provide **backup** to their owners when the main power grid is unavailable.” *Id.*, ¶[0008]. Lasseter also uses batteries to provide power, which serve as another form of **backup power**. *See above*, [45.a].

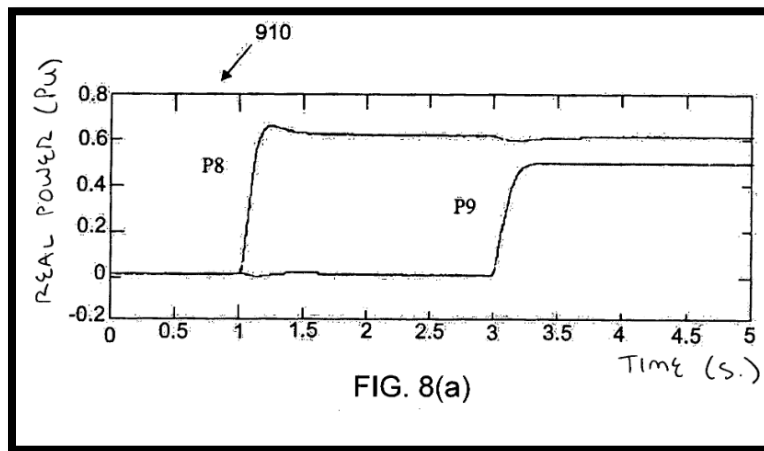
318. A DERs as discussed in Lasseter may have “exemplary microsource **200**” that “can include a prime mover **210**” which “can be, for example...PV, or wind turbine.” EX1005, ¶[0070]. POSITA would have understood PV (photovoltaics) and wind turbines to be **renewable** power sources, given their ubiquitous use as alternatives to traditional fossil fuels and Lasseter’s descriptions of the sources as “renewable” in other publications.. EX1005, [0008]; EX1006, 2; EX1029, 1; EX1026, 1:13-27; EX1016, 3.

319. The **interface switches 118** discussed by Lasseter are **contactors or transfer switches**. These **interface switches 118** could sever the connection between a microsource and a utility supply **110** or “can be positioned in other places.” EX1005, ¶¶[0064]-[0067]. For example, in Figure 1, an **interface switch 118** couples microsource **130** to **loads 160** and **provides output AC power**, as I discussed above in [45]. *Id.*



320. Loads **160** would be powered by utility supply **110** (*the grid*) if the microsources provided no power. EX1005, ¶¶[0064]-[0067]. For example, Lasseter explains that its microgrid can operate where it is “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 exporting all power for the loads from the grid because the microsources are disconnected and the utility supplies the total demand of the loads. EX1005, ¶¶[0096]-[0097], ¶[0068]; 1007, 31-32, 38. In the alternative, POSITA would have come to this conclusion by determining that the microsources otherwise provide “backup” power, EX1011, 1; EX1014, 7-8; EX1016, 1; EX1021, ¶¶[0004], ¶¶[0016], ¶¶[0023]; EX1028, 8-9; EX1029, 1-2.. Additionally,

Figure 7 “illustrate[s] the dynamics of the microsource controls described with reference to FIGS. 1-6” and Figure 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.



321. As I explain above (in reference to element [45.a.2]), the **output AC power is synchronized with the power grid**. Lasseter further explains the 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 that it can “supplement or replace conventional power sources...when the main power grid is available.” EX1005, ¶[0008]. Lasseter also explains that its microsources can operate to be “importing power from the grid” or “exporting power to the grid.” EX1005, ¶¶[0111]-[0116], ¶[0124], ¶¶[0134]-[0136], ¶¶[0139]-[0140], FIGS. 14-17. POSITA would have understood, or find obvious,

that by importing power to the grid, so that it can 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* because the microsources would be producing energy the loads are not consuming. EX1005, ¶[0008] (“can supplement or replace conventional power sources...when the main power grid is available”); EX1011, 7 (export occurs during “low load scenario,” implying loads are not consuming much energy); EX1026, 2:54-3:7 (“may provide power to various devices...during periods where electrical grid costs exceed certain thresholds.”).

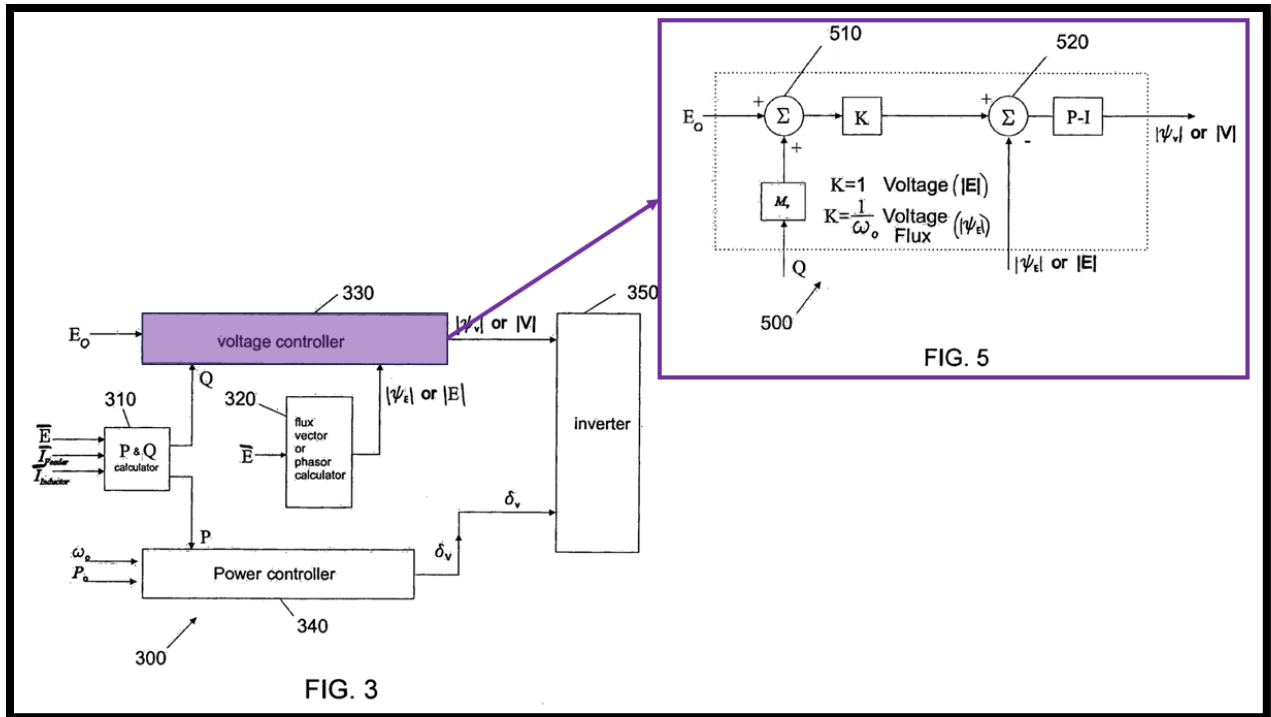
[47.] A power system as claimed in claim 45 which provides renewable and backup power in addition to grid power, wherein the power source provides output AC power which is coupled via one or more contactor or transfer switch to the one or more loads in parallel with grid power, and when grid power is 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.

322. My above discussion of the following is also relevant here: [46]. Microsources “provide backup to their owners when *the main power grid is unavailable.*” EX1005, ¶[0008]. If the main power grid is unavailable, 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, which is to say, microsources *decouple* from it. *Id.*, ¶[0101].

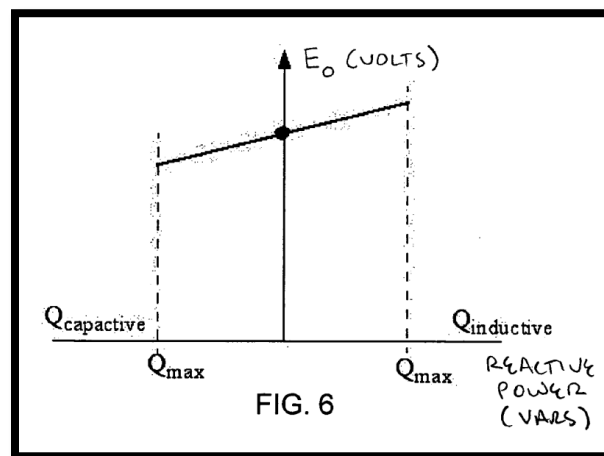
[49.] A power system as claimed in claim 45 wherein in b) the control circuit controls the output AC power voltage to decrease from a standard voltage to

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.

323. The controller **300** (which is, as defined by the '857 patent, a *control circuit*) *controls the output AC power voltage* using voltage controller **330**. “[V]oltage controller **500**...can be...voltage controller **330**.” EX1005, ¶[0086]-[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 “as defined by the slope” of the 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 , which is *a standard voltage*. EX1005, ¶[0090], FIGS. 3, 5-6.



324. The voltage decreases *a known amount* within the framework of the '857 patent because it falls along a known slope that POSITA would have understood, or find obvious, "to have been previously stored in a memory" of the voltage controller **330/500** for its use. EX1005, ¶[0090], FIGS. 5-6; EX1021, ¶¶[0092], EX1009, 6: 4-18, 7: 7-17; EX1027, Abstract; EX1027: 6, 41-55.



325. The microsources generate capacitive or inductive power when the reactive current changes, which adjusts the voltage set point because reactive power is a function of current and voltage. Lasseter explains that “small 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]. POSITA would have understood or find obvious that a reactive current exceeding the ratings of the microsource is a departure from the power output specifications, amounting to an overload, *which if continued for a period of time*, can cause *risk damage* to the microsource or *loss of power*, e.g., by overheating or tripping because excessive current is supplied being supplied during an overload. *Id.*; EX1011, 4; *see also* EX1017, 6; EX1021, ¶[0057] (“limiting the total instantaneous consumption of electrical energy”). Because power is a function of current, when a source’s power exceeds its maximum power rating at a particular output voltage, the value of supplied current would be an *excessive current*. Operating in this state would constitute the power source being *overloaded*, as defined by the ’857 patent, which POSITA would have understood to risk damage or loss of power. *Id.*, EX1005, ¶[0119], ¶[0130]; EX1008, 1:11-27, 2:14-24, 4:47-5:29; EX1011 4; EX1021 ¶[0021], ¶¶[0026]-[0034].

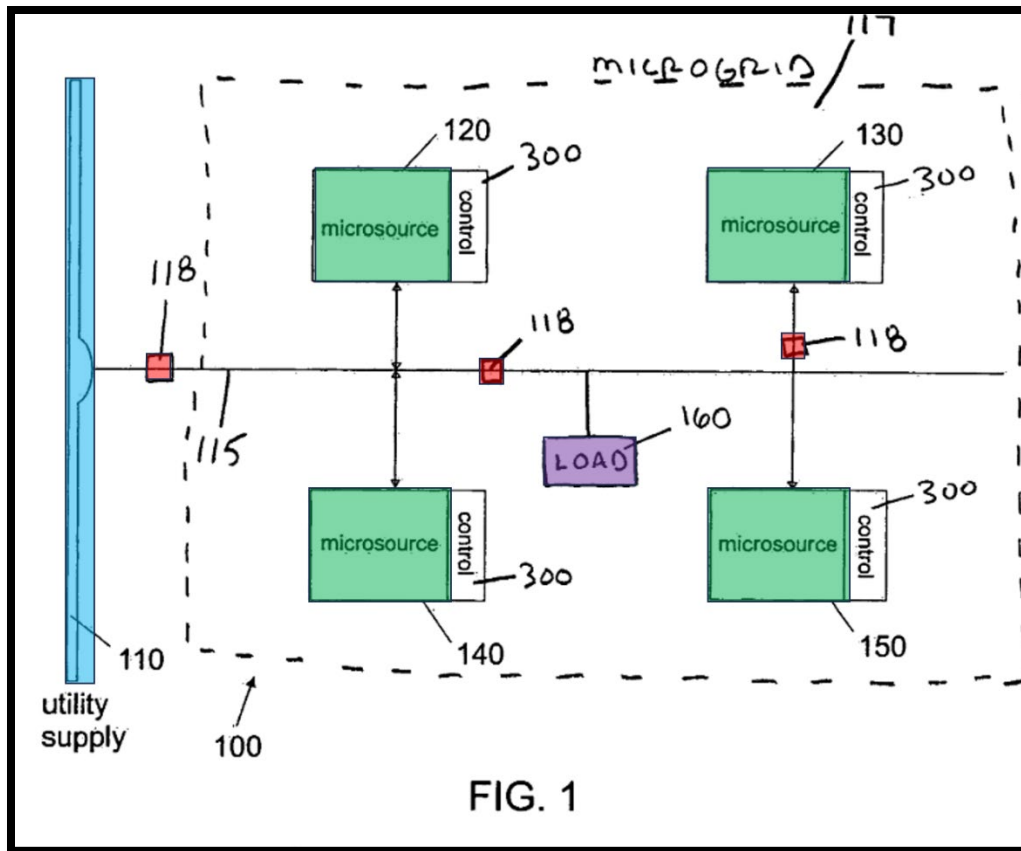
[50.] A power system as claimed in claim 45 wherein in b) when the power source has been supplying an excessive current for a period of time which if continued may risk power source damage or loss of AC power, the control circuit controls the output AC power voltage to decrease from a first standard

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.

326. My above discussion of the following is also relevant here: [49]. A POSITA would have understood that an overload of a microsource can occur as an excessive feature of current. POSITA would have understood, or found it obvious, that supplying an excessive current for a period of time, which if continued may risk power source damage or loss of AC power, to encompass overload conditions for the same reasons I discussed in [49]. As I discussed above in [45.b] and [49], when excessive reactive power conditions occur, controller **300** would decrease voltage *from a first standard voltage to a second known voltage*, and, in the event of a real power overload, *control the frequency of the ac power to decrease from a first standard frequency to a second known frequency*. Both adjustments (to voltage and frequency) would occur if changes occurred in both real and reactive load power demand.

[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.

327. My above discussion of the following is also relevant here: [46] (backup power, loads partially powered by the grid).



328. The “[i]nterface 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], FIG. 1. Lasseter explains that its 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]. When microsources 120-50 are isolated from utility supply 110, *only backup power from the* microsources is *coupled for use by* loads 160.

[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.

329. My above discussion of the following is also relevant here: [49]. Lasseter's microsources are *not overloaded* by the reactive power Q when operating at the standard E_0 (the "*first voltage*"), because they are operating at the setpoint between reactive and inductive power Q . The discussed *excessive current*, and its corresponding reactive power Q , is an *overload*, as defined in the '857 patent, because it "exceeds the ratings of the microsources," and thus "depart[s] from the specification for the power output from the power source." POSITA would have understood or found obvious that exceeding the ratings of the microsource's is a departure from the power output specifications, amounting to an overload, *which if continued for a period of time*, can cause *risk damage* to the microsource or *loss of power*, e.g., by overheating or tripping. EX1005, ¶[0119], ¶[0130]; EX1008, 1:11-27, 2:14-24, 4:47-5:29; EX1011 4; EX1021 ¶[0021], ¶¶[0026]-[0034].

[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.

330. My above discussion of the following is also relevant here: [45.a.1], [46]. If a Lasseter microsource produces *sufficient power, additional output AC power is sent into the power grid*. Lasseter confirms this understanding by disclosing situations where microsources are “exporting power to the grid,” and so additional power must be available to export. EX1005, ¶[0111]; *id.*, ¶[0115], ¶[0116], ¶[0124], FIGS. 14-15, 17, 27.

[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.

331. My above discussion of the following is also relevant here: [45.a.2] (ω_0 is grid frequency), [45.b] (first frequency no overload, second, lower frequency is overload).

[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.

332. My above discussion of the following is also relevant here: [49] (first and second voltages), [52] (not overloaded, overloaded).

[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.

333. My above discussion of the following is also relevant here: [49], [50]. Lasseter-Lopes discusses a nominal voltage set point when connected to the grid (in the language of the '857 patent, a *first voltage*). EX1005. Grid-connected microsources are *not overloaded*, for in exemplary 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.

334. On the other hand, Lasseter discusses a droop-adjusted voltage set point present when injecting current above what was being supplied while connected to the grid (in the language of the '857 patent, a *second voltage*). EX1005, ¶[0075], ¶¶[0086]-[0090], FIG. 6. Because “circulating reactive currents...can exceed the ratings of the microsources,” (as opposed to necessarily exceed), EX1005, ¶[0075], ¶¶[0086]-[0090], FIG. 6, POSITA would have understood or found obvious that there are situations where circulating reactive currents exceed those in grid-connected mode while the microsource *is not overloaded*. See above [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.

335. My above discussion of [49] and [59] are also relevant here. The Lasseter-Lopes power source when not overloaded and not supplying excessive current would have AC power with *a first voltage*. It would also have *a second voltage* that is *less than the first voltage when the power source is not overloaded* but is *supplying excessive current*.

336. I also understand that Lasseter-Lopes power system, if overloaded and supplying an excessive current, has *a third voltage* that is *less than the second voltage*. *The power system being overloaded* and continuing to supply *excessive current for a period of time risks power source damage or loss of AC power*.

[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:

337. My above discussion of the following is also relevant here: [45.pre].

[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;

338. My above discussion of the following is also relevant here: [45.a.1] (non-utility type power source), [45.b] (frequency, voltage, current vary with loading), [49] (voltage and current vary with loading), [45.c] (controllably coupled to loads). An AC power-generating circuit in Lasseter's microsources **outputs sinusoidal single or multiple phase AC power** to the "one or more loads 160" in the microgrid. 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," which shows that inverter 230/350 inverts the generated DC power to **sinusoidal** AC power. *Id.*, ¶[0071], [0107], FIG. 1, 10(a) and (b) (sinusoidal).

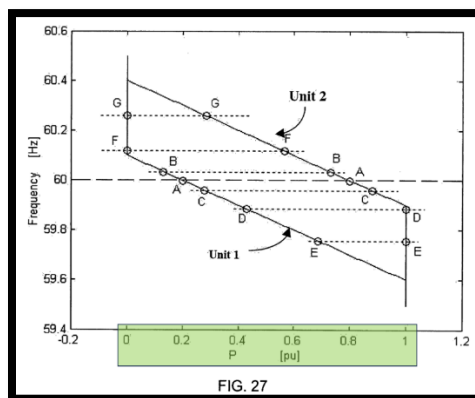
339. All **AC power** has various **parameters including frequency, voltage, sine wave distortion, and current**. These parameters **may range from zero to a maximum amount**. POSITA would have understood, or would have found it obvious, that each of these parameters **depends on the loading of the power source** because sine wave distortion is indicative of power source overloading. EX1021, [0057], [0059]. Also, as I explained above in [45.b] and [49], Lasseter has a controller 300 with a power controller 340 and a voltage controller 330/500 that control both **frequency** and **voltage** as a function of real and reactive output power of the microsource, those parameters **depend on the loading of the power source**.

Because the power is measured and calculated based on “instantaneous voltage or current measurements,” ***voltage and current vary based on loading of the power source.*** *Id.*, ¶[0075], FIG. 3; EX1022, 63-64.

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

340. Lasseter explains that even small differences between the voltage setpoint and measured system voltage (which it calls “voltage error”) “can give rise to relatively large circulating reactive currents.” EX1005, ¶[0088]-[0089].

341. Lasseter’s microsources have a “maximum output power,” “minimum output power,” “maximum frequency,” “minimum frequency,” current “ratings of the microsource,” and that these parameters vary between maximum and minimum based on the system’s loading state. 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 as shown below in Figure 27:



342. As Figure 27 demonstrates, when power drops to 0, all parameters (including frequency, voltage, sine wave distortion, and current) would follow. And so, each parameter *may range from zero to a maximum amount depending on the loading of the power source*.

343. Additionally, the parameter for power relates to the frequency of the AC power output. EX1005, ¶[0010], ¶[0012], ¶¶[0015]-[0018], ¶¶[0057]-[0058], FIGS. 10(a)-(c).

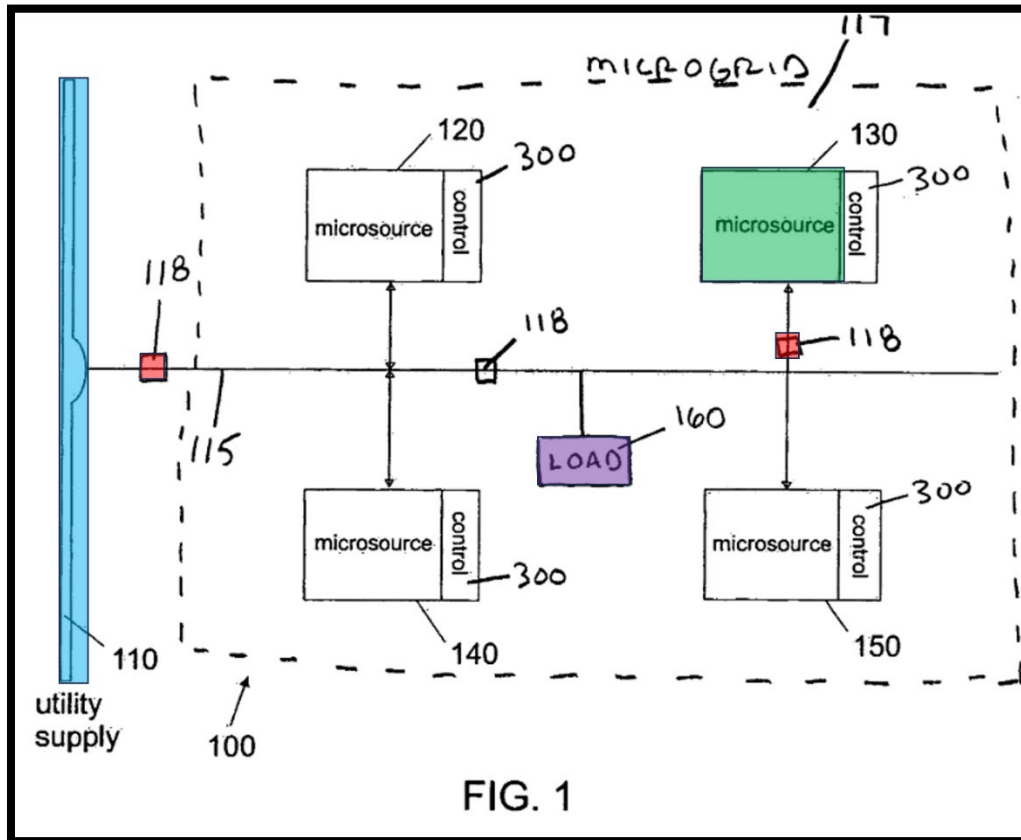
$$\omega_i = \omega_0 - m(P_0 - P_{\text{meas}})$$

[Eq. 8]

[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;

344. The interface switches **118** discussed in [46] above are *contactor and/or transfer switches*. The Lasseter-Lopes combination may selectively open or close to disconnect a **utility supply 110** and connect a **microsource 130** that was previously disconnected. EX1005, ¶¶[0064]-[0067]. Based on Figure 1, for example, the far-left **switch 118** may disconnect from the **utility supply 110** from **load 160** and the right-upper **switch 118** (attached to **microsource 130**) can connect to provide AC power to **load 160** from **microsource 130**. *Id.*, FIG. 1. Because the switches' placement permits selective disconnection of **utility supply 110** and **microsource 130**, POSITA would also have found it obvious that *AC power may*

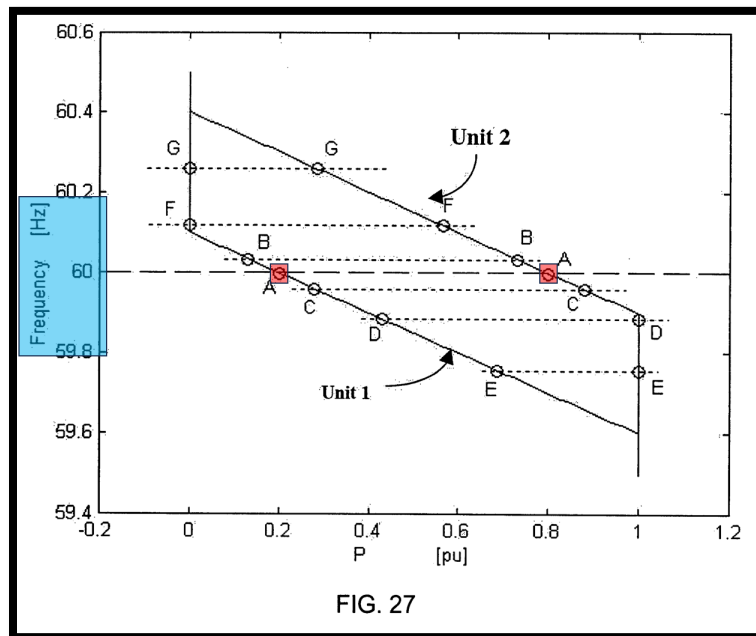
be connected in place of grid power because it is generally understood that the grid supplies AC power. EX1005, ¶¶[0064]-[0067], [21]; EX1009, 4:5-13; EX1022, 40; EX1028, 1..



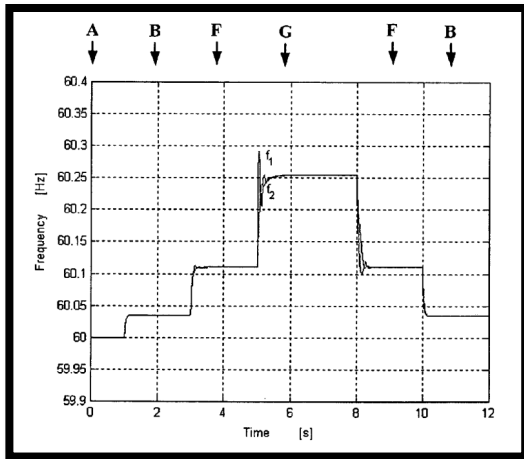
345. My discussion in [46] is relevant here as well. The power controller units in Lasseter “[i]mport[]” grid power. EX1005, FIGS. 14-15, 17, 27. Finally, as I discussed in [45.a.2], the *power source* (microsource) *controls the AC power*. [66.b.2] the frequency of the AC power is responsive to the 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

346. As I discussed in [46], microsources (like the ones in a Lasseter-Lopes combination) can provide power in parallel with a utility supply, like an electrical grid. “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*. “When the microsources are connected to the grid...they both operate at the same nominal frequency ω_o .” EX1005, ¶[0111]. For example, as shown in Figure 27 below, at “grid connected” state A, EX1005, ¶[0165], frequency is 60 Hz:



347. While a microsource system is in grid-mode, the grid-connected frequency would remain constant, like is shown in Figure 26(b) (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

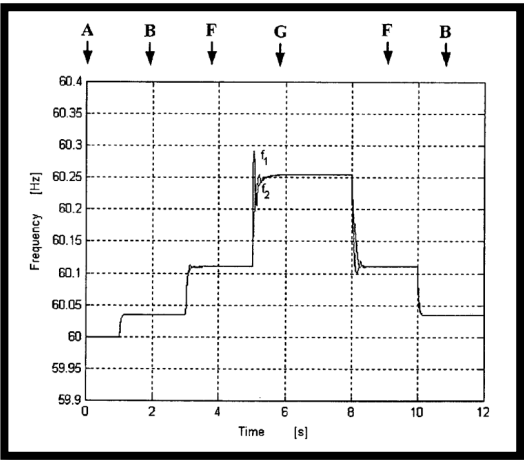
348. POSITA would have understood or found obvious that microsources like in Lasseter-Lopes that are importing or exporting power to a utility grid would probably assume the utility grid's frequency during operation because the microgrid matches the utility grid. EX1005, ¶¶[0113], [0139]; EX1011, 3-5.. In the alternative, it would have been obvious for a microsource to match its operating frequency to the grid's to avoid system disturbances and potential instability. EX1023, ¶¶[0038]-[0039], [0064]-[0065] (describing the “out of step”).

349. “[T]he output power of each microsource unit matches its corresponding power setpoint, P_{o1} and P_{o2} ” when the microsource is operating in grid mode. EX1005, ¶¶[0113]. Also, while in grid mode, connected ***loads receive power from both the power source and grid***, because 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”). In the alternative, because microsources’ output power is “reduced when the system islands,” the microsources can “export[] power

to the grid,” and so connected loads may *receive power from one of the power source and grid*. *Id.*, ¶[0111]. In these situations, microsources are providing more power than the loads need, solely supplying them and providing excess to the grid.

[66.b.3] 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;

350. My discussion above in [66.b.2] is relevant here as well. When a microgrid is in island mode, *AC power is not paralleled with the grid*. When the power is not paralleled, the *frequency is responsive in a manner that the frequency represents the loading of the power source*, because “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, as shown below in Figure 26, an islanded microsources’ frequency *responds 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].

[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.

351. My above discussion in [45.b]-[45.c] is relevant here as well. The LCs or LC-under frequency combinations in Lasseter-Lopes to be *load manager circuits comprising one or more processor*. The LCs and under-frequency relays *respond to the frequency of the AC power*, because in a combination of Lasseter with Lopes' load-shedding scheme with the "frequency deviation" set to or below Lasseter's minimum frequency (i.e., the second frequency), loads would be shed when there is an "imbalance between local load and generation." Compare EX1011, 4 with EX1005, ¶[0130]. Above this frequency, *AC power is provided to at least one of the one or more of a plurality of loads*. See above [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; See above [45.c].

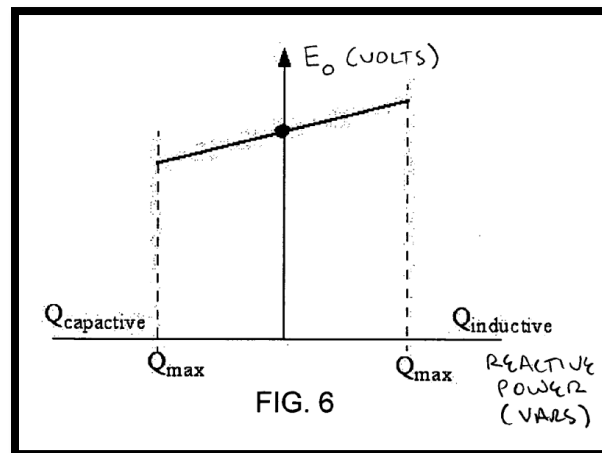
[67.] The power system of claim 66 wherein in b) ii. the power source also controls a second parameter of the AC power in response to power source loading.

352. When the microsource In Lasseter-Lopes is converting power to "usable AC voltage," the "inverter **230** controls both the magnitude and phase" "of its output voltage," either of which is *a second parameter of the AC power*.

EX1005, ¶[0010], ¶¶[0070]-[0072]. Because “unit power controller...control[s] the instantaneous operating frequency ω_i of the inverter by changing the operating phase angle of the inverter $\delta_v(t)$,” frequency is controlled *in response to power source loading*.” *Id.*, ¶[0107]; *See above* [66.b.3].

[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.

353. My above discussion of the following is also relevant here: [60]. The voltage E_0 (a “first voltage”) is a *standard* voltage because, as I discussed above, it conforms with the grid standard of 120 volts. EX1005, ¶[0160], FIG. 25(b) and 26(b) ($t=0$ “grid connected”). POSITA would have understood or found it obvious that voltage droop inherently yields different voltages (i.e., a *first*, *second*, and *third*) as current rises, because that voltage droop is controlled via a slope formed by various loading states. 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.

354. Lopes' load shedding scheme *responds to the AC power "frequency deviation"* by shedding loads after the that deviation has persisted 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 the frequency be at or beyond the threshold frequency for a "certain time interval" because POSITA would want to prevent load shedding for momentary, near instantaneous frequency departures that would not damage the microsource. EX1011, 2-4, Fig. 4. And so, when a certain frequency deviation and duration are satisfied, shedding commences, and power is not provided to the load. EX1011, 4.

B. GROUND 1B: The Lasseter-Lopes-Baldassarre Combination.

1. The Lasseter-Lopes-Baldassarre Combination would have been obvious to a POSITA.

355. The same reasons to combine Lasseter, Lopes, and Baldassarre I discussed above in reference to Petition 1 and Petition 2 apply here as well.

356. POSITA motivated by a desire to disconnect groups of loads connected to a "sub-panel" would have found it obvious to combine Lopes' "controllers located at loads or at groups of loads [load controller (LC)]" with Baldassarre's control system **114** because it would allow for efficient, convenient, and rapid shedding and restoring of the specific "group of circuits" managed by

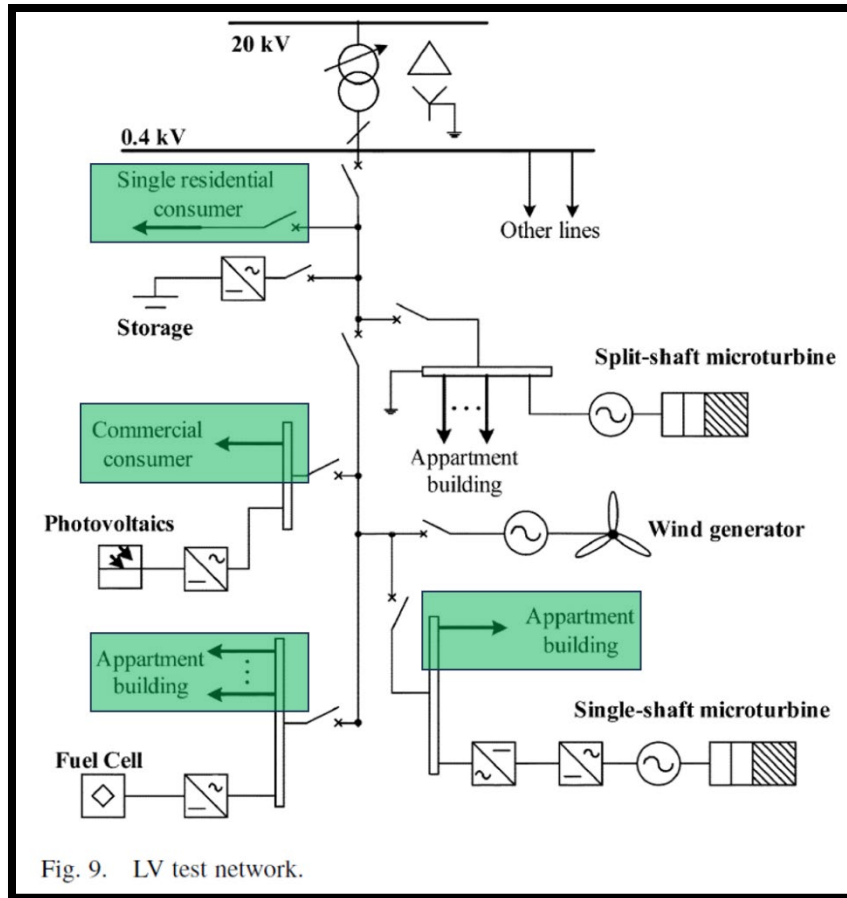
that sub-panel in real-time, thereby optimizing the system's ability to "maintain[] the total usage of power by the user at or just below the maximum capacity of the" microsource. EX1021, ¶¶[0016], [0054], [0083]-[0089]. Baldassarre's subpanels do not interfere with Lopes' under-frequency load-shedding scheme but enhance it—Lopes' relays would continue to respond to Lasseter's frequency droop in the same manner, 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 when combining the three references because it would simply be "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.

2. A POSITA would have found claims 48, 56-57, and 71 obvious in view of the combination of Lasseter-Lopes-Baldassarre.

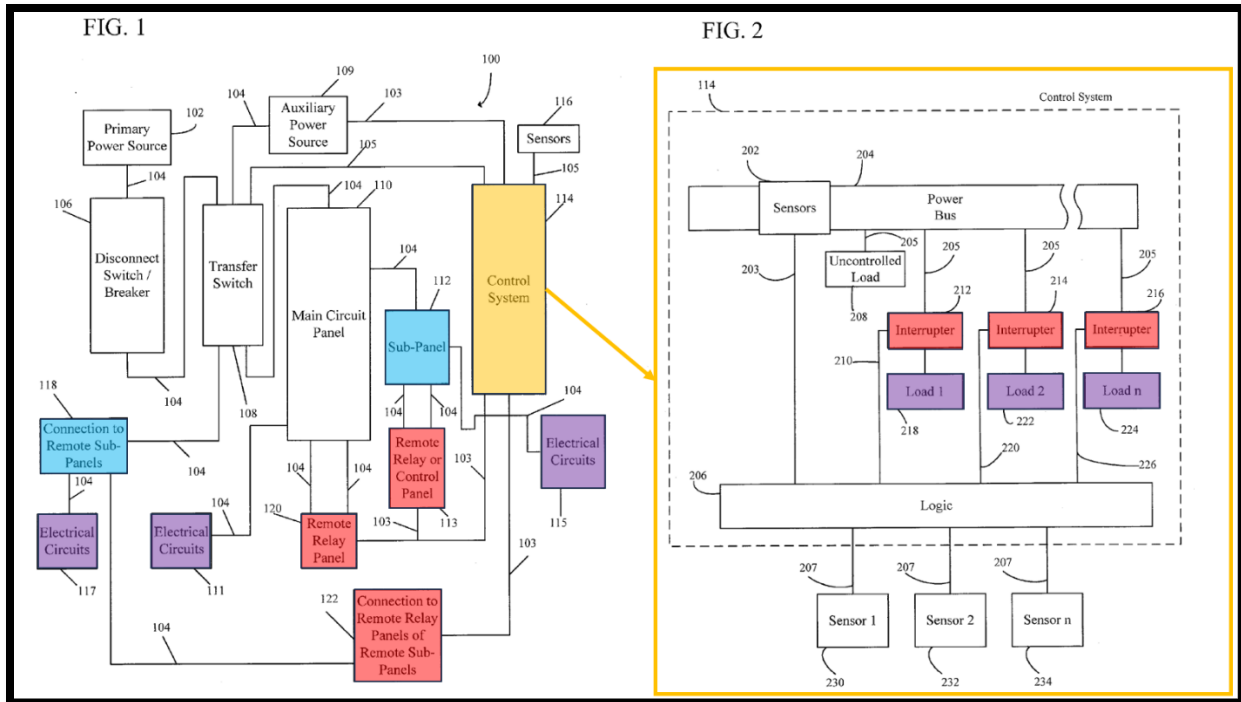
[48.] A power system as claimed in claim 45 which provides renewable and backup power in addition to grid power to a sub-panel, wherein the power source provides output AC power which is coupled via one or more contactor or transfer switch to the sub-panel to power a plurality of loads, each of which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

357. My above discussion in Lasseter-Lopes [46] is applicable here as well. Lopes has "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. Because Lopes depicts *residential*, *commercial*, and *apartment building loads*, POSITA would have understood or found obvious that the “groups of loads” referenced in the document 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; EX1022, 481 (“[S]ubpanels (service panels that get their power from the main service panel but which are located some distance from the main service panel).”). Similarly, Baldassarre discloses a “sub-panel 112” “with loads or electric circuits” (plural) and connected “remote sub panels” and explains they are “commonly known in the art as implemented within electrical systems of a dwelling or building.” EX1021, ¶¶[0083]-[0084]. And so, POSITA would have found it obvious to provide Lasseter-Lopes’ renewable, backup power and grid power to a sub-panel, such as Baldassarre’s, particularly in an application involving premises. POSITA would have been motivated to do so and have 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. *Id.*



358. Because a sub-panel passes power to loads or circuits attached to it, POSITA would have understood or found obvious that the LCs or under-frequency relays would couple Lasseter-Lopes' microsources to the *sub-panel to power the loads*. EX1022, 481 ("[F]or certain critical applications (e.g., computer and life-support systems), the ground wire probably will be included within the conduit. Also, if a subpanel is not located in the same building as the main panel, a new ground rod typically is used to ground the subpanel.")



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

360. POSITA would have been motivated to combine Lopes' “controllers located at loads or at groups of loads [load controller (LC)]” with Baldassarre's control system 114 because it would permit the convenient disconnection of groups of loads connected to a “sub-panel.” Baldassarre describes “sub-panel 112” or “remote sub-panel 118,” noting that these panels are coupled to “loads or electrical

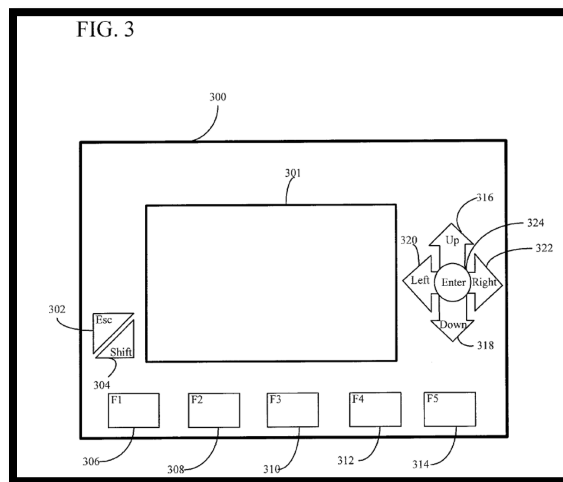
circuits...115” or “electrical circuits 117,” indicating multiple loads are connected to a single panel. EX1021, ¶¶[0083]-[0088], FIGS. 1-2.

[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.

361. My above discussion in Lassetter-Lopes [45.c] is relevant here, too. Lopes provides LCs (or under-frequency relays, which are *processor circuits*) that *control coupling output AC power* to the *loads* in Lassetter-Lopes-Baldassarre. POSITA would have found it obvious to coordinate Lassetter’s microsource control and Lopes’ LCs’ (or under-frequency relays’) functionality with a processor that is *part of* the microsource because this reduces system cost and complexity. The location of the processor circuit is an obvious matter of design choice and an option that a POSITA would have readily envisaged. *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.

362. Moreover, as I discussed above, POSITA would have been motivated to control Lopes' LCs' (or under-frequency relays') operating parameters using Baldassarre's control system **114** and user interactive device **300**. Baldassarre's "user interactive device **300** is a graphical *user interface*." EX1021, ¶[0097].



363. "[U]ser 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. Each of the load priorities being selected via a user interface.

364. Finally, while Lopes' LCs and under-frequency relays are depicted proximate to the loads they control, POSITA would have incorporated Baldassarre's teachings of control over "remote sub-panel 118" that "controls electrical circuits 117...via electrical wire 104." Including remote relays allows the control system to manage loads contained in distant panels without needing additional processors for each relay. 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].

[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.

365. As shown in Figure 1, Lopes' LCs and under-frequency relays (*processor circuits*) are *physically distinct* and located near the loads themselves. EX1011, 2-4, 6, FIG. 1. POSITA would have understood or found it obvious (for example, at least from Lasseter's enclosed switches 118) that the distinct processor

circuits located at different loads would each have their own enclosures because the distance between these processors would make a single enclosure infeasible. EX1005, FIG. 1 (switch 118 showing box enclosure). POSITA would have understood or found obvious that the LCs and under-frequency relays are *physically wired* between the microsources' *output (receiving the output AC power)* and the loads given the ubiquity of physical wiring in power transfer and given the basic function of relays and load shedding generally—they break the electrical connection in a wire to prohibit the flow of current from a power source to a load.

366. The LCs and under-frequency relays (*processor circuits*) respond to the occurrence of the second frequency and disconnect loads. *See above* Lasseter-Lopes [45.c]. Because this is a “temporary disconnection of less important loads,” POSITA would have understood or found obvious that such loads automatically reconnect. EX1011, 4, 6. POSITA would also be motivated to control Lopes' under-frequency relays via Baldassarre's user interactive device **300** because 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. *See above* [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*.

[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.

367. AC power is typically delivered in “sinusoidal” waves. EX1005, ¶[0101], FIGS. 10(a)-(b). POSITA would have understood, or at least found it obvious to anticipate, that sinusoidal AC power will experience *sine distortion* because no AC power transmission is perfectly sinusoidal. EX1019, 2 (“An increasing number of these new equipment operate in a non-linear way, and thus they produce the so-called harmonic distortion An increasing number of these new equipment operate in a non-linear way, and thus they produce the so-called harmonic distortion.”); EX1015, 5 (“It is necessary to create a power electronic interface, which allows large clusters of microgenerators to operate in both an island mode and as a satellite to the power grid *while provide high quality of power.*”).

368. As Baldassarre discloses:

[0059] While the control system of the present invention may sense the current of the loads of the auxiliary power source, the control system may sense the power through other means as well, such as, power and frequency monitors, 60 Hertz cycles, sine waves, etc. to determine when the auxiliary power source is overloaded.

EX1021, ¶[0059]. POSITA would have understood of found obvious that such monitoring entails detecting *distortion* in the AC waveform—i.e., deviations from an ideal sinusoid—as a standard indicator of poor power quality or overloading. Because monitoring power quality metrics was well known to POSITA, EX1007, 27 (“What is the power quality of the utility source?”), Baldassarre’s teaching of sensing the system’s “sine waves” would have led a POSITA to measure waveform distortion to identify overload conditions. Without affecting the operating principle of Lopes’ LCs (or Lopes’ under-frequency relays), Baldassarre could evaluate the sine waves 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*.

C. GROUND 1C: The Lasseter-Lopes-Tsukida Combination.

1. The Lasseter-Lopes-Tsukida Combination would have been obvious to a POSITA.

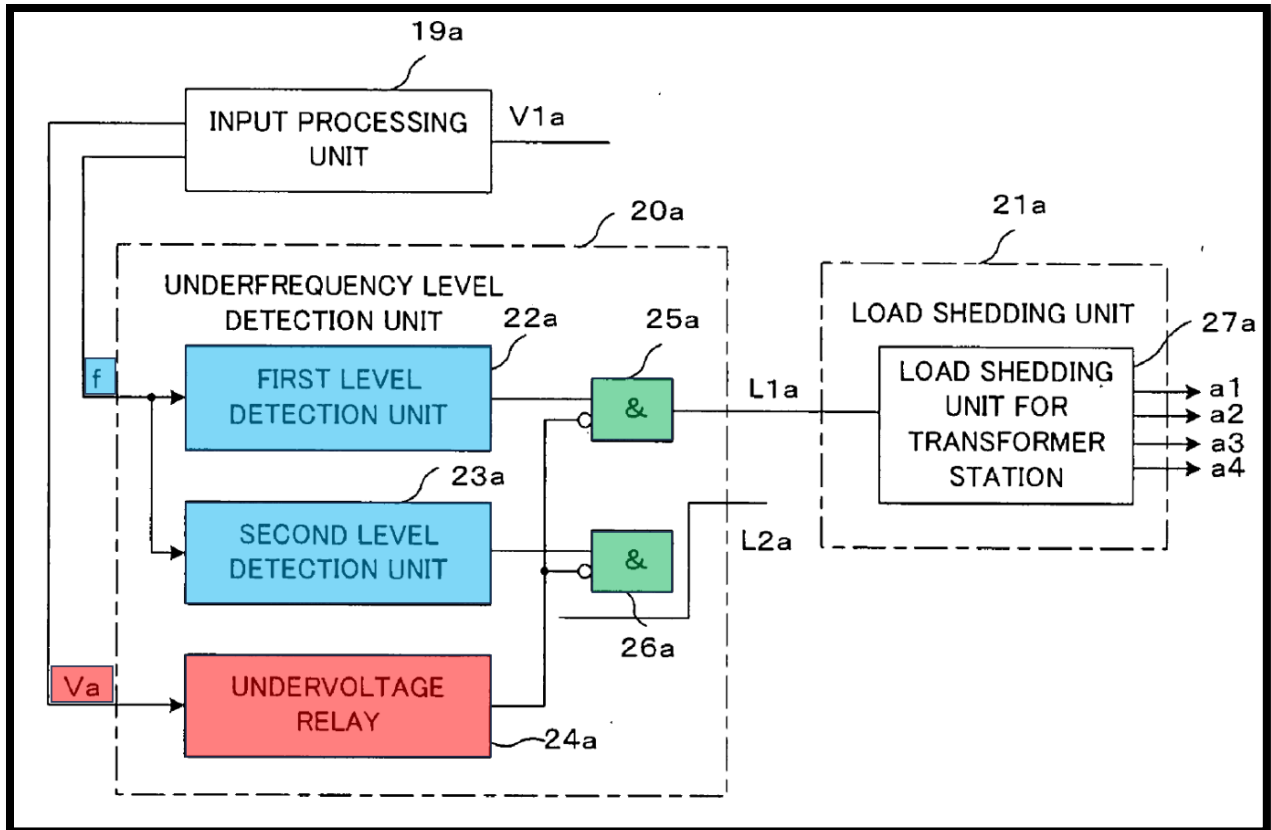
369. The same motivations to combine Lasseter, Lopes, and Tsukida discussed in reference to Petition 2 apply here.

2. A POSITA would have found claim 55 obvious in view of the combination of Lasseter-Lopes-Tsukida.

[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.

370. An improved “underfrequency load-shedding system” in the Lasseter-Lopes-Tsukida combination would “stably manag[e] a power system” by incorporating undervoltage sensing to avoid shedding loads when a power source’s frequency drops because it is “out of step” (instead of dropping because of increased loading). EX1023, ¶¶[0001], [0038]-[0039], [0064]-[0065]. In this system, a processor “receives the voltage *V_{la}* detected by the voltage transformer” on the bus-bar 18a to which the loads “A1 to Ai” are connected (*responsive to the voltage of the AC power*). EX1023, ¶¶[0026]-[0033], FIGS. 1-2. The processor also “obtains a power system frequency” and “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.



371. Using the voltage, the system is able 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 it does not shed loads “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].

And so, the system *is responsive to the AC power frequency and voltage* and determines whether to shed (*provide or not provide power to*) loads.

D. GROUND 1D: The Lasseter-Lopes-Baldassarre-Tsukida Combination.

1. The Lasseter-Lopes-Baldassarre-Tsukida Combination would have been obvious to a POSITA.

372. For the same reasons that POSITA would be motivated to combine each of Baldassarre and Tsukida with Lasseter-Lopes individually, POSITA would be motivated to combine them all collectively. 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. 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. POSITA would have recognized that 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. EX1021, ¶¶[0025]-[0027], [0063]-[0075], [0093]; EX1023, ¶¶[0029]-[0042], [0046]-[0050], [0054]-[0057], [0060]-[0068], [0075]-[0080], [0082]-[0090].

373. POSITA would have understood that implementing Baldassarre's user interface with Tsukida's algorithmic control enhances the overall system—it allows the user to configure the frequency-deviation thresholds that underlie Tsukida's logic. EX1021, ¶¶[0020], [0096]-[0104], [0105]-[0107]. This is motivating because such configurability drove POSITA design decisions. EX1025, 11 (“[U]se of the cross-point switch matrix in a load shedding scheme enables...utilization of an operator settable quantity of load to shed for each of a number of secondary contingency triggers.”). Though Tsukida provides an algorithm for determining when and how to shed loads based on measured frequency and elapsed time, it does not disclose how users select the relevant timing intervals, setpoints, or frequency thresholds. *E.g.*, EX1023, ¶¶[0029]-[0044]. In contrast, Baldassarre's interface and controller **114** expressly allow the user to define and adjust such parameters similar to the parameters for which Baldassarre already discloses configurability—including load priority, restoration order, and timing sequences. EX1021, ¶¶[0075]-[0076], ¶¶[0095]-[0103], ¶[0108]. 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.

374. When combining Baldassarre and Tsukida in the Lasseter-Lopes system, POSITA would have reasonably expected success because both 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.

2. A POSITA would have found claim 55 obvious in view of the combination of Lasseter-Lopes-Baldassarre-Tsukida.

[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.

375. See above [45.c] (coupling), [48] (user interactive device **300**), [56] (disconnected for a first time period based on load priority set via user interactive device **300**).

376. The power system described by Tsukida has 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].

377. Tsukida discloses that 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

378. Tsukida keeps loads that have been shed disconnected for a time period responsive to the load's priority—this time period is selected via a user interface. See above [57].

X. CONCLUSION

All statements made herein of my own knowledge are true, and all statements made on information and belief are believed to be true. Further, I am aware that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both,

under 18 U.S.C. § 1001. I declare under penalty of perjury that the foregoing is true and correct.

Executed on October 9, 2025 (date), in Belmont, MA (city, state).

A handwritten signature in black ink, appearing to read "Steven B. Leeb", written in a cursive style.

Dr. Steven B. Leeb

APPENDIX A

Resume of Steven B. Leeb

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Education:

Ph.D. degree, Massachusetts Institute of Technology, 1993
E.E. degree, Massachusetts Institute of Technology, 1990
S.M. degree, Massachusetts Institute of Technology, 1989
S.B. degree, Massachusetts Institute of Technology, 1987

Experience:

Joint Appointment, MIT Department of Mechanical Engineering
MacVicar Professor of Electrical Engineering and Computer Science, Massachusetts Institute of Technology 2005 – Present
(Classes taught include: Feedback Control Systems, Signals and Systems, Circuits, Advanced Mechatronics Project Laboratory, Fields and Forces, Introduction to Power Systems, Motor Design)
Associate Professor of Electrical Engineering, Massachusetts Institute of Technology 1997 – June 2005
Assistant Professor of Electrical Engineering, Massachusetts Institute of Technology 1993—1997
Lieutenant, U.S. Air Force Reserve, Wright Research and Development Center, Microelectronics Branch (part time) 1987—1991

Legal Consulting with Trial/Deposition/Report:

Lynch, Brewer, Hoffman, and Sands, 101 Federal Street, Boston, Massachusetts, beginning January 1998,
Cyberstorage vs. Trimm, Massachusetts District Court, Deposition, Expert Reports, Trial Testimony. (1:97-cv-12369)
Fish and Neave, 1251 Avenue of the Americas, New York, NY, beginning August 2001,
VLT vs. Lucent/Tyco, Massachusetts District Court, Expert Report, Hearing Testimony.
Tyco vs. Power One (product examination, claim review).
Synqor vs. Ericson, Boxborough, MA, Massachusetts District Court, 2001/2002, Expert Report
Vinson and Elkins, 2001 Ross Avenue, Dallas, Texas, beginning August 2003,
Genlyte vs. Lutron, District Court, Expert Reports, Deposition, Trial Testimony.
Latham and Watkins, LLP, 633 W. 5th street, Suite 4000, Los Angeles, CA, beginning August 2004,
Linear Technology vs. Monolithic
Wilson, Sonsini, Goodrich and Rosati, 650 Page Mill Road, Palo Alto, CA beginning September 2004,
LeapFrog vs. Fisher-Price
Lutron, 7200 Suter Road, Coopersburg, Pennsylvania, beginning September 2004 (in-house),
German Patent Application
Vinson and Elkins, 2001 Ross Avenue, Dallas, Texas, beginning July 2005,
Lutron vs. Leviton, U.S. District Court, Eastern Pennsylvania.
McDermott, Will, and Emery, beginning December 2005,
Nilssen versus Wal-Mart Stores, et.al., No. 04-C-5363
WilmerHale, beginning January 2007,
Analog Devices versus Linear Technology Corporation

Vinson and Elkins, 2001 Ross Avenue, Dallas, Texas, beginning January 2007,
Lutron Electronics Co., Inc. versus Leviton Manufacturing Co., Inc.
Sidley Austin, LLP, One South Dearborn, Chicago, Illinois, beginning February 2008,
Synqor vs. Artesyn et.al., Eastern District, Texas, Expert Reports, Deposition, Trial
Testimony.

Vinson and Elkins, 2001 Ross Avenue, Dallas, Texas, beginning April 2008,
Lutron Electronics Co., Inc. versus C4 , Deposition, Expert Report

Vinson and Elkins, 2001 Ross Avenue, Dallas, Texas, beginning August 2010,
Lutron Electronics Co., Inc. versus Crestron, et.al. (Case 2:09-cv-707)

Sidley Austin, LLP, One South Dearborn, Chicago, Illinois, beginning January 2011,
Synqor vs. Lineage., Eastern District, Texas, Declarations, Reports, Depo/Trial Testimony

Sidley Austin, LLP, One South Dearborn, Chicago, Illinois, 2011
Synqor vs. Cisco, et. al., Eastern District, Texas, Declarations, Depo/Testimony (2:14-CV-
00232, 2:14-CV-286, 2:11-cv-54-TJW-CD)

Sidley Austin, LLP, One South Dearborn, Chicago, Illinois, 2011
Synqor vs. Vicor, Eastern District, Texas, Declarations, Depo/Testimony (2:14-CV-287)

McDermott, Will, and Emery, beginning February 2012,
Power Integrations Inc. v. Fairchild Semiconductor Int'l, Inc., et. al.,
(No.: 5:09-CV-05235-JW)

Baker Botts, beginning January 2013
Volterra v. Infineon, et. al. USPTO Re-exam declaration.

Woodcock Washburn, LLP, beginning February 2013
USPTO Re-examination of US 8,111,008, US 7,619,539, Declarations.

Duane Morris, LLP, beginning February 2014
USPTO Re-examination of US 5,905,442, Declaration, Interview.

McDermott, Will, and Emery, beginning June 2015,
Network-1 v. Alcatel-Lucent et.al., 6:11-cv-492-LED

Day Pitney LLP, March-April 2016
Philips v. Amerlux, CV 1:15-cv-13086-LTS, and USPTO proceedings

WilmerHale, starting December 2016
R2 v. Intel, (ITC Inv. No. 337-TA-1024 and 2:16-CV-1011-RWS (EDTX)), IPR filings

WilmerHale, starting December April 2017
Nokia v. Apple, (Inv. No. 337-TA-1039)

Kirkland & Ellis, LLP, starting August 2017
Fundamental Innovation Systems International LLC v. Samsung et.al.,
Case No. 2:17-cv-00145, Eastern District of Texas.

Kirkland & Ellis, LLP, starting September 2017
Avaya Inc., et. al., Case No. 17-10089, Southern District of New York

Paul Hastings, starting March 2019
IPR's for Samsung (vs. NuCurrent), USPTO

Finnegan, Henderson, Farabow, Garrett, & Dunner, LLP, starting May 2019
Asetek Danmark A/S v. CoolIT, Case No. 3:19-cv-00410-EMC

WilmerHale, starting August 2019
VLSI Technology, LLC v. Intel, (W.D. Texas Case Nos. 19-254, -255, -256-ADA) reports,
deposition, trial testimony.

Latham & Watkins, starting December 2019
Technical expert. Chamberlain v. OHD, 2:21-cv-00084 ED Texas, reports, deposition

Latham & Watkins, starting April 2020
Technical expert. Civil Action No. 1:20-cv-393 (ED Va) and ITC "In the matter of certain
tobacco heating articles and components thereof." (INV.NO. 337-TA-1199)

Carter Arnett, PLLC, starting June 2020

Technical expert. Case No. 4:20-cv-234 (ED TX)
 Brian Cave Leighton Paisner LLP, starting February 2021
 Technical expert. Case No. 4:16-cv-0399-JAR and 4:13-cv-01895-SEP (ED Missouri)
 (Nidec Motor Corporation v. Broad Ocean Motor Co. Ltd et.al.)
 Quinn Emanuel, starting December 2021
 Technical expert. Cases: Inv. No. 337-TA-1285; Civil Action No. 6:21-cv-01008-ADA;
 Civil Action No. 6:21-cv-01010-ADA
 Cozen O'Connor, starting February 2022
 Technical expert. IPR US 7,382,103; 1:22-cv-10090-MPK
 Latham & Watkins, starting September 2022
 Technical expert. Overhead Door in ITC proceedings.
 Quinn Emanuel, starting December 2022
 Technical expert, *Boston Dynamics, Inc. v. Ghost Robotics Corporation*,
 Case No. 1:22-cv-01483-UNA
 Kirkland & Ellis, LLP, starting December 2022
 Technical expert, R2 Semiconductor, Inc. v. (1) Intel Corporation (UK) Limited,
 and (2) Intel Corporation (Claim No. HP-2022-000031).
 Faegre Drinker Biddle & Reath, LLP, starting September 2023
 Technical expert, CogniPower LLC v. Samsung Elec. Co. Ltd. Et al., Case No. 2:23-cv-
 160 (E.D. Texas).
 Kirkland & Ellis, LLP, starting October 2023
 Technical expert, Vicor Corporation v. Delta Electronics, Inc. et. al., ITC Investigation
 No. 337-TA-3688, Vicor Corporation v. Delta Electronics, Inc. et al, No. 2:23-cv-00323
 (E.D. Tex.), and PTO IPR.
 Latham & Watkins, starting September 2024
 Technical expert. Inter Partes Review of US Patent 9,771,169.
 O'Melveny & Myers, LLP, starting March 2025
 Technical expert, Palisade Techs., LLP v. Micron Tech., Inc. et.al. No. 7:24-CV-00262
 (W.D. Tex.).

Sample Technical Consulting (not exhaustive):

Lutron Electronics Co., Inc., beginning in 2009
 NEMOmetrics, beginning in 2010
 U.S. Department of Energy, 2011
 Talking Lights, LLC, 1340 Soldiers Field Rd, Massachusetts, beginning December 1998
 EPRI-PEAC, 942 Corridor Park Blvd., Knoxville, TN, beginning August 2003

Honors:

AT&T New Ventures Grant 1993
 MIT Leader's for Manufacturing Program Junior Faculty Fellow 1993—1996
 Spira Teaching Award 1996
 Bose Teaching Award 1997
 Edgerton Faculty Award 1998
 Technology Review's TR100 Outstanding Young Innovator 1999
 IEEE Outstanding Young Power Electronics Engineer 1999
 R&D 100 Award, 2000
 IEEE Senior Member, 2001
 R&D 100 Award, 2002
 MIT MacVicar Fellow, 2004
 Eta Kappa Nu EECS Undergraduate Teaching Award, 2006

IEEE Fellow, 2007
Bose Faculty Award, 2013
Landsman Chair, 2021

Sample Publications (not exhaustive):

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17. Norford, L.K., S.B. Leeb, D. Luo, and S.R. Shaw, "Advanced Electrical Load Monitoring: A Wealth of Information at Low Cost," *Diagnostics for Buildings Conference: from Research to Practice*, San Francisco, CA, June 1999.
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