8.4 WALL

N/A for this system.

9.0 ELECTRICAL DATA

Refer to Z-14 series drawings for additional electrical details.

9.1 MAINS SUPPLY & QUALITY

The following Table provides the electrical power output and supporting data for the *Ingenuity CT* system:

Configuration with LM Transformer (standard)	3 phase delta, 3 wire (U1, V1, W1, PE1) into LM Transformer unit 3 phase wye, 4 wire (U2, V2, W2, N2, PE2, PE4 – electrode ground) output to CT gantry
Voltages with LM Transformer (standard)	200, 208, 240, 380, 400, 415, 440, 480, 500 VAC delta input to LM Transformer unit and 480 VAC wye output to CT Gantry server cabinet
System Sub-components	220 VAC ancillary power is fed directly from CT gantry (or through console UPS) to the CRC
Nominal frequency	50 Hz/ 60 Hz
Mains branch power capacity	112.5 kVA minimum (150 kVA is preferred) from a dedicated supply circuit. These sizes reflect North American standards. A dedicated facility branch transformer is not required to feed the LM Transformer unit.
Maximum/momentary power required	110 kVA @ 5 sec. Maximum 80 kW x-ray exposure
Steady state / long time / processing	15 kVA
Standby / idle	3 kVA
Line voltage variation	+10% -10% total (absolute) limits
Phase to phase imbalance	3%
Load voltage regulation	+/-5% not to exceed absolute limits
Voltage drop allowed in feeders (copper)	2% in feeder wires when supply source and other line impedance contributors do not exceed an additional 3%, which equates to 5% total regulation limit.
Conductor impedance	Ohms /1000 ft. (305 m), 0.85 PF, copper wires in steel conduit
Power Factor	0.85 min. PF (includes LM Transformer unit)
Mains resistance (for all source impedance measured at CT Gantry)	160 mOhm line to line, max at 480 VAC
Supply current **440/480 VAC** (standby, steady state, maximum)	Standby 4 Amps, 3 phase average, Steady state 20 Amps, Maximum 149 Amps (80 kW scan @ 480 VAC, 0.85 PF) 5 sec.
Supply current **380/400/415 VAC** (standby, steady state, maximum)	Standby 5 Amps, 3 phase average, Steady state 25 Amps, Maximum 189 Amps (80 kW scan @ 380 VAC, 0.85 PF) 5 sec.

Supply current **200/208/240 VAC** (standby, steady state, maximum)	Standby 9 Amps, 3 phase average, Steady state 46 Amps, Maximum 345 Amps (80 kW scan @ 208 VAC, 0.85 PF) 5 sec.
Voltage variation	+10 %, -10 % total within absolute limits @ 380-480 VAC
Voltage impulse	+/- 2kV per IEC 61000-4-4
Voltage surge	+/- 2kV per IEC 61000-4-5
Voltage sag	-10% of nominal within absolute limits
Harmonic distortion (voltage, total)	8 % max. THDv
LM Transformer Main Internal Circuit Breaker input	125Amp for 440/480 VAC / 150Amp for 380/400/415 VAC / 175Amp for 200/208/240 VAC
Room Safety Disconnect to CT Gantry	125 Amp @ 480 VAC/ 160 Amp @ 380/400/415 VAC - Fused disconnect (Class R or J) slow trip curve characteristic. This fuse size has been de-rated as permitted by NEC 517-72. See specifications above for actual load. ***This size represents external circuit protection within 7.6 m (25 ft.) of CT Gantry***. See **Figures 9-2a through 9-2c** for mains connection schematics and diagrams.

9.1.1 Equipment Isolation

The CT system equipment components shall be insulated from building steel, such as; raceways, trough ducts, junction boxes, floor rebar, etc. Apply Philips kit #453567245951 (Patient Table) and #453567245941 (Gantry) having the Mylar washers and strips. Only isolated ground wires from the facility power source or power conditioner shall provide proper grounding to the CT system, assuring safety and ground quality in compliance with country and local codes. See *Protective Earth Ground and Ground Impedance* paragraph below.

9.1.2 Supply Device

The supply source shall provide isolation between its input mains and output with copper windings and a 3.5% regulation rating or better (2% is preferred) compliant to UL1561 and grounded per N.E.C. Article 250-30 Grounding and Bonding, Exhibit 250.13.where the wye is bonded to protective earth. When stepping up voltage to meet Philips requirements, reverse orientation and wiring of the supply transformer is forbidden. Floating delta or corner/split leg ground is only permitted when the Philips approved LM Isolation Transformer (or other Philips approved power conditioners) are provided as a separately derived source and re-grounded as specified above. Philips shall approve the type and use of any power protection and conditioning equipment.

A dedicated facility branch transformer is not needed when the Philips LM Transformer unit is provided. The LM Transformer will provide isolation between its delta input and wye output as a separately derived source. The benefits of having this isolation transformer on the branch line feeding the CT system are:

a. Provides isolated and dedicated earth conductors (PE1 and PE2) at the Neutral / Ground X0 reference point directly to the CT system.
b. Minimizes the run length of feeders to within 61 meters (200 ft.).
c. Improve power factors and reduce fault current.
d. Adjusts voltages from 200V – 480V to meet CT system input requirements.
e. Reduce harmonic currents induced in the supply.
f. Enables CT system to meet EN/IEC regulatory requirements.

9.1.3 Protective Earth Ground and Ground Impedance

The customer's facility staff shall maintain the facility to local codes and industry standards, such that Protective Earth Ground currents are properly returned to the source of the power. The facility's Protective Earth Grounding system shall be connected to a physical earth grounding network via dedicated protective earth conductors, supplied by the medical facility. All branch circuits for fixed electrical equipment and receptacles supplying power to equipment in the patient care area are required to have this redundant grounding system in order to maintain the functionality and integrity of Philips medical diagnostic (CT) systems and to protect against potential damage the CT system. If Protective Earth facility and/or physical earth grounding network integrity is compromised, functionality or safety issues can arise from normally occurring leakage currents in the milli amp range, or system damage due to catastrophic events such as the facility being compromised from power surges and/or lightning strikes, which can occur in the 100,000 Amps range.

Preferably, the earth conductors shall have their origin at the facility electric utility power entrance or a separately derived supply source (or Philips approved power conditioner) with an N/G reference point per NEC 250-30, Exhibit 250.13 (see Supply Device above) or NEC 250, Exhibit 250.14 (see Exception Note below). For reduced maintenance, protective earth conductors are recommended to have copper chemical electrode grounding.

The medical facility staff shall measure and approve the protective earth ground impedance of the conductor at the electric utility's power entrance to the facility or a newly derived supply source.

- **A ground impedance value of less than 5.0 Ohms is recommended.**
- **Ideally, the facility ground impedance value should be limited to 2.0 Ohms or less.**
- **For China**: if the facility ground connects to an Independent Grounding point, the facility ground impedance value should be limited to 2.0 Ohms. If the facility ground connects to a Common Earthing point, the facility ground impedance value should be limited to 1.0 Ohm or less (as per Ch. 12.4.3 and 12.4.7 of National Standard JGJ16-2008 *Civil Building Electrical Design Specifications*).

From the output of the LM Transformer (or power conditioner) the primary earth (PE1/PE2) conductors shall be sized equal to, and routed with, the output power conductors between the supply device and the CT system incoming line connections. The alternate primary earth (PE3) conductor can be the minimum size allowed by local codes and must be routed in the same conduit as the primary earth (PE2).

- **Per IEC 62353, resistance between CT Gantry ground and the facility earth ground must not exceed 0.3 Ohm.**
- **For China**: the resistance between CT Gantry ground and the facility earth ground must not exceed 0.2 Ohm (as per Ch. 9.3.4 of National Standard JGJ312-2013 *Medical Building Electrical Design Specifications*).

Important Note: For Corner Grounded Delta (CGD) systems, the ground fault sensing is undefined for the grounded phase. Therefore, CGD is not suitable for healthcare facilities, where GF is required.

Exception Note: Grounding and bonding per NEC 250.14 is permitted when the grounding electrode conductor connection is made at the first disconnecting means, then fed directly to the Exam Room's Safety Disconnect Box.

In general, negligence to maintain the facility grounding system, and/or the physical earth grounding network will impact the CT product reliability and warranty coverage.

9.1.4 Over-Current Protection and Residual Current Protective Devices (RCDs)

Over-current protection on the mains circuit shall be provided connecting the supply device, LM transformer, power conditioner or full system UPS that feed the CT system as specified by local and national codes. Some power conditioners have over-current protection built in. Refer to Philips specifications above

on maximum demand, steady state and standby modes of operation. Where external protective devices are applied, such as RCDs, circuit breaker or line fuses, size of these circuit protection devices must not exceed amp ratings of the feeder wires, as specified by local or national codes within allowable de-rating rules. RCDs should be rated at < 40 msec. or faster.

9.1.5 Remote Emergency Off (EPO)

As a minimum, there shall be a means for remotely turning OFF the power at the supply side of the LM transformer or other Philips approved power conditioning equipment. The Philips power conditioning devices have built-in provisions to accommodate a remote EPO switch. These switches are to be installed in the Control Room near the operator's console or as determined by local or national codes.

9.1.6 Room Safety Disconnect

A means shall be provided to lockout power to the CT Gantry as may be required by local or national codes. This 3 phase room disconnect switch with line fuse is to be located within visual inspection of the Gantry such that service personnel can lockout the power source, and easily view its state of operation. Additional protection may be required further up the line within 7.6 m (25 ft.) of the LM transformer unit or power conditioner output (load side) when unit is remotely located away from CT suite.

9.1.7 Filters, Surge Suppressor & Phase Protection

Line filters and surge protection is provided within the optional power conditioning equipment available from Philips. Phase conductors shall comply with, and be sized per, U.S. NEC 517.73 and Table 310-16, and/or IEC 61089:1991+A1:1997 EN 50182:2001 (international standard), or GB/T1179-2008 (standard for China), or local applicable code(s). Phase conductors shall use 90˚C copper wires, and be in accordance with Philips voltage drop requirements (See *Section 9.2 Facility Wiring*).

9.1.8 Ground Fault Detectors

Installation of external ground fault detectors and contactors are not permitted between the Philips-approved power conditioner or LM isolation transformer device and the CT gantry, in accordance to Standards IEC60601-2-32 and IEC60601-1-1.

9.1.9 Static Electricity & Electrostatic Discharge (ESD)

Static electricity, most commonly caused by people, can cause an electrical device to operate erratically or intermittently (causing "soft" failures), thereby affecting the operational characteristics of integrated circuits used in computer circuit boards and related peripheral equipment. Where possible, provide electronic equipment shielding and conductive equipment grounding to minimize ESD. If a floor covering is used in the CT suite, it should be of a type designed to minimize the effects of static electricity. Do not install nylon floor coverings. Additionally, insure proper relative humidity levels are maintained, since the electrostatic voltages generated will increase as the surrounding relative humidity is decreased.

9.2 Power Conditioning and UPS (Uninterruptible Power Supply)

The LM transformer is supplied as standard equipment for the *Ingenuity Elite* system and cannot be substituted, unless other approved power protection options are obtained through Philips, which may still require the LM transformer be included.

As an option, Philips offers Full System UPS products to meet customer input voltage and frequency requirements and assure performance compatibility with *Ingenuity CT* Systems.

Refer to the PRD webpage on InCenter for user and installation manuals describing all BU approved transformers, power conditioning and UPS equipment options on incoming power, installation, safety, shipping and handling requirements. Other commercial brand UPS devices may not be compatible. Philips must approve substituting or adding other power protection equipment. Contact the Helpdesk if additional information is required.

The LM transformer is required between the UPS and Gantry for regulatory certification reasons, until further notice, or for stepping up voltage to Gantry for non-480V locations. It is not permitted to locate the LM transformer unit before the UPS. Customer's facility power must supply the correct voltage and capacity to feed the requirements of the UPS device as labeled.

When these power protection devices are applied, facility power ratings must be based on input capacity requirements of these devices, which may be greater than the CT system itself. This applies mainly to the UPS devices. Always provide customer's architects and engineers with manufacturer's installation and wiring instructions prior to room construction or facility renovations.

The console UPS option is for protecting the CRC or Host and Server Recon cabinets and is powered from the Gantry with Philips supplied cables to and from this UPS. No substitutes are permitted for this option.

9.2.1 Isolation Transformers

Philips will provide an LM (Line Matching) isolation transformer power unit as standard equipment to meet customer input and system output voltages and assure performance compatibility with the *Ingenuity CT* System. As an option, the Plus model is available. Always refer to the main page of the PRD for additional information as it relates to the entire *Ingenuity CT* system.

Two ECT series isolation transformer models have been approved by the CT BU. Various levels of incoming voltages have been identified to meet the needs of the customer and will provide 480 volt wye output assuring proper operation to the CT System and both include a primary EPO circuit breaker:

Philips p/n 459800313191:

- ECT (LM) part CT-PDU-115KVA-3: 35 KVA continuous, 115 KVA intermittent 15s @ 9 cycles per hour, 50/60 Hz
- Input: 200, 208, 240, 380, 400, 415, 440, 460, 480, 500 VAC
- Output: 480 VAC

Philips p/n 459801204831:

- ECT (Plus) part CT-PDU-115KVA-Plus 35 KVA (480 V), continuous, 115 KVA intermittent 15s A 9 cycles per hour, 50/60 Hz
- Input: 200, 208, 240, 380, 400, 415, 440, 460, 480, 500 VAC
- Output: 480 VAC

These isolation transformers are designed to deliver conditioned power to non-linear high harmonic current loads and operate at safe temperatures while minimizing the harmonic current effect delivered to the power grid. Another protection function is to attenuate both common and transverse mode noise going to the CT system load. The *Plus* model will include surge protection, line filters and remote start/stop functions on the load side of the transformer. Either model will establish a new ground reference point as an SDS (separately derived source).

9.2.2 Full System UPS

The optional Full System UPS devices include a separate Battery rack cabinet and are designed to provide complete power conditioning and protection against blackout situations, loss of phase, transient voltage sags & surges, waveform distortion, RFI, all mode noise disturbances to the CT system and will minimize the harmonic current effect delivered to the power grid. The Full UPS will provide a newly established ground reference point as an SDS (separately derived source). See Drawings Z-1.10.1 and Z-1.10.2 for views and dimensions.

Frequency and incoming voltage levels have been identified under the following Part Numbers (p/n) to meet the needs of the customer and to assure proper operation of the *Ingenuity CT* System:

Philips model number 989605201162

- Staco UPS 480 VAC, 125 kVA, **60 Hz**
- Input: 480 VAC. Output: 480 VAC

Philips model number 989605201172

- Staco UPS 400 VAC, 120 kVA, **50 Hz**
- Input: 380/400/415 VAC. Output: 380/400/415 VAC

The Full system UPS devices operate as on-line, double conversion UPS regulator systems as follows:

Normal: The rectifier derives power from a utility AC source and supplies DC power to the inverter as needed. The battery charger automatically maintains the battery in a full charged and optimal operation condition. The inverter converts the DC power into clean and regulated AC power that is then supplied to the CT system load.

Emergency: Upon failure or degradation of the incoming AC power, the critical AC load supplied by the inverter will draw its power form the batteries and then back to AC power instantaneously without interruption.

Recharge: Upon restoration of AC power the UPS will restart, the rectifier and charger shall assume the inverter and battery charge loads. If the bypass mode is within acceptable limits, the UPS will transfer the CT load back to the inverter.

Bypass: When the inverter overload capacity is exceeded, the static transfer switch shall perform a transfer of the load from the inverter to the bypass source with no interruption in power to the CT load.

9.3 FACILITY WIRING

For a complete diagram of power cable interconnections and schematics see below **Figures 9-3a through 9.3d** and Drawings Section Z-14 Cable Data Mains Connection Wiring Diagrams required of the customer's facility**.**

Note: Cable runs over 200 ft (61 m) from the UPS to the PDU have been seen to cause high current, high impedance and CT system failures with High Rail shutdowns.

9.3.1 480 VAC with LM Isolation Transformer or Plus

RUN A	Run distances and cable / conductor sizes from Facility Supply **-to-** input of LM/Plus unit **480 VAC** supply side:
0 - 50 ft. (15.2m)	3 #1 (42mm^2) Power 1 #1 (42mm^2) Dedicated Ground
51 - 100 ft. (30.5m)	3 #0 (54mm^2) Power 1 #0 (54mm^2) Dedicated Ground
101 - 200 ft. (61m)	3 #00 (67mm^2) Power 1 #00 (67mm^2) Dedicated Ground
RUN B	Run distances and cable/ conductor sizes from output of LM/Plus unit **-to-** Room Safety Disconnect **480 VAC** input:
0 - 50 ft. (15.2 m)	4 #2 (34 mm^2) Power and Isolated Ground (PE1) 1 #6 (13 mm^2) Redundant Ground (PE2)
51 - 100 ft. (30.5 m)	4 #1 (42 mm^2) Power and Isolated Ground (PE1) 1 #6 (13 mm^2) Redundant Ground (PE2)
101 – 200 ft. (61 m)	4 #00 (67 mm^2) Power and Isolated Ground (PE1) 1 #4 (21 mm^2) Redundant Ground (PE2)
Note: Total combined length between **Run A** and **Run B** not to exceed 250 ft. (76.2 m). Select below **Figure 9.2a** (LM) or **Figure 9.2b** (Plus) to see Mains Connection Diagram, Download Drawings Z-14.1.1or Z-14.1.2.	
RUN C	Run distance and cable / conductor sizes from Room Safety Disconnect **-to-** CT Gantry **480 VAC** input:
0 - 25 ft. (7.6 m)	4 #2 (34 mm²) Power and Isolated Ground (PE1) 1 #6 (13 mm²) Redundant Ground (PE2)

9.3.2 480 VAC with Full UPS and LM Isolation Transformer

RUN A	Run distances and cable / conductor sizes from output of UPS device **-to-** input of LM unit **480 VAC** supply side:
0 - 50 ft. (15.2 m)	4 #1 (42 mm^2) Power and Isolated Ground (PE1)
51 - 100 ft. (30.5 m)	4 #1 (42 mm^2) Power and Isolated Ground (PE1)
101 - 200 ft. (61 m)	4 #00 (67 mm^2) Power and Isolated Ground (PE1)
RUN B	Run distances and cable/ conductor sizes from output of LM unit **-to-** Room Safety Disconnect **480 VAC** input:
0 - 25 ft. (7.6 m)	4 #2 (34 mm^2) Power and Isolated Ground (PE1) 1 #6 (13 mm^2) Redundant Ground (PE2)
RUN C	Run distance and cable / conductor sizes from Room Safety Disconnect **-to-** CT Gantry **480 VAC** input:
0 - 25 ft. (7.6 m)	4 #2 (34 mm²) Power and Isolated Ground (PE1) 1 #6 (13 mm²) Redundant Ground (PE2)
Note: Total combined length between **Run B** and **Run C** not to exceed 50 ft.(15.2 m). Select **Figure 9.2c** (60 Hz) or **Figure 9.2d** (50 Hz) below to see Mains Connection Diagram, Download Drawings Z-14.1.3 or Z-14.1.4.	

9.3.3 380/400/415 VAC with LM Isolation Transformer or Plus

RUN A	Run distances and cable / conductor sizes from Facility Supply **-to-** input of LM/Plus unit **380/400/415 VAC** supply side:
0 - 50 ft. (15.2 m)	3 #0 (54mm^2) Power 1 #0 (54mm^2) Dedicated Ground
51 - 100 ft. (30.5 m)	3 #00 (67mm^2) Power 1 #00 (67mm^2) Dedicated Ground
101 - 200 ft. (61 m)	3 #000 (85mm^2) Power 1 #000 (85mm^2) Dedicated Ground
RUN B	Run distances and cable/ conductor sizes from output of LM/Plus unit **-to-** Room Safety Disconnect **480 VAC** input:
0 - 50 ft. (15.2 m)	4 #2 (34mm^2) Power and Isolated Ground (PE1) 1 #6 (13mm^2) Redundant Ground (PE2)
51 - 100 ft. (30.5 m)	4 #1 (42mm^2) Power and Isolated Ground (PE1) 1 #6 (13mm^2) Redundant Ground (PE2)
101 – 200 ft. (61 m)	4 #00 (67mm^2) Power and Isolated Ground (PE1) 1 #4 (21mm^2) Redundant Ground (PE2)
Note: Total combined length between **Run A** and **Run B** not to exceed 250 Ft. (76.2M). Select below **Figure 9.2a** (LM) -or- **Figure 9.2b** (Plus) to see Mains Connection Diagram, Download Drawings Z-14.1.1 -or- Z-14.1.2.	
RUN C	Run distance and cable / conductor sizes from Room Safety Disconnect -to- CT Gantry 480 VAC input:
0 - 25 ft. (7.6 m)	4 #2 (34mm²) Power and Isolated Ground (PE1), 1 #6 (13mm²) Redundant Ground (PE2)

9.3.4 380/400/415 VAC with Full UPS and LM Isolation Transformer

RUN A	Run distances and cable/conductor sizes from output of UPS device **-to-**input of LM unit **380/400/415 VAC** supply side:
0 - 50 ft. (15.2 m)	4 #0 (54mm^2) Power and Isolated Ground (PE1)
51 - 100 ft. (30.5 m)	4 #00 (67mm^2) Power and Isolated Ground (PE1)
101 - 200 ft. (61 m)	4 #000 (85mm^2) Power and Isolated Ground (PE1)
RUN B	Run distances and cable/ conductor sizes from output of LM unit **-to-** Room Safety Disconnect **480 VAC** input:
0 - 25 ft. (7.6 m)	4 #2 (34mm^2) Power and Isolated Ground (PE1) 1 #6 (13mm^2) Redundant Ground (PE2)
RUN C	Run distance and cable / conductor sizes from Room Safety Disconnect **-to-** CT Gantry **480 VAC** input:
0 - 25 ft. (7.6 m)	4 #2 (34mm²) Power and Isolated Ground (PE1), 1 #6 (13 mm²) Redundant Ground (PE2)
Note: Total combined length between **Run B** and **Run C** not to exceed 50 ft. (15.2 m). Select **Figure 9.2c** (60 Hz) -or- **Figure 9.2d** (50 Hz) below to see Mains Connection Diagram, Download Drawings Z-14.1.3 -or- Z-14.1.4.	

9.3.5 200/208 VAC with LM Isolation Transformer or Plus

RUN A	Run distances and cable / conductor sizes from Facility Supply **-to-** input of LM/Plus unit **200/208 VAC** supply side:
0 - 50 ft. (15.2 m)	3 #350 kcm (177 mm^2) Power 1 #350 kcm (177 mm^2) Dedicated Ground
51 - 100 ft. (30.5 m)	N/A
RUN B	Run distances and cable/ conductor sizes from output of LM/Plus unit **-to-** Room Safety Disconnect **480 VAC** input:
0 - 50 ft. (15.2 m)	4 #2 (34 mm^2) Power and Isolated Ground (PE1) 1 #6 (13 mm^2) Redundant Ground (PE2)
51 - 100 ft. (30.5 m)	4 #1 (42 mm^2) Power and Isolated Ground (PE1) 1 #6 (13 mm^2) Redundant Ground (PE2)
101 – 200 ft. (61 m)	4 #00 (67 mm^2) Power and Isolated Ground (PE1) 1 #4 (21 mm^2) Redundant Ground (PE2)
Note: Total combined length between **Run A** and **Run B** not to exceed 250 ft. (76.2 m). Select below **Figure 9.2a** (LM) -or- **Figure 9.2b** (Plus) to see Mains Connection Diagram, Download Drawings Z-14.1.1 -or- Z-14.1.2.	
RUN C	Run distance and cable / conductor sizes from Room Safety Disconnect **-to-** CT Gantry **480 VAC** input:
0 - 25 ft. (7.6m)	4 #2 (34 mm^2) Power and Isolated Ground (PE1) 1 #6 (13 mm^2) Redundant Ground (PE2)

General Note 1: All cable conductor wire sizes specified above are based on 90 Deg. C stranded copper with not more than 2% voltage drop within specified distances. The total voltage loss, including the supply source and these wires, must not exceed 5% combined. Increase wire sizes as required to meet total regulation requirements specified by Philips. Wire size for each of the voltage ranges indicated are determined based upon regulations for maximum current carrying capacity relative overcurrent protections and a maximum allowance 2% voltage drop (source to system) at the maximum momentary power 110 kVA. Other objective determining factors are also used in these calculations (copper conductors, conductor temperature, steel conduit, etc.).

General Note 2: A Licensed electrical contractor shall supply and install all copper cable/conductor wiring described above and is responsible for connecting to the Philips-supplied isolation transformer. A Philips Field Service Engineer (FSE) will make final connections to scanner Gantry and consoles, as required.