Part 1 General

1.1 SUMMARY

.1 This specification describes the requirements for automatic harmonic current reduction which shall be done by means of installing electronic harmonic filtering equipment capable of monitoring and actively reducing harmonic currents, as they are or may become present, within the electrical system.

.2 The harmonic current measured at the Point(s) of Common Coupling (PCC) shall be less than or equal to the magnitudes outlined in IEEE Std. 519-1992, Table 10.3 " Current Distortion Limits for General Distribution Systems (120 V Through 69,000 V)".

.3 For this specification the PCCs shall be as shown on the drawings, the bus to which the non-linear load is connected. The maximum short-circuit current (ISC) at each PCC shall be defined as ten (10) times the full load rating of the first transformer up-stream from the PCC. The maximum demand load current (IL) at each PCC shall be defined as the sum of the full load current ratings, in amperes RMS, of the supplier's non-linear loads connected at the PCC. The Total Demand Distortion (TDD) shall be defined as the ratio of the total harmonic current (IH) to the total maximum load current (IL) of the non-linear loads, expressed as a percentage. Where non-linear loads are inter-locked to prevent simultaneous operation only the larger of the loads that can be connected need be considered.

.4 Each supplier shall determine the "ISC to IL " Ratio based on their non-linear loads only and verification will be made based on only these loads being connected.

.5 Provide one (1) harmonic filter, sized at 100 amp to mitigate harmonics created by the chiller (CH-1) VFD.

Maximum Harmonic Current Distortion
In Percent of IL *

	Individual Harmonic Order (Odd Harmonics)					
Isc / IL	<11	11≤ h ≤17	17≤ h ≤23	23≤ h ≤35	35≤ h	TDD
<20	4.0	2.0	1.5	0.6	0.3	5.0
20<50	7.0	3.5	2.5	1.0	0.5	8.0
50<100	10.0	4.5	4.0	1.5	0.7	12.0
100<1000	12.0	5.5	5.0	2.0	1.0	15.0
>1000	15.0	7.0	6.0	2.5	1.4	20.0
Even Harmonics are limited to 25% of the odd harmonic limits above.						

*The above table is based on IEEE Std. 519-1992, Table 10.3

1.2 RELATED WORK

.1 Section 16192 – MECHANICAL EQUIPMENT CONNECTIONS: GENERAL ELECTRICAL REQUIREMENTS Section 16010 and items common to more than one section of Division 16.

.2 Section 16122 – WIRES AND CABLES.

.3 Section 16450, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and for providing a low impedance path for possible ground fault currents.

.4 Section 16111, CONDUITS, CONDUIT FASTENING AND CONDUIT FITTINGS.

1.3 SUBMITTALS

.1 In accordance with Section 16010 1.26, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES, submit the following:

.2 Shop Drawings:

.1 Clearly present sufficient information to determine compliance with drawings and specifications.

.2 Include electrical ratings, dimensions, weights, mounting details and materials, terminations, and connection diagrams.

.3 Complete nameplate data including manufacturer's name and catalog number.

.3 Calculated harmonic analysis that predicts the full-load voltage and current harmonic distortion at the bus to which the adjustable frequency drives are connected.

.4 Letter from manufacturer demonstrating compatibility between the harmonic mitigation equipment and the adjustable frequency drives proposed for the project.

.5 Manuals:

.1 When submitting the shop drawings, submit companion copies of complete maintenance and operating manuals including technical data sheets and wiring diagrams.

.2 If changes have been made to the originally submitted maintenance and operating manuals, then two weeks prior to final inspection, submit four copies of updated maintenance and operating manuals to the Contract Administrator.

.6 Certification: Two weeks prior to the final inspection, submit four copies of the following: Certification by the contractor that the equipment has been properly installed, adjusted, and tested.

1.4 APPLICABLE PUBLICATIONS

.1 Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

.2 Institute of Electrical and Electronics Engineers (IEEE): 519-92, Section 6 Harmonic Control in Electrical Power Systems. 1100-05 Powering and Grounding Electronic Equipment

.3 National Fire Protection Association (NFPA): 70-08 National Electrical Code (NEC)

.4 Underwriters Laboratories, Inc. (UL): 508-08 Industrial Control Equipment

Part 2 Products

2.1 ACCEPTABLE MANUFACTURES

.1 Aim Energy Incorporated

2.2 GENERAL REQUIREMENTS

.1	Input Voltage:	(600V), 3 Phase, 3 Wire, + ground +6%, -14% (±10% @ 208V) steady state +11%, -19% (±15% @ 208V) for 20 minutes
.2	Input Frequency:	60Hz. ±5%
.3	Environmental:	0° to 40°C Operating Temperature -30° to 50° C Storage Temperature To 95% Humidity, non-condensing To 1500 meters altitude

2.3 ELECTRICAL RATINGS

.1	Nominal Voltage:	(600V) AC, 60Hz.
.2	Harmonic Current Cancellation: [1]	100 (90 @ 600V) Amps. RMS
.3	Corrective Reactive Current (A RMS): [1]	(75 @ 600V)
.4	Total Current Injected (A RMS): [1]	(117 @ 600V)
.5	Corrective kVar (85% electronic): [1]	(78 @ 600V)
.6	Losses @ Rated Output (kW): [1]	(2.2 @ 600V)
.7	Transient Protection:	Transient IEEE 587, Class B
.8	Interrupting Capacity:	100 kA RMS symmetrical
.9	Peak Harmonic Current:	3X nominal rms maximum rating
.10	Start-up time:	6 seconds

.11 Harmonic Current Attenuation Factor:

IH (source) / IH (load)	Harmonic Number	Harmonic Factor (typical)
	2	0.3
	3	0.2
	4	0.1
	5-7	0.05
	8-11	0.08
	12-15	0.1
	16-21	0.15
	22-27	0.2
	28-33	0.3

34-41	0.4
42-51	0.5

[1] Values shown are for the 100 Amp Configuration. Other configurations (25A, 50A, 150A, 200A, 300A) are proportional to these values. The 50 Amp Configuration unit would have values at 50% of those marked above.

2.4 ACCEPTABLE UNIT TYPE

.1 Aim Energy Inc., Series 3A AIM Conditioners 100 Amp, 50 Amp, 150 Amp and 200 Amp Configurations.

2.5 MECHANICAL DESIGN

.1 Enclosure

.1 The Unit shall be housed in a free standing, NEMA type 1 enclosure. Cabinet doors/covers shall require a manufacturer supplied key or tool to gain access. Front access only shall be required for servicing, adjustment and installation.The cabinet shall be structurally adequate and have provisions for hoisting, jacking and forklift handling. Color and finish to manufacturer's standard. Cabinet to be complete with fused disconnect with compression lugs for customer top entry connection. Terminal blocks for manufacturer supplied (contractor installed) Current Transformers shall be provided. The cabinet will have fan forced ventilation sufficient to maintain an internal temperature of less than 50°C. with an external ambient temperature of up to 40°C.

.2 Alarms

.1 The harmonic filter shall provide an audible and visual alarm on the front of the unit for any fault condition within the unit related to malfunction, over temperature, and overload.

.2 The filter shall have a form “C” Summary Alarm Contact for remote alarm indication of any alarm condition.

.3 Controls

.1 The front panel will have an on-off/reset switch to allow for a controlled startup of the filter and a clearing of latched alarms.

.2 LED indicators will display the system's status; Power Applied, Operating, and At Maximum Capacity.

.3 The filter shall have a form “C” contact for remote indication of the operating status.

2.6 OPERATION

.1 The harmonic filter shall consist of a three-phase transconductance power amplifier which is connected in parallel to the AC line. The amplifier rectifies line current and stores energy in a DC capacitor bank. Using current transformers the system measure the load current and feeds an analogue signal to the amplifier's control circuit. This signal is proportional to the harmonic current generated by the load. The amplifier uses the harmonic current signal and energy from the DC capacitor bank to inject the inverse of the load's harmonic current into the AC line.

.2 The amplifier shall use Pulse Width Modulation (PWM) to generate the current waveform. The filter shall respond instantly to changes in the system and the power components shall be switched at sufficient speed to allow for cancellation from the 2nd to 52nd harmonic.

.3 The filter shall current limit its output at its rated harmonic injection current but continue to operate, while displaying " At Max Capacity" on the front panel.

.4 The harmonic filter shall be capable of being paralleled with additional harmonic filters for additional capacity and redundancy.

.5 The filter shall be designed to work in conjunction with variable frequency drives static UPS systems, rectifiers for main frame computers, x-ray equipment power supplies, electronic ballasts, and other non-linear loads. The system shall work with either the utility or diesel generators as the source of power.

Part 3 Execution

3.1 EQUIPMENT INSTALLATION

.1 Install wiring to conform to the requirements of the National Electrical Code and applicable State and Local Codes and manufacturer’s requirements.

3.2 START-UP

.1 Manufacturer shall provide a factory trained service representative to start-up, and commission the equipment, and perform a harmonic survey to verify compliance to this specification.

3.3 TRAINING

.1 Provide a training course for Owner’s staff covering sequence of operation and general maintenance requirements.

3.4 ACCEPTANCE CHECKS AND TESTS

.1 Perform tests in accordance with the manufacturer's recommendations. Include the following visual and mechanical inspections.

- .1 Compare equipment nameplate data with specifications and approved shop drawings.
- .2 Inspect physical and mechanical condition.
- .3 Inspect all field-installed bolted electrical connections, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method.
- .4 Perform specific inspections and mechanical tests as recommended by manufacturer.
- .5 Verify correct equipment grounding.

.2 Perform the following electrical tests. //For adjustable frequency drive loads, perform test both with all drives in bypass mode and motors operating at full load, and with add drives and motors operating at full load.// Measure and record current and voltage total harmonic distortion at the filter input terminals, using harmonic measuring equipment

with a current calibration certificate. Show voltage and current waveforms and total and individual harmonic spectrum analysis.

3.5 FOLLOW-UP VERIFICATION

.1 Upon completion of acceptance checks and tests, the contractor shall show by demonstration in service that the filters are in good operating condition and properly performing the intended function.

END OF SECTION