Project Name: UNIVERSITY OF CALIFORNIA, MERCED SCIENCE AND ENGINEERING BUILDING 2 SHIELDING REBID Project No.: 900020

ADDENDUM NO. 9

to the

CONTRACT DOCUMENTS

April 25, 2013

I. Bidder acknowledges that it is the Bidder's responsibility to ascertain whether any Addenda have been issued and if so, to obtain copies of such Addenda. Bidder therefore agrees to be bound by all Addenda that have been issued for this bid.

This Addendum forms a part of the Contract Documents and modifies the original Bidding Documents. The following changes, additions, or deletions shall be made to the following documents as indicated and all other Contract Documents shall remain the same.

II. CLARIFICATIONS

- A. PRE-BID QUESTIONS Questions received from bidders and responses are as follows:
 - 1. Question: Is this a Build as Designed contract or Design/Build contract?
 - Answer: This is a Build as Designed contract, same as Design-Bid-Build contract, where the designer is responsible for the design and the Prime Trade Contractor is responsible for providing the complete shielding detailing and installation of the work as required by the Contract Documents.
 - Question: Spec Section 13092 "1.3 A. Design Requirements 1. Shielding Performance Objective: 1 mG rms (3 mG peak-to-peak) and less measured <u>1-meter directly above each shielded NMR</u> tool."

Please clarify at what elevation the performance objective relates to (e.g. 1-meter above each tool – if NMR tool stands at 8' elevation, would it be assumed that the performance objective is measured at 1-meter above that – making the elevation 11.28 feet?

- Answer: It shall be measured at 1-meter above the shielded floor, directly at the location of each NMR tool.
- 3. Question: Spec Section 13092 "1.4 D. Shop Drawings 2. Shop drawings to include wall shields and floor shield in the NMR rooms."

Please clarify that only one (1) NMR room (Room# 020) is to receive magnetic shielding.

- Answer: Confirmed.
- 4. Question: Spec Section 13092 "1.5 QUALITY ASSURANCE A. Contractor: EMF/EMI Contractor is responsible for quality control of the work and specified AC ELF <u>Shielding Performance</u> <u>Guarantee</u>."

Please resolve the conflict between the terms "Shielding Performance Objective" and "Shielding Performance Guarantee."

- Answer: Replace the term "Guarantee" with "Objective".
- 5. Question: Spec Section 13092 "1.5 E. Contractor Responsibility: 1. Correctness between drawings and actual dimensions of the floor, walls, and <u>ceiling</u> to be shielded including <u>constructed</u> <u>extensions</u> and surface walls."

Please clarify "Ceiling" surfaces are not included in this section. Also, please clarify what "constructed extensions" refer to.

- Answer: Replace 13092-1.5 E.1 with "Correctness between drawings and actual physical dimensions of the floors and walls to be shielded.
- 6. Question: Spec Section 13092 "1.5 E. Contractor Responsibility: 2. Material quantities necessary to completely cover the walls, floors, and <u>ceiling</u> surfaces with aluminum plates as specified in the drawings."

Please clarify "Ceiling" surfaces are not included in this section.

- Answer: Replace 13092-1.5 E.2 with "Material quantities necessary to completely cover the walls and floors with aluminum plates as specified in the drawings".
- Question: Spec Section 13092 "1.5 E. Contractor Responsibility: 3. Accurate <u>substrate fabrication</u> procedures (cutting and joint preparation) according to the final shop and fabrication drawings submitted for review."

Please clarify what "substrate fabrication" refers to in this section.

- Answer: Delete word "substrate".
- Question: Spec Section 13092 "1.6 DELIVERY, STORAGE, AND HANDLING B. Do not bend or damage the plates and <u>AA6061-T6 aluminum channels</u> during installation as precise joint spacing is required."

Please confirm that AA6061-T6 aluminum channels are not required for this installation.

- Answer: "Channels" will be replaced by 1-1/2" by 2" extruded rectangles. See detail on sheet EMF-1.0
- 9. Question: Spec Section 13092 "1.7 PROJECT CONDITIONS OR SITE CONDITIONS A. Environmental Requirements: Proceed with the Work in accordance with <u>manufacturer's</u> requirements and instructions and any agreements or restrictions of the Pre-Construction Conference."

Please clarify and provide the "manufacturer's requirements and instructions" referred to in this section.

Answer: Delete section 13092-1.7.

10. Question: Spec Section 13092 "2.2 MATERIAL A. Aluminum Plates: Aluminum Association AA1100-H14, ¹/₄" thick aluminum plates in <u>widths and lengths as required and indicated</u>."

Please clarify and provide the "widths and lengths as required" referred to in this section. Also, please clarify where the "widths and lengths" are indicated, either in the specification or drawings EMF 1.0 or 2.0.

- Answer: Replace 13092-2.2 A with "Aluminum Plates: Aluminum Association AA1100-H14, ¼-inch thick aluminum plates 5 ft. by 10 ft. size only."
- 11. Question: Spec Section 13092 "2.3 FABRICATION A. AC ELF Magnetic shielding will be constructed in-place, there will be <u>no pre-fabrication utilized</u> for shielding components."

Please clarify statement "no pre-fabrication utilized" referred to in this section - Sections 3.2.A and 3.3.A both refer to "fabrication" as it relates to Preparation and Installation. Wouldn't pre-fabrication allow overall costs and installation schedule to be minimized.

- Answer: Replace 13092-2.3 A with "AC ELF Magnetic Shielding may be prefabricated and/or constructed in-place."
- 12. Question: Spec Section 13092 "3.2 PREPARATION A. Field Measurements: Field measurements must be taken prior to preparation of shop drawings and <u>fabrication</u> where possible to ensure proper fitting of work."

Please clarify statement.

- Answer: Replace 13092-3.3 A with "Field Measurements: Field measurements must be taken prior to preparation of shop drawings and installation to ensure proper fitting of the work."
- 13. Question: Spec Section 13092 "3.3 INSTALLATION A. General: Install AC ELF Magnetic Shielding System in accordance with the attached drawings EMF_1.0, <u>Fabrication and Installation</u> <u>Instructions</u>, submittals, applicable industry standards, and governing regulatory requirements."

Please clarify statement.

- Answer: Replace 13092-3.3 A. with "General: Install AC ELF Magnetic Shielding System in accordance with the Contract Documents approved submittals applicable industry standards, and governing regulatory requirements."
- 14. Question: Spec Section 13092 "3.3 INSTALLATION B. <u>Wall Shielding Work</u>: First Layer Install...<u>on the floor</u>...<u>Stitch (2 inches on 4 inches) shielding metal arc weld (SMAW) steel</u> plate using 3/16 inch saw E7014 (or equivalent) welding rods."

Section refers to Wall shielding but states 1st layer is installed on floor; please confirm. Please clarify "Stitch (2 inches on 4 inches) shielding metal arc weld (SMAW) steel plate using 3/16 inch saw E7014 (or equivalent) welding rods. Neither the Specifications nor Drawings call for the use of steel plates or indicates any welding instructions for steel material.

Answer: Replace 13092-3.3 B with "Shielding Work: First Layer - Install 1/4" thick AA1100 H-14 grade aluminum plates as shown in EMF_1.0. Cut and install first layer of aluminum plates on the floor. Secure the aluminum plates using the appropriate fasteners/anchors. After the floor shield is installed and secured, install the first aluminum layer on the walls. Secure and weld using the welding method described below. Stitch weld 1-1/2" by 2" extruded aluminum rectangles directly onto the first layer aluminum plate at 2'0" and 2'6" on-center as shown in EMF 1.0. Install and plug weld second aluminum plate wall shield to 1-1/2" by 2" extruded aluminum rectangles. Coordinate with appropriate trades (i.e. HVAC, electrical, plumbing, etc.) for all penetrations needed. Continuous seam Gas Metal Arc Weld (GMAW) all aluminum plate butt, corner, and edge joints with 3/64-inch 4043 aluminum filler wire using 100% Argon Gas. Care should be taken not to deform the plates while continuous welding the joints; therefore, it may be necessary to stitch weld selected plate joints to minimize plate deformation, then go back to complete the continuous seam weld."

15. Question: Spec Section 13092 "3.4 FIELD QUALITY CONTROL B. Testing: <u>After the AC ELF</u> <u>magnetic shielding has been installed a Shielding & Compliance Test should be completed by</u> <u>the shielding installer and/or contractor.</u> Finally, after each shield is tested and EMF/EMI <u>shield Testing & Compliance Report will be issued for review and acceptance</u>. Once the building is occupied with the (LV) low-voltage transformers/switchgears fully-operational and loaded to a minimum of 25-30%, <u>mapped magnetic flux density readings</u> will be recorded by a qualified EMF consultant with ten years of EMF engineering experience, to verify the shielding performance objective and issue a Final Shielding System Performance & Compliance Report."

Please clarify why the shielding installer and/or contractor is required to perform a shielding and Compliance Test if the power/loading requirements stated later in this section are not operational? Testing at installation completion would be meaningless and would negate the need for a "Review and Acceptance" process. The above statement also states "after each shield" is tested; Please confirm there is only one NMR shield.

This section requires "mapped magnetic flux density reading" which refers to an area, whereas, sections 1.3.A.1 and 3.4.B.2 refer to a single testing location "measured 1-meter above each shielded NMR tool". Please clarify the testing requirements

- Answer: Replace 13092-3.4 A with "Site Test: The University will employ an EMF consultant to perform the testing specified in section 3.4 B".
- 16. Question: Spec Section 13092 "3.4 FIELD QUALITY CONTROL B. Testing: 2. Recorded timed 60 Hz magnetic flux density levels at <u>1-meter directly above the shielded NMR.</u> Verify compliance with the <u>Shielding Performance Objectives</u>: 1 mG rms (3 mG peak-to-peak) and less measured 1-meter above the shielded tools."

Please clarify at what elevation "1-meter directly above the shielded NMR" refers to. Please resolve the apparent conflict on whether the testing location is a single point or multiple "shielded tool" locations.

- Answer: It shall be measured at 1-meter above the shielded floor, directly at the location of each NMR tool.
- 17. Question: Spec Section 13092 "3.4 FIELD QUALITY CONTROL B. Testing: 3. Use the <u>calculated</u> <u>load multiplier</u> to estimate worst-case emission levels during <u>peak summer loads</u>. Verify AC ELF magnetic shield complies with <u>Shielding Performance Objective</u>."

Please provide "calculated load multiplier for peak summer loads" (in amperes). Although a redundant question, please clarify whether to shielding installer is required to meet a "Performance Objective" or provide a "Performance Guarantee".

Answer: Refer to question 15 response.

18. Question: Spec Section 13092 "3.4 FIELD QUALITY CONTROL B. Testing: 4. Warning: Excessive...If the problems persists with the final shielding performance, the <u>EMF Consultant</u> <u>must complete a comprehensive Ground/Net and Zero-Sequence Assessment</u> at the Owner's expense to <u>evaluate and recommend remediation measures</u>."

Please clarify the above statement.

Answer: Delete Section 13092-3.4.B.4.

19. Question: Spec Section 13092 "3.4 FIELD QUALITY CONTROL B. Testing: 5. The <u>decision of the</u> <u>EMF Consultant</u> on acceptability shall be <u>binding on the contractor.</u>"

Please clarify the above statement.

Answer: Delete Section 13092-3.4.B.5.

20. Question: Drawings EMF_1.0 and EMF_2.0 "<u>Install Notes NMR Room</u>: 1. AC ELF Shielding consists of 2 isolated (<u>separated by furring strips</u>) layers of ¼" thick AA1100 H-14 Grade Aluminum on the walls and one layer of ¼" thick AA1100 H-14 grade aluminum on the floor (<u>see specification documents for more information</u>)."

Please clarify in Drawing A9.2.1 (Partition type Details), specifically detail "OW" if any other materials can be substituted for the 1" Fire Treated Plywood Furring Strip (e.g. aluminum, steel, etc.).

Please clarify in Drawing A9.2.1 (Partition type Details), specifically detail "OV" if contractor is required to provide 1 ¹/₄" Fire Treated Furring Strip. If so, please clarify exact dimensions (along wall) where furring strips are to be provided.

- Answer: For detail OW Use AA6061-T6 extruded aluminum 1-1/2" by 2" rectangle spaced vertically every 2'0" to 2'6" where there are two (2) ¼" thick layers of aluminum on the NMR room wall. See sheet A9.2.1 for revised detail OV.
- 21. Question: Drawings EMF_1.0 and EMF_2.0 "Install Notes NMR Room: 2. Active Cancellation Systems must maintain 2'-0" separation (typ.) between adjacent ACS systems."

Please clarify and provide details for Active Cancellation Systems. The Specification document (section 13092) does not include any information pertaining to the use or installation of Active Compensation Systems.

- Answer: There is no Active Cancellation System for the installation covered in 13092. Note to be removed.
- 22. Question: Spec Section 13096 "1.3 SUBMITTALS A. Product Data: ASTM B-209. *NO OTHER GRADE OF ALUMINUM PLATE IS ACCEPTABLE."

Please clarify if any other grade of aluminum is acceptable (e.g. AA3003 H-14) with regards to lead time. NOTE: Lead time for AA1100 H-14 materials is approximately 8-12 weeks (Mill Run). If Construction scheduling conflict / delay occurs, can AA3003 aluminum be utilized in lieu of AA1100?

- Answer: AA1100-H14 is the only acceptable aluminum for this application.
- 23. Question: Spec Section 13096 "1.3 SUBMITTALS B. Grain-Oriented, Fully Processed, Silicon –Iron Electrical Steel grade M-6 with lamination C5 surface, 1 meter wide coils, conforming to ASTM A876-09. Shop Drawings: Submit for review and show drawing details of items to be used to fabricate and install the two AC ELF and DC EM magnetic shielding systems.

..."

Please clarify there is only one (1) AC ELF / DC EM Magnetic shielded room (090B), and two (2) AC ELF <u>ONLY</u> magnetic shielded rooms (090A, 090C)?

Answer: Confirmed.

24. Question: Spec Section 13096 "1.4 QUALITY ASSURANCE A. Qualifications: Contractor: EMF/EMI Contractor is responsible for quality control of the work and specified <u>AC ELF</u> <u>Shielding Performance Guarantee</u>."

Please resolve the conflict between the terms "Shielding Performance Objective" and "Shielding Performance Guarantee".

Depending on the answer to the above question, please confirm the AC ELF shielding is the only shielding component the contractor is responsible for and confirm there are no passive DC shielding performance objectives or performance guarantee requirements?

- Answer: Replace the term "Guarantee" with "Objective". Confirmed there are no DC guarantee requirements. See also Response to Question 41.4.
- 25. Question: Spec Section 13096 "1.4 QUALITY ASSURANCE E. Contractor Responsibility: 1. Correctness between drawings and actual dimensions of the floor, walls, and ceiling to be shielded including <u>constructed extensions</u> and surface walls."

Please clarify what "constructed extensions" refer to.

- Answer: Replace 13096-1.4.E.1 with "Correctness between drawings and actual physical dimensions of the floors, walls and ceiling to be shielded, including exposed ceiling I-Beams, columns and surface walls."
- 26. Question: Spec Section 13096 "1.4 QUALITY ASSURANCE E. Contractor Responsibility: 2. Material quantities necessary to completely cover the walls, floors, and ceiling surfaces with aluminum plates as specified in the drawings."

Please clarify if the Silicon-iron steel was intentionally not included in this section.

- Answer: Replace 13096-1.4 E.2 with" Material quantities necessary to completely cover the walls, floors and ceiling surfaces with aluminum plates and M-6 grain-oriented silicon-iron steel sheets as specified in the drawings."
- 27. Question: Spec Section 13096 "1.4 QUALITY ASSURANCE E. Contractor Responsibility: 3. Accurate <u>substrate fabrication</u> procedures (cutting and joint preparation) according to the final shop and fabrication drawings submitted for review."

Please clarify what "substrate fabrication" refers to in this section.

- Answer: Delete word "substrate".
- 28. Question: Spec Section 13096 "1.5 DELIVERY, STORAGE, AND HANDLING A. General 2. Do not bend or damage aluminum plates and fully processed M-6 grain- oriented silicon iron steel coils prior to installation of work."

Please confirm how silicon-iron steel sheets are to be installed in the intended areas if bending, especially at corners, is not allowed. If bending of the silicon-iron steel is not permitted, then each of the vertical and horizontal corner seams (floor-wall seams around ceiling, floor, and each vertical wall seam) will have small gaps. Please confirm recommended installation method.

- Answer: This section requires caution of delivery and handling of the materials prior to installation. Care should be taken to transport materials to avoid damage due to negligence. Carefully bending, ideally with a sheet metal break, the material during installation is necessary.
- 29. Question: Spec Section 13096 "2.2 MATERIALS A. Aluminum Association AA1100-H14 ¼" thick aluminum plates and fully processed M-6 grain-oriented silicon-iron steel coils. 1. Procure in the <u>lengths</u>, sizes and quantities specified in the drawings."

Please clarify and provide the "lengths, sizes and quantities" referred to in this section. Also, please clarify where these specification are indicated in the drawings (EMF1.0 or 2.0). If 1- meter wide material is not available (see 1.3.B), can a smaller or larger width be accepted?

- Answer: Replace 13096-2.2 A with: "Aluminum Association AA1100-H14 ¼-inch thick 5 ft. by 10 ft. aluminum plates and fully processed 0.014" thick 1-meter or 36" wide M-6 grainoriented silicon-iron steel coils."
- 30. Question: Spec Section 13096 "2.2 MATERIALS B. <u>DC Magnetic Field Active Cancellation</u> <u>/Compensating System</u> – Recommend ETS-Lindgren DC Magnetic Active Compensation System (MACS)."

Please clarify if other manufactures of similar Active Compensation Systems (ACS) are acceptable. Please clarify who's responsible to <u>procure</u>, <u>provide and install</u> the ACS system. Please clarify who is responsible for the <u>performance</u>, <u>tuning and warranty</u> of the ACS system. Should a maintenance contract be made part of this submittal?

Answer: Replace 13096-2.2 B with "Not Used"

31. Question: Spec Section 13096 "2.2 MATERIALS C. Accessories and Fasteners 1. Provide a list of...required for AC ELF & DC magnetic shielding system in rooms 090A, 090B, and 090C as shown in EMF Drawing Series."

Please confirm rooms 090A and 090C only require aluminum (AC ELF) and room 090B requires aluminum (AC ELF) and silicon iron steel (DC) shielding?

- Answer: Confirmed.
- 32. Question: Spec Section 13096 "2.2 MATERIALS D. Construction Film: Provide film between concrete and shielding as shown in details to inhibit corrosion."

Please confirm the requirements for the construction film – details on EMF_2.0 (detail 5) and drawing A9.2.20 indicates room 090B is the only room identified as having the floor shielding embedded in between concrete pours. Drawing A9.2.20 clearly identifies all three EM rooms (090A, 090B, and 090C) are scheduled to be embedded in between concrete pours. Which room / rooms require construction film?

Answer: Remove sheet EMF_2.0. Construction film shall be only placed over and below the

shielding, in the Rooms 090A, 090B, 090C. Delete construction film shown in the Room 020 (NMR room).

33. Question: Spec Section 13096 "2.3 FABRICATION A. AC ELF & DC shields must be carefully designed according to the Shop Drawings, and then selected sections fabricated to conform to dimension of the EM Tool rooms on site."

Please clarify and provide details for the above statement "then selected sections fabricated"?

- Answer: Replace 13096-2.3 A with "The AC ELF & DC shields must be carefully installed according to the Shop Drawings, and to conform to dimensions of the EM rooms on site."
- 34. Question: Spec Section 13096 "3.3 ERECTION / INSTALLATION / APPLICATION A. General:
 1. Install AC ELF & DC Magnetic Shielding System in accordance with the EMF Drawing Series...Shielding installation sequence: Aluminum base shield (floor, four walls, and ceiling shield), six (6) layers (<u>4-2 layers</u> per wall, floor, and ceiling) of oriented M-6 silicon-iron steel."

Please confirm each wall, ceiling, and floor surface will only receive a <u>total of 2 layers</u> of Si-Fe?

Answer: Replace 13096 3.3 A. 1 with "Install AC ELF & DC magnetic shielding systems in accordance with the contract documents, approved submittals, applicable industry standards, and governing regulatory requirements. Shielding Installation sequence: Aluminum shield (floor, four walls and ceiling shield), then six (6) layers of oriented M-6 silicon-iron steel."

35. Question: Spec Section 13096 "3.3 ERECTION / INSTALLATION / APPLICATION C. First two horizontal M-6 Grain-oriented silicon-iron steel layer installation. 1. Per the EMF Drawing Series, cut, fabricate, assemble, and install the first two (2) horizontal 0.014 inch thick M-6 grain-oriented silicon iron steel layers (total of 0.056 inches thick). Cut and install

oriented M-6 by stacked row as shown in drawing with edge less than 1/32nd of an inch

from the adjacent sheet edge. Cut the 1st...Secure each oriented M-6 steel layer row to the <u>base steel plate</u> and preceding M-6 layers with appropriate anchors /fasteners as shown in Shop Drawings."

- 35.1 Please confirm the total thickness for the 1st two horizontal layers is 0.028 inches thick, not 0.56"
- Answer: Each axis (x,y,z) will receive (2) layers of 0.014 thick M-6 resulting in 0.028 inches thick of M-6 per each axis (x,y,z). Once the second vertical layer is installed, this will result in a total of (4) layers of M-6 for a total of 0.056 inches thick of M-6 per each surface.
 - 35.2 Please provide drawing detail for installation of silicon iron steel material?
- Answer: See added diagram on Sheet EMF-1.0.
 - 35.3 Please confirm what type of material is referred to in the statement "base steel plate"? There is no reference in the specification or design details that refers to "steel plates".
- Answer: Replace "base steel plate" with "aluminum plate".
 - 35.4 Sections 3.3.D.1 and 3.3.E.1 are written similar to 3.3.C.1 and therefore to avoid duplication or redundancy, please confirm the same items for each section.

Answer: Confirmed. Please see responses above.

36. Question: Spec Section 13096 "3.3 MATERIALS F. <u>Detailed penetration schedule will be provided</u> in the Drawings for the <u>two</u> EM Tool room shield systems for control, electrical power and all other ancillary services supplied in support of the EM tool rooms."

Please provide the detailed penetration schedule as listed above. Also, the above item specifies two EM rooms, whereas there are three (3) rooms identified (rooms 090A, 090B, and 090C), please confirm?

Answer: Delete Section 13096-3.3.F.

37. Question: Spec Section 13096 "3.4 FIELD QUALITY CONTROL A. Site Test 1. EMF Consultant with 10 years ...verify shielding performance objective."

Please resolve the conflict between the terms "Shielding Performance Guarantee" and "Shielding Performance Objective".

- Answer: Replace term "Guarantee" with "Objective.
- 38. Question: Spec Section 13096 "3.4 FIELD QUALITY CONTROL B. Testing 1. After the DC <u>Magnetic Active Compensation System (MACS)</u> has been installed inside the <u>three EM</u> <u>Tool rooms</u> the site is operational, timed DC magnetic flux density readings will be recorded over 10 minutes at the appropriate sampling rate with a calibrated MEDA FVM-400 threeaxis fluxgate magnetometer or similar with 1 nT resolution in <u>each</u> EM Tool room at each column location 1 and 2 meters above the floor."
 - 38.1 Please resolve the issues related to the responsibility of (1) procurement, (2) installation, (3) performance, (4) warranty of the ACS system.
 - Answer: The University will procure such a system. This system is not included in the Prime Trade Contractor's work.
 - 38.2 Please confirm the DC testing is limited to only EM Room 090B?
 - Answer: Confirmed.
- 39. Question: Spec Section 13096 "3.4 FIELD QUALITY CONTROL B. Testing 2. <u>After the AC ELF</u> <u>magnetic shielding has been installed an AC ELF Shielding and Compliance Test should be</u> <u>completed by the shielding installer and/or contractor</u>. Once the building is occupied with the (LV) low-voltage transformers/switchgears fully-operational and loaded to a minimum of 25-30%, <u>mapped magnetic flux density readings</u> will be recorded by a qualified EMF consultant with ten years of EMF engineering experience, to verify the shielding performance objective and issue a Final Shielding System Performance & Compliance Report."
 - 39.1 Please clarify why the shielding contractor is required to perform a Shielding and Compliance Test if the power/loading requirements stated later in this section are not operational? Testing at this time would be meaningless and would negate the need for a "Review and Acceptance" process.
 - Answer: The University will employ an EMF consultant to perform the testing. Shielding installer/contractor is not required to perform any final acceptance testing.

- 39.2 This section requires "mapped magnetic flux density reading" which refers to an area, whereas, section 3.4.B.1 refers to a single testing location "measured 1 and 2 meters at each column location". Please clarify the testing requirements for each room.
- Answer: The testing requirements are 0.1mG peak to peak (Bx, By, Bz axis) measured at each column at 1 and 2 meters above the shielded floor.
- 40. Question: Spec Section 13096 "3.4 FIELD QUALITY CONTROL B. Testing 2. a) Testing will be performed...<u>Timed AC ELF magnetic flux density</u> data shall be recorded at site with a calibrated <u>FVM-400 magnetometer</u> or similar instrument (provide NIST traceable calibration certificate), and a wideband 12 Hz to 50 kHz three axis gaussmeter or similar with 1 nT resolution...."
 - 40.1 Please confirm testing equipment (e.g. FVM-400 magnetometer is only capable of recording DC magnetic field emission levels in the range of 0 Hz to 10 Hz).
 - Answer: See Response to Question 39.1.
 - 40.2 Please confirm testing of the frequency range 12 Hz to 50 kHz is necessary for this project or can a smaller frequency bandwidth be acceptable, for example 10 Hz to 1 kHz?
 - Answer: Only 10Hz to 1kHz or higher shall be accepted.
- 41. Question: Spec Section 13096 "3.4 FIELD QUALITY CONTROL B. Testing 2. b) Recorded timed AC ELF and DC magnetic flux density levels in EM <u>090B</u>, <u>090C</u>, <u>and 090D</u> rooms at <u>1</u>-<u>meter above the floor</u>. Timed column wideband AC ELF and quasi-static DC magnetic flux density data must be recorded at 1 and 2 meters elevations over 10 minutes at the <u>appropriate sampling rate</u>. Verify compliance with the <u>AC ELF Shielding Performance Objectives</u>: 0.1 mG peak-to-peak (0.035 mG rms) and less in the Bx, By, and Bz axis measured at the column at 1 and 2 meters."
 - 41.1 Please confirm testing is to be performed in rooms <u>090A</u>, <u>090B</u>, and <u>090C</u> and not in <u>room 90D</u>? Confirm rooms 090A and 090C are shielded for AC ELF magnetic emissions only and room 090B is to be shielded for both AC ELF and DC magnetic emissions.
 - Answer: Confirmed.
 - 41.2 Please confirm what 'appropriate sampling rate" should be utilized?
 - Answer: See Response to Question 39.1.
 - 41.3 Please resolve the conflict between the terms "Shielding Performance Guarantee" and "Shielding Performance Objective".
 - Answer: Replace term "Guarantee" with "Objective".
 - 41.4 There doesn't appear to be DC passive shielding performance objective or a DC EMI performance requirement for the ACS System, however the specification requires testing, please confirm?
 - Answer: The DC passive shielding performance is the ambient measured levels within the DC shielded

room before the ACS is installed. There are not performance objectives except static geomagnetic DC field reduction within the shielded room.

42. Question: Spec Section 13096 "3.4 FIELD QUALITY CONTROL B. Testing 2. c) Use the <u>calculated</u> <u>load multiplier</u> to estimate worst-case emission levels during <u>peak summer loads</u>. Verify AC ELF magnetic shield complies with <u>Shielding Performance Objective</u>."

Please provide the "calculated load multiplier for peak summer loads" (in amperes). Although a redundant question, please clarify whether to shielding installer is required to meet a "Performance Objective" or provide a "Performance Guarantee".

- Answer: Shielding contractor/installer is not responsible for final acceptance testing. Replace term "Guarantee" with "Objective".
- 43. Question: Spec Section 13096 "3.4 FIELD QUALITY CONTROL B. Testing 2. d) Warning: Excessive...If the problems persists with the final shielding performance, the <u>EMF</u> <u>Consultant must complete a comprehensive Ground/Net and Zero-Sequence Assessment</u> at the Owner's expense to <u>evaluate and recommend remediation measures</u>."

Please resolve the apparent conflict with the above statement.

- Answer: Delete Section 13096-3.4.B.2.d.
- 44. Question: Spec Section 13096 "3.4 FIELD QUALITY CONTROL B. Testing 2. e) The <u>decision of</u> <u>the EMF Consultant</u> on acceptability shall be <u>binding on the contractor</u>."

Please resolve the apparent conflict with the above statement.

- Answer: Delete Section 13096-3.4.B.2.e.
- 45. Question: Spec Section 13096 "3.6 DEMONSTRATION A. Final Site Survey 1. Shielding Performance can be demonstrated by conducting a final site survey which compares the actual recorded values to <u>predicted/simulated values</u>."

Please provide all information related to predicted/simulated values for comparison.

- Answer: See Response to Question 39.1.
- 46. Question: Spec Section 13096 "3.6 DEMONSTRATION B. DC EMI Magnetic <u>Shielding</u> <u>Performance Requirement</u> at Columns 1. 0.1 mG peak-to-peak (0.035 mG rms) and less in the Bx, By, and Bz axis measured at the future column locations with the <u>DC ACS system</u> <u>activated</u> from <u>vehicles traveling on adjacent roads</u> around the facility at 1 and 2 meters above the floor in <u>each shielded EM Tool Rooms</u>."
 - 46.1 Please resolve the <u>Shielding Performance Requirement</u>. Section 3.4.B.2.b refers to an AC ELF objective, but not a DC component. This section refers to testing with the DC ACS system activated, but has no requirement for the passive shielding alone. Is the sole requirement for DC performance to be fulfilled by the DC ACS system? If so, why would the responsibility for performance reside with the contractor and not the manufacturer of the ACS System? Please confirm that the requirements referred to above apply only to room 090B.
 - Answer: Replace 13096-3.4 B.2.b with "Recorded at least 10 minutes of timed AC ELF magnetic flux density data in EM 090B, 090C and 090D room at 1 meter above the floor. Recommend

wideband (10 Hz to at least 1000 Hz and higher) three-axis fluxgate magnetometer with 1 nT resolution and 1000 mG range (i.e. Bartington Mag-03MC100 or similar) to record time data with 24-bit A/D data acquisition with signal processing and presentation software. Simultaneously sample three axis (Bx, By & Bz) data at a minimum of 1200 samples per second or higher and generate peak-to-peak waveforms and calculated RMS values with Fast Fourier Transforms (FFT) to evaluate harmonic components. Timed column wideband AC ELF magnetic flux data must be recorded at 1 meter elevations. Verify compliance with the AC ELF Shielding Performance Objectives: 0.1 mG peak-to-peak (0.035 mG rms) and less in the Bx, By, and Bz axis measured at the column at 1 meter."

- 46.2 Does the testing require vehicles to be present and moving during the testing to verify ACS Systems performance? If so, what are the testing protocols for such testing?
- Answer: See Response to Question 39.1.
- 47. Question: Spec Section 13096 "3.6 DEMONSTRATION B. DC EMI Magnetic <u>Shielding</u> <u>Performance Requirement</u> at Columns 2. Shield will be compared to initial design, as described above."

Although redundant, there appears to be a conflict in assigning a performance (objective, requirement, guarantee, etc.) to the shielding system alone versus shielding system along with the ACS activated. If the testing requires the ACS system to be activated, then shouldn't the responsibility for the DC requirement/objective/guarantee of room 090B be assigned to the ACS system manufacturer and not the contractor/installer?

Answer: Installer/contractor not responsible for DC performance. Delete Section 130963.6.

48. Question The specs describe a shielding installation that is impossible to construct:

a. One Example: the DC shielding insists on a maximum of 1/32" between any two sheets of shielding. This material (M-6) is 0.014" thick. There are to be 6 layers of this material, cross-grained (horizontally and vertically) and extending in single sheets across multiple walls, floor and ceiling. Clearly, maintaining a 1/32" separation between all of these sheets would be impossible – at a minimum, setting aside the vagaries of construction quality, it would require a underlying room construction that was perfectly square, perfectly flat and perfectly plumb.

Answer: It is acceptable to overlap the adjacent sheets rather than maintain a maximum of 1/32" spacing between the edges of two sheets of shielding installed side by side.

III. SPECIFICATIONS

- A. Re-Issue the following SPECIFICATION SECTIONS dated 25 April 2013:
 - 1 SECTION 13092 ELECTROMAGNETIC SHIELDING NMR ROOM
 - 2 SECTION 13096 AC ELF/DC MAGNETIC SHIELDING EM ROOMS

IV. <u>DRAWINGS</u>

A. Re-Issue the Following SHEETS dated 25 April 2013:

1. A9.1.3 FINISH DETAILS

2. A9.2.1 PARTITION TYPE DETAILS

SCIENCE AND ENGINEERING BUILDING 2 UNIVERSITY OF CALIFORNIA, MERCED

3. A9.2.20 INTERIOR PARTITION DETAILS - SHIELDING 4. A9.2.21 INTERIOR PARTITION DETAILS – SHIELDING 5. EMF-1.0 AC ELF/DC SHIELDING SYSTEM BASEMENT

UNIVERSITY OF CALIFORNIA, MERCED

By: University of California, Merced University's Representative

> Wenbo Yuan, Sr. Project Director

> > End of Addendum No.9

SECTION 13092 - ELECTROMAGNETIC SHIELDING – NMR ROOMS (Add #09)

PART 1 - GENERAL

1.1 SUMMARY

- A. The contractor shall fabricate and install an AC ELF (extremely low frequency) Magnetic Shielding System inside the NMR room, 020. The NMR room shields are comprised of two layers of highly conductive 1/4-inch thick seam-welded aluminum plates installed on the designated walls and one layer on the floor with each seam being continuously Gas Metal Arc Welded (GMAW). The work to be performed under this Section consists of all labor, materials, and equipment in performing all operations in connection with the furnishing, fabrication, and installation of the AC ELF Magnetic Shielding System complete as shown in drawings EMF_1.0 and as specified herein the contract document. (Add #09)
- B. Related Sections: Requirements that relate to this section are included but not limited to the sections below.
 - 1. Division-1 "General Requirements".
 - 2. Division-3 sections "Cast-In-Place Concrete" for concrete materials and placement procedures.
 - 3. Division-8 sections "Custom Hollow Metal Work" for installation requirements of aluminum plates.
 - 4. Division-8 section "Builders-Door Hardware" for installation requirements of door hardware. (Add #09)
 - 5. Division-9 sections "Gypsum Board-Assembly and Non-Load Bearing Steel Framing" for metal furring or supports. (Add #09)

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM B209 "Standard Specification for Aluminum and Aluminum-Alloy Shield and Plate".
 - 2. ASTM B221 "Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod and Wire".
 - 3. ASTM B308 "Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles".
- B. Federal Specifications (FS):
 - 1. FS QQ-A-250/1 "Aluminum and Aluminum Alloy Plate and Sheet, General Specs" for Aluminum Association Grade 1100.
 - 2. FS QQ-A-225/8D and FS QQ-A-200/16 "Aluminum and Aluminum Alloy Plate and Sheet, General Specs" for Aluminum Association Grade 6061

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- C. International Electrical & Electronics Engineers (IEEE) Standards.
 - 1. "IEEE Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields from AC Power Lines", IEEE Standard No. 644-1994"
- D. National Council on Radiation Protection and Measurement (NCRP)
 - 1. NCRP Report No. 86 Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields (1986) and Section 8 of the June 13, 1995, NCRO draft report of NCRP Scientific Committee 89-3 on Extremely Low Frequency Electric and Magnetic Fields.
- E. American Conference of Governmental Industrial Hygienists (ACGHI)
 - 1. "Threshold Limit Values for Chemical Substances and Physical Agents 1999", Cincinnati, Ohio

1.3 SYSTEM DESCRIPTION

A. Design Requirements: Performance: (Add #09)

- Shielding Performance Objective: 1 mG rms (3 mG peak-to-peak) and less measured 1meter above the shielded floor, directly at the location of above-each shielded-NMR tool. (Add #09)
- After AC ELF Magnetic Shielding System has been completely installed as specified in this Section, the final performance testing must comply with Shielding Performance Objectives stated in Item #1 above 1.3 (A) (1). All EMF testing shall be performed by a qualified EMF Consultant with at least ten (10) years of ELF magnetic field testing experience with NIST traceable calibration certificates. Testing will be performed by University's Representative. (Add #09)
- 3. <u>Deleted</u> Thickness/grade of all aluminum plates shall be 1/4 inch and AA1100-H14 grade. (Add #09)

1.4 SUBMITTALS

- A. General: Submit the following in accordance with requirements.
- B. Review drawings and specifications, and then confirm room dimensions, fabrication instructions, and material requirements in writing. (Add #09)
- C. Product Data & Literature:
 - 1. Submit for review and describe properties of items to be used to fabricate AC ELF magnetic shielding system. Include the following:
 - a. Aluminum AA1100-H14, ¹/₄-inch 6" x 6" thick plates conforming to QQ-A-250/2 and ASTM B-209.
 - b. Appropriate fasteners/anchors to secure aluminum plates to walls, floor, and ceiling.

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- D. Shop Drawings:
 - 1. Submit for review and show drawing details of items to be used to fabricate AC ELF magnetic shielding system as shown in Drawings EMF_1.0 the contract documents. (Add #09)
 - 2. Shop drawings to include wall shields and floor shield inside the NMR rooms. (Add #09)
- E. Samples:
 - 1. Verification: Submit for action and review. Furnish-small 6-inch by 6-inch square sample of the AA1100-H14 aluminum plate to be used in the construction of the AC ELF Magnetic Shielding System. The samples will be required for verification of stock and grade. Also, submit samples of anchors, screws and bolts used to secure plates. (Add #09)
- F. Closeout Submittals: Submit the following to the Owner.
 - 1. Record documents. Record documents of as-built drawings for the AC ELF Magnetic Systems (3 hard copies and one CD).
- 1.5 QUALITY ASSURANCE
 - A. Qualifications:
 - 1. Contractor: EMF/EMI Contractor is responsible for quality control of the work and specified AC ELF Shielding Performance-Guarantee Objective. (Add #09)
 - 2. <u>Contractor's</u> Fabricator & Installer: (Add #09)
 - a. EMF shielding <u>Contractor's</u> installer shall have a minimum of ten (10) years of experience in successfully fabricating and installing work with a similar scope as this project.
 - b. EMF shielding <u>Contractor's</u> installer shall have sufficient production capacity to complete the shielding project without causing delay in the work.
 - c. EMF shielding <u>Contractor's</u> installer shall provide a list of successfully completed projects along with related project references.
 - B. Regulatory Requirements: Comply with all applicable requirements of the laws, codes, ordinances and regulations of Federal, State and Municipal authorities having jurisdiction. Obtain necessary approvals from all such authorities.
 - C. Single Source Responsibility: Obtain materials from a single manufacturer for each different product required.
 - D. Pre-Installation Meetings: Contractor to conduct meetings at site prior to start of Work and coordinate work with other trades including Electrical Contractor. <u>Provide notice of Pre-Installation meeting to the University's Representative. Notify University at least two</u> weeks in advance. (Add #09)
 - E. Contractor Responsibility:
 - 1. Correctness between drawings and actual physical dimensions of the floors <u>and</u>, walls and ceiling to be shielded-including constructed extensions and surface walls. (Add #09)

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- 2. Material quantities necessary to completely cover the walls, and floors, and ceiling surfaces with aluminum plates as specified in the drawings. (Add #09)
- 3. Accurate substrate fabrication procedures (cutting and joint preparation) according to the final shop and fabrication drawings submitted for review. (Add #09)
- 4. Precise installation of the aluminum plates, extruded aluminum stock and continuous seam welding of all the plates to ensure proper performance.
- 5. All construction means, methods, techniques, sequences and procedures of shield construction; and, the coordination of this work with all other trades.

1.6 DELIVERY, STORAGE, AND HANDLING

A. General: Upon material delivery carefully unload materials avoid bending and damage. All plates must be flat, plumb and without damage. Stack the plates in securable location (WARNING THE ALUMINUM PLATES ARE PRIME MATERIALS STOLEN FOR-RECYCLING PURPOSES IF NOT STORED IN A SECURE LOCATION) and store materials in a protected dry location off ground. <u>Coordinate with University's Representative at least five</u> working days before delivery for lay down and storage locations.^(Add #09)

- B. Do not bend or damage the plates and AA6061-T6 aluminum ehannels 1-1/2" by 2" extruded rectangles during installation as precise joint spacing is required. (Add #09)
- 1.7 Deleted PROJECT CONDITIONS OR SITE CONDITIONS (Add #09)
 - A. Environmental Requirements: Proceed with the Work in accordance with manufacturer's requirements and instructions and any agreements or restrictions of the Pre-Construction Conference.

PART 2 - PRODUCTS

2.1 SUPPLIERS OF ALUMINUM SHIELDING MATERIALS

- A. Suppliers: Subject to compliance with requirements, provide the following.
 - 1. Ryerson Inc., (see www.ryerson.com)
 - 2. O'Neal Steel (see www.onealsteel.com)
 - 3. Phoenix Metals (see www.phoenixmetalscompany.net)
 - 4. <u>Deleted</u> Other local and regional metal suppliers are acceptable. (Add #09)
 - 5. Or equal. (Add #09)
- 2.2 MATERIALS
 - A. Aluminum Plates: Aluminum Association AA1100-H14, ¹/₄-inch thick aluminum plates in widths and lengths as required and indicated 5 ft. by 10 ft. size only. ^(Add #09)

Accessories:

1. Accessories and Fasteners: Provide the manufacturer's standard concrete anchors, self- tapping drywall screws, fasteners and accessories as required to mount the aluminum wall and floor, plates.

2.3 FABRICATION

A. AC ELF Magnetic Shielding-will be constructed in-place, there will be no prefabrication utilized for shielding components may be prefabricated and/or constructed in-place. (Add #09)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Site Verification of Conditions: Examine and correct conditions of area to receive the Work prior to installation. Report any deficiencies to University's Representative. (Add #09)
- 3.2 PREPARATION
 - A. Field Measurements: Field measurements must be taken prior to preparation of shop drawings and fabrication_installation where possible to ensure proper fitting of the work. (Add #09)

3.3 INSTALLATION

- A. General: Install AC ELF Magnetic Shielding System in accordance with the <u>Contract</u> <u>Documents attached drawings EMF_1.0</u>, <u>approved submittals Fabrication and Installation</u> <u>instructions, submittals</u>, applicable industry standards, and governing regulatory requirements. <u>(Add #09)</u>
- B. Wall-Shielding Work: First Layer Install 1/4" thick AA1100 H-14 grade aluminum platesas shown in EMF_1.0. Cut and install first layer of aluminum_plates on the floor. Secure the aluminum plates using the appropriate fasteners/anchors. After the floor shield is installed and secured, install the first aluminum layer on the walls. Secure and weld using the welding method described below. Stitch weld 1-1/2" by 2" extruded aluminum rectangles directly onto the first layer aluminum plate at 2'0" and 2'6" on-center as shown in the contract documents EMF 1.0. Install and plug weld second aluminum plate wall shield to 1-1/2" by 2" extruded aluminum rectangles. Coordinate with appropriate trades (i.e. HVAC, electrical, plumbing, etc.) for all penetrations needed. Stitch (2 inches on 4inches) shield metal arc weld (SMAW) steel plate using 3/16 inch saw E7014 (or equivalent)welding

rods.—Continuous seam Gas Metal Arc Weld (GMAW) all aluminum plate butt, corner, and edge joints with 3/64-inch 4043 aluminum filler wire using 100% Argon Gas. Care should be taken not to deform the plates while continuous welding the joints; therefore, it may be necessary to stitch weld selected plate joints to minimize plate deformation, then go back to complete the continuous seam weld. (Add #09)

3.4 FIELD QUALITY CONTROL

- A. Site Test: <u>The University will employ an EMF consultant to perform the testing as</u> <u>specified in paragraph 3.4 (B).</u> <u>EMF Consultant with 10 years of professional experience</u> shall be engaged at the Owner's expense and discretion, and perform the following activitiesat the Owner's direction. Work not meeting specified requirements, shall be corrected at nocost to the Owner by the installer. (Add #09)</u>
- B. Testing: After the AC ELF magnetic shielding has been installed by the shielding contractor, a Shielding & Compliance Test-should be completed by shielding installer and/or contractor_shall be performed by the University's EMF consultant. Note: the shielding contractor is not responsible for final testing. Finally, after each shield is tested an EMF/EMI Shield Testing & Compliance Report will be issued for review and acceptance. Once the building is occupied with the (LV) low-voltage transformers/switchgears fully-operational and loaded to a minimum of 25-30%, mapped magnetic flux density readings will be recorded by a qualified EMF Consultant with ten years of EMF engineering experience, to verify the shielding performance objective and issue a Final Shielding System Performance & Compliance Report. (Add #09)
 - 1. Testing will be performed in accordance with requirements stated in "IEEE Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields from AC Power Lines", IEEE Standard No. 644-1994. AC ELF magnetic flux density data shall be recorded at the site with a calibrated FieldStar 1000 gaussmeter (provide NIST traceable calibration certificate) and survey wheel. <u>Record mapped perimeter and contour magnetic flux data at 1 foot intervals within the NMR room at 1-meter above the shielded floor at each NMR tool. Present recorded magnetic flux density data with Hatch, Profile and 3-D plots to assess shielding effectiveness in the NMR room. Record load currents (phases and neutrals) on all LV switchgears to ascertain the power load factor on gears before recording AC ELF magnetic field data (this data is used to calculated worst-case peak load emission levels). <u>Verify compliance with the Shielding Performance Objectives: 1 mG rms (3 mG peak-to-peak) and less measured 1-meter above the shielded NMR tools. ^(Add #09)</u></u>
 - 2. Recorded <u>at least ten minuites of timed 60 Hz magnetic flux density levels at 1 meter directly above the shielded floor at each NMR tool. Recommend wideband (10 Hz to at least 1000 Hz and higher) three-axis fluxgate magnetometer with 1 nT resolution and 1000 mG range (i.e., Bartington Mag-03MC100 or similar) to record timed data with 24-bit A/D data acquisition with signal processing and presentation software. Simultaneously sample three axis (Bx, By and Bz) data at a minimum of 1200 samples per second or higher and generate peak-to-peak waveforms and calculated RMS values with Fast Fourier Transforms (FFT) to evaluate harmonic components. Verify compliance with the Shielding Performance Objectives: 1 mG rms (3 mG peak-to-peak) and less measured 1-meter above the shielded <u>NMR tools. (Add #09)</u></u>
 - Use the calculated load multiplier to estimate worst-case emission levels during peak summer loads. Verify AC ELF magnetic shield complies with Shielding Performance Objective <u>during average and predicted peak building loads</u>. See Warning in Item 4 below: (Add #09)
 - 4. <u>Deleted_Warning: Excessive ground/net and zero-sequence currents (defined asgreater than 2.5 amps) in the primary 13.8 kV feeders/HV switchgears due to N.E.C.S.utility code violations and in the low-voltage electrical distribution system due to</u>

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N.E.C. code violations can compromise the final shielding performance and are the responsibility of the utility and/or client to remediate/correct. If problems persist with the final shielding performance, the EMF Consultant must complete a comprehensive Ground/Net and Zero Sequence Assessment at the Owner's expense to evaluate and recommend remediation measures.

- 5. <u>Deleted</u> The decision of the EMF Consultant on acceptability shall be binding on the contractor. (Add #09)
- 6. Repair or replace defective work, including other work affected thereby and conduct additional testing to the satisfaction of the EMF Consultant, at no additional expense-to the Owner at no additional expense to the University. (Add #09)

3.5 CLEANING

A. At the end of each work day, remove unused materials, debris and containers from the site. At the end of each wok-day, remove unused materials, debris and containers from the site. (Add #09)

END OF SECTION 13092

(Add #09) 04/25/13; Addendum No. 09

SECTION 13096 - AC ELF/DC MAGNETIC SHIELDING - EM ROOMS

PART 1 - GENERAL

1.1 SUMMARY

- A. The contractor shall fabricate and install an AC ELF and DC Magnetic Shielding System composed of 1 layer of 1/4-inch thick seam-welded aluminum plates installed on the ceiling, floor, and walls (x4) of EM Rooms 090A, 090B, 090C with each seam being continuously Gas Metal Arc Welded (GMAW) and six (6) layers of 0.014" thick grain oriented M-6 silicon iron steel layers (two layers per dimension) installed on the walls, floor and ceilings of EM Room 090B. The work to be performed under this Section consists of all labor, materials, appliances and equipment necessary in performing all operations in connection with the furnishing and installation of the AC ELF and DC magnetic shielding system as shown in the EMF Drawing-Series, and as specified herein (note: to the extent necessary the construction drawings and other divisions of the specifications shall be included) the contract document. (Add #09)
- B. Related Sections: Requirements that relate to this section are included but not limited to the sections below.
 - 1. Division 1 "General Requirements".
 - 2. Division 3 "Cast-In-Place Concrete" for concrete materials and placement procedures.
 - 3. Division 8 "Custom Hollow Metal Work" for installation requirements of aluminum plates.
 - 4. Division 8 "Door Hardware" for installation requirements of door hardware.
 - 5. Division 9 "Gypsum Board" and "Non-Load bearing Steel Framing" for metal furring or supports.

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM B209 "Standard Specification for Aluminum and Aluminum-Alloy Shield and Plate".
 - 2. ASTM B221 "Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod and Wire".
 - 3. ASTM A876–09 "Standard Specification for Flat-Rolled, Grain-Oriented, Silicon-Iron, Electrical Steel, Fully Processed Types"
- B. Federal Specifications (FS): (Add #09)
 - 1. FS QQ-A-250/1 "Aluminum and Aluminum Alloy Plate and Sheet, General Specs" for Aluminum Association Grade 1100.
 - 2. FS QQ-A-225/8D and FS QQ-A-200/16 "Aluminum and Aluminum Alloy Plate and Sheet, General Specs" for Aluminum Association Grade 6061

- C. International Electrical & Electronics Engineers (IEEE) Standards. (Add #09)
 - 1."IEEE Standard Procedures for Measurement of Power Frequency Electric and MagneticFields from AC Power Lines", IEEE Standard No. 644-1994"
- D. National Council on Radiation Protection and Measurement (NCRP) (Add #09)
 - Image: NCRP Report No. 86 Biological Effects and Exposure Criteria for Radiofrequency

 Electromagnetic Fields (1986) and Section 8 of the June 13, 1995, NCRO draft report

 of NCRP Scientific Committee 89-3 on Extremely Low Frequency Electric and

 Magnetic Fields.
- E. American Conference of Governmental Industrial Hygienists (ACGHI) (Add #09)
 - 1. "Threshold Limit Values for Chemical Substances and Physical Agents -1999", Cincinnati, Ohio

1.3 SUBMITTALS

- A. Product Data: Submit for review and describe properties of items to be used to fabricate the DC magnetic shielding system. Include the following:
 - 1. Aluminum AA1100-H14 plates by ¼-inch thick conforming to QQ-A-250/2 and ASTM B-209. *NO OTHER GRADE OF ALUMINUM PLATE IS ACCEPTABLE.
- B. Grain-Oriented, Fully Processed, Silicon-Iron Electrical Steel grade M-6 with lamination C5 surface, 1 meter or 36" wide coils, conforming to ASTM A876-09.Shop Drawings: Submit for review and show drawing details of items to be used to fabricate and install the two AC ELF and DC EM magnetic shielding systems. Shop drawings are to include base Aluminum layer, 6 layers of M-6 oriented silicon-iron steel with detailed information on all components to be used in the shielding system. This includes, but is not limited to, structural anchoring, material, components and attaching accessories. (Add #09)
- C. Samples for Verification: Submit for action and review. Furnish a small 6-inch by 6-inch square sample of the AA1100-H14 aluminum plate, fully processed M-6 grain-oriented silicon- iron steel. The samples shall show verification of stock and grade. Also, submit samples of all stainless steel anchors, screws and accessories used to secure the Aluminum plates, M-6 grain- oriented silicon-iron steel to the EM Tool room walls.
- D. Shop Drawings: (Add #09)
 - 1. Submit for review and show drawing details of items to be used to fabricate magnetic shielding system.
 - 2. Shop drawings to include wall, ceiling and floor shields shield inside the EM rooms.
- E. Closeout Submittals: Submit the following to the Owner. (Add #09)
 - 1. Record documents. Record documents of as-built drawings for the AC ELF and AC ELF/DC Magnetic Systems (3 hard copies and one CD).

1.4 QUALITY ASSURANCE

A. Qualifications

- 1. Contractor: EMF/EMI Contractor is responsible for quality control of the work and specified AC ELF Shielding Performance-Guarantee Objective. (Add #09)
- 2. <u>Contractor's</u> Fabricator & Installer: (Add #09)
 - a. EMF shielding <u>Contractor's</u> installer shall have a minimum of ten (10) years of experience in successfully fabricating and installing work with a similar scope as this project.
 - b. EMF shielding <u>Contractor's</u> installer shall have sufficient production capacity to complete the shielding project without causing delay in the work.
 - c. EMF shielding <u>Contractor's</u> installer shall provide a list of successfully completed projects along with related project references.
- B. Regulatory Requirements
 - 1. Comply with all applicable requirements of the laws, codes, ordinances and regulations of Federal, State, and Municipal authorities having jurisdiction. Obtain necessary approvals and/or permits from all such authorities.
- C. Single Source Responsibility
 - 1. Obtain materials from a single manufacturer for each different product required.
- D. Pre-Installation Meetings
 - 1. Contractor to conduct meetings at site with installer prior to start of Work. Familiarize installer with conditions at site and related Work. Provide notice of Pre-Installation meeting to the Owners representative at least two days in advance. <u>Pre-</u> Installation Meetings: Contractor to conduct meetings at site prior to start of Work and coordinate work with other trades including Electrical Contractor. Provide notice of Pre-Installation meeting to the University's Representative. Notify University at least two weeks in advance. (Add #09)
- E. Contractor Responsibility
 - Correctness between drawings and actual physical dimensions of the floors, walls and ceiling to be shielded, including constructed extensions exposed ceiling I-Beams, columns and surface walls.
 - Material quantities necessary to completely cover the walls, floors and ceiling surfaces with aluminum plates and M-6 grain-oriented silicon-iron steel sheets as specified in the drawings. (Add #09)
 - 3. Accurate substrate fabrication procedures (cutting and joint preparation) according to the final shop and fabrication drawings submitted for review. (Add #09)
 - 4. Precise installation of the aluminum plates and grain oriented silicon iron with continuous seam welding of all aluminum plates to ensure proper performance.
 - 5. All construction means, methods, techniques, sequences and procedures of shielding construction; and, the coordination of this work with all other trades.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. General
 - 1. Upon material delivery, carefully unload aluminum plates and fully processed M-6 grain- oriented silicon-iron steel coils avoid bending and damage. Special care must be applied to handling (and final shielding performance) with harsh treatments (i.e., bending, banging, crushing and other assaults) while handling the material. Stack all materials in securable location and store materials in a protected dry location off the ground. Coordinate with the Owners representative at least five working days before delivery for lay down and storage locations.
 - 2. Do not bend or damage aluminum plates and fully processed M-6 grain-oriented silicon- iron steel coils-during prior to installation of work. (Add #09)

1.6 SYSTEM DESCRIPTION (Add #09)

- A. Performance:
 - 1. AC ELF Shielding Performance Objective in EM Rooms 090A, 090B, 090C: 0.1 mG peak-to-peak (0.035 mG rms) and less in the Bx, By, and Bz axis measured at the future columns at 1 and 2 meters.
 - 2. DC Quasi-Static Performance Objective In EM Room 090B only: 0.1 mG peak-topeak (0.035 mG rms) and less in the Bx, By and Bz axis measured at the future column locations with the DC ACS system activated from vehicles traveling on adjacent roads around the facility at 1- and 2-meters above the floor in each shielded EM Tool rooms.
 - 3. After the Magnetic Shielding Systems have been completely installed in EM Rooms 090A, 090B, 090C in this Section, the final performance testing must comply with Shielding Performance Objectives stated in Items #1 and #2 above as noted. All EMF testing shall be performed by a qualified EMF Consultant with at least ten (10) years of ELF magnetic field testing experience with NIST traceable calibration certificates.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Suppliers
 - 1. Ryerson, Inc., (see www.ryerson.com) supplies AA1100-H14 aluminum plates
 - 2. O'Neal Steel (see www.onealsteel.com) supplies AA1100-H14 aluminum plates
 - 3. Phoenix Metals (see www.phenixmetalscompany.net) supplies AA1100-H14 plates
 - 4. National Material Company, L.L.C. (see www.nmlp.com) supplies M-6 silicon-iron steel
 - 5. LSI Steel (www.lsisteel.com) supplies M-6 silicon-iron steel
 - 6. ETS Lindgren, Inc. (see www.ets-lindgren.com) DC Active Compensation-System (ACS). No Active Cancellation System in scope. (Add #09)
 - 7. <u>Deleted</u> Other local regional metal suppliers are acceptable but dimensions,

thickness and sizes must be nearly identical to ensure optimal shieldingperformance. (Add #09)

8. Or equal. (Add # 09)

2.2 MATERIALS

- A. Aluminum Association AA1100-H14 ¹/₄-inch thick <u>5 ft. by 10 ft.</u> aluminum plates and fully processed <u>0.014" thick 1-meter or 36" wide M-6 grain-oriented silicon-iron steel coils. (Add #09)</u>
 - 1. <u>Deleted</u> Procure in the lengths, sizes and quantities specified in drawings. (Add #09)
 - 2. <u>Deleted_Before procurement of materials, reconcile types, sizes, quantities and</u> other pertinent information for a correct order to minimize waste and error. (Add #09)
- B. <u>Deleted_DC Magnetic Field Active Cancellation/Compensating System Recommend-ETS-Lindgren DC Magnetic Active Compensation System (MACS).</u> (Add #09)
- C. Accessories and Fasteners
 - Provide a list of manufacturer's concrete anchors, bolts, nuts, washers, lock washers, self- tapping screws, fasteners and accessories as required to fabricate and install the aluminum plates and six (6) layers of M-6 grain oriented silicon iron (4 layers per floor, wall, and ceiling) required for the AC ELF & DC magnetic shielding system in rooms 090A, 090B and 090C as shown in the EMF Drawing Series contract documents. Note: Only Room 090B is an AC ELF/DC magnetic shield with aluminum plates and grain-oriented silicon-iron steel sheets. (Add #09)
 - D. Construction Film: Provide film between concrete and shielding as shown in details to inhibit corrosion.
 - 1. Products:
 - a. MCI Construction Film;
 - b. Or equal.
 - 2. Physical Properties:
 - a. Tensile Strength at Break (ASTM D 882): 2690/2628 psi
 - b. Elongation at Break (ASTM D 882): 17.0/17.5 inches
 - c. Percent Elongation at Break (ASTM D 882): 850/875%
 - d. Tear Resistance (ASTM D 1922): 1606/2499 gf
 - e. Puncture Resistance (ASTM D 3420): 2.04 Joules
 - f. Static Coefficient of Friction (ASTM D 1894): 0.29
 - g. Kinetic Coefficient of Friction (ASTM C 1894): 0.21

2.3 FABRICATION

A. The AC ELF & DC shields must be carefully <u>designed installed</u> according to the Shop Drawings, and then selected sections fabricated to conform to dimensions of the EM rooms on site. (Add #09)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Site Verification of Conditions
 - 1. Examine and correct conditions of the area to receive the work prior to the installation. Report any deficiencies to the University's Representative. (Add #09)
- B. Field Measurements
 - 1. Take field measurements prior to the preparation of the shop drawings and fabrication where possible to ensure proper fitting of the work.
- 3.2 <u>Deleted EXAMINATION (Add #09)</u>

A. Final Examination

1. Once area to receive Work has been cleaned, conduct a final examination prior to startof Work.

- 3.3 ERECTION / INSTALLATION / APPLICATION
 - A. General
 - Install AC ELF & DC magnetic shielding systems in accordance with the EMF-Drawing Series, Instruction & Notes, Shop Drawing details and the contract documents, approved submittals, applicable industry standards, and governing regulatory requirements. Shielding installation sequence: Aluminum-base shield (floor, four walls and ceiling shield), then six (6) layers (4 layers per wall, floor, and ceiling) of oriented M-6 silicon-iron steel. (Add #09)
 - B. Aluminum base shielding system installation
 - 1. Cut and install 1/4" thick AA1100 H-14 grade aluminum wall plates on the floor, four walls, and ceiling. Secure the aluminum plates to the wall with the appropriate fastener. Continuous seam Gas Metal Arc Weld (GMAW) all aluminum plate butt, corner, and edge joints with 3/64-inch 4043 aluminum filler wire using 100% Argon Gas. Care should be taken not to deform the plates while continuous welding the joints; therefore, it may be necessary to stitch weld selected plate joints to minimize plate deformation, then go back to complete the continuous seam weld.
 - C. First two horizontal M-6 Grain-oriented silicon iron steel layer installation
 - Per the EMF Drawing Series approved shop drawings, cut, fabricate, assemble, and install the first two (2) horizontal 0.014 inch thick M-6 grain-oriented silicon iron steel layers (total of 0.056-0.028 inches thick). Cut and install oriented M-6 by stacked row as shown in drawing-with each edge less than 1/32nd of an inch from the adjacentsheet edge. Cut the first layer of the 2nd sheet in half, so the preceding layers are staggered over the 1st layer seams. Secure each oriented M-6 steel layer row to the base steel aluminum plate and preceding M-6 layers with the appropriate anchors/fasteners as shown in Shop Drawings. (Add #09)

- D. First two vertical M-6 Grain-oriented silicon iron steel layer installation
 - Per the EMF Drawing Series approved shop drawings, cut, fabricate, assemble, and install the first two (2) vertical
 0.014 inch thick M-6 grain-oriented silicon iron steel layers (total of 0.0560.028 inches thick). Cut and install oriented M-6 stacked row as shown in drawing with each edge less than 1/32nd of an inch from the adjacent sheet edge. Cut the first layer of the 2nd sheet in half, so the preceding layers are staggered over the 1st layer seams. Secure each oriented M-6 steel layer row to the base steel aluminum plate and preceding M-6 layers with the appropriate anchors/fasteners as shown in Shop Drawings. (Add #09)
- E. Second two vertical M-6 Grain-oriented silicon iron steel layer installation
 - 1. Per the EMF Drawing Series approved shop drawings, cut, fabricate, assemble, and install the second two (2) vertical 0.014 inch thick M-6 grain-oriented silicon iron steel layers (total of 0.0560.028 inches thick). Cut and install oriented M-6 stacked row as shown in drawing with each edge less than 1/32nd of an inch from the adjacent sheet-edge. Cut the first layer of the 2nd sheet in half, so the preceding layers are staggered over the 1st layer seams. Secure each oriented M-6 steel layer row to the base steel-aluminum plate and preceding M-6 layers with the appropriate anchors/fasteners as shown in Shop Drawings. (Add #09)
- F. <u>Deleted</u> Detailed penetration schedule will be provided in the Drawings for the two EM-Tool room shield systems for control, electrical power and all other ancillary servicessupplied in support of the EM tool rooms. (Add #09)

3.4 FIELD QUALITY CONTROL

- A. Site Test
 - 1. EMF Consultant with 10 years of professional experience shall be engaged at the Owner's expense and discretion, and perform the following activities at the Owner's direction to verify the shielding performance-objective. Work not meeting specified requirements, shall be corrected at no cost to the Owner by the installer. Site Test: The University will employ an EMF consultant to perform the testing as specified in paragraph 3.4 (B). (Add #09)
- B. Testing
 - After the <u>DC Magnetic Shield in Room 90B has been installed by the shielding</u> <u>contractor, a Shielding & Compliance Test shall be performed by the Univeristy'sa</u> <u>qualified EMF consultant engage by the University.</u> Note: the shielding contractor is <u>not responsible for final testing</u>. <u>DC Magnetic Active Compensation System (MACS)</u> <u>has been installed inside the three EM Tool rooms the site is operational, Record at</u> <u>least 10 minutes of timed DC magnetic flux density data at the column location 1-meter</u> <u>above the shielded floor readings</u>. Recommend timed DC static data with a MEDA <u>FVM-400 three-axis fluxgate magnetometer (0 Hz to 10 Hz bandwidth) with 1 nT</u> <u>resolution and 1000 mG range (provide NIST traceable calibration certificate)</u>. Sample DC magnetic flux density data at 0.2 second samples with the MEDA FVM-

<u>Sample DC magnetic flux density data at 0.2 second samples with the MEDA FVM-</u> <u>400 will be recorded over 10 minutes at the appropriate sampling rate with a calibrated MEDA FVM 400 three axis fluxgate magnetometer or similar with 1 nT-</u>

resolution in each EM Tool room at each <u>at</u> column location 1-<u>meter and 2-meters</u> above the <u>shielded</u> floor. <u>Document recorded timed DC Bx</u>, By and Bz magnetic flux density levels in DC shielded Room 090B. ^(Add #09)

- 2. After the AC ELF magnetic shielding has been installed in EM Rooms 090A, 090B, 090C, an AC ELF Shielding & Compliance Test-should be completed by shielding installer and/or contractor shall be performed by a qualified EMF consultant engaged by the University. Note: the shielding contractor is not responsible for final testing. Once the building is occupied with the (LV) low-voltage transformers/switchgears fully- operational and loaded to a minimum of 25-30%, mapped and timed magnetic flux density readings will be recorded by a qualified EMF Consultant with ten (10) years of EMF engineering experience, to verify the shielding performance objective. (Add #09)
 - Testing will be performed in accordance with requirements stated in "IEEE a. Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields from AC Power Lines", IEEE Standard No. 644-1994. AC ELF magnetic flux density data shall be recorded at the site with a calibrated FieldStar 1000 gaussmeter (provide NIST tranceable calibration certificate) and survey wheel. Record mapped perimeter and contour magnetic flux data at 1 foot intervals within AC ELF shielded Rooms EM Rooms 090A, 090B, 090C. Present recorded magnetic flux density data with Hatch, Profile and 3-D plots to assess shielding effectiveness in three (3) EM AC ELF shielded rooms. Timed-AC ELF magnetic flux density data shall be recorded at the site with a calibrated FVM-400 magnetometer or similar instrument (provide NIST traceablecalibration certificate), and a wideband 12 Hz to 50 kHz three-axis gaussmeter or similar with 1 nT resolution. Record load currents (phases and neutrals) on all LV switchgears to ascertain the power load factor on gears before recording AC ELF magnetic field data (this data is used to calculated worst-case peak load emission levels). (Add #09)
 - b. Recorded <u>at least 10 minutes of timed AC ELF and DC</u>-magnetic flux density <u>levels-data</u> in EM 090B, 090C and 090D room at 1 meter above the floor.
 <u>Recommend wideband (10 Hz to at least 1000 Hz and higher) three-axis fluxgate</u> magnetometer with 1 nT resolution and 1000 mG range (i.e. Bartington Mag-03MC100 or similar) to record time data with 24-bit A/D data acquisition with signal processing and presentation software. Simultaneously sample three axis (Bx, By & Bz) data at a minimum of 1200 samples per second or higher and generate peak-to-peak waveforms and calculated RMS values with Fast Fourier Transforms (FFT) to evaluate harmonic components. Timed column wideband AC ELF and quasi-static DC-magnetic flux data must be recorded at 1 meter and 2 meter elevations. over 10 minutes at the appropriate sampling rate. Verify compliance with the AC ELF Shielding Performance Objectives: 0.1 mG peak-to-peak (0.035 mG rms) and less in the Bx, By, and Bz axis measured at the column at 1 meter. and 2 meters. (Add #09)
 - c. Use the calculated load multiplier to estimate worst-case emission levels during peak summer loads. Verify AC ELF magnetic shields in EM Rooms 90A, 90B and 90C complies with 0.1 mGp-p (0.035 mG rms) and less in the Bx, By and Bz Shielding Performance Objective measured at the column 1-meter above the floor during average and predicted peak building loads. See Warning in Item d below: (Add #09)
 - d. <u>Deleted Warning: Excessive ground/net and zero-sequence currents (defined-</u>

> as greater than 2.5 amps) in the primary 13.8 kV feeders/HV switchgears due to N.E.C.S. utility code violations and in the low-voltage electrical distributionsystem due to

N.E.C. code violations can compromise the final shielding performance and are the responsibility of the utility and/or client to remediate/correct. If problems-persist

with the final shielding performance, the EMF Consultant must complete a comprehensive Ground/Net and Zero-Sequence Assessment at the Owner's expense to evaluate and recommend remediation measures. (Add # 09)

- e. <u>Deleted</u> The decision of the EMF Consultant on acceptability shall be binding on the contractor. (Add #09)
- f. <u>Repair or replace defective work , including other work affected thereby</u> <u>and conduct additional testing at no additional expense to the</u> <u>University.Repair or replace defective work, including other work</u> <u>affected thereby and conduct additional testing to the satisfaction of the</u> <u>EMF Consultant, at no additional expense to the Owner.</u> (Add #09)

3.5 ADJUSTING AND CLEANING

- A. General
 - 1. At the end of each work-day, remove unused materials, debris and containers from the site.

3.6 <u>Deleted DEMONSTRATION</u> (Add #09)

- A. Final Site Survey
 - 1. Shielding Performance can be demonstrated by conducting a final site survey which compares the actual recorded values to predicted/simulated values.

B. DC EMI Magnetic Shielding Performance Requirement At Columns

- 0.1 mG peak-to-peak (0.035 mG rms) and less in the Bx, By and Bz axis measured at the future column locations with the DC ACS system activated from vehicles travelingon adjacent roads around the facility at 1- and 2-meters above the floor in eachshielded EM Tool rooms.
- 2. Shield will be compared to initial design, as described above.
- C. AC ELF Magnetic Shielding Performance Requirement At Columns.
 - 1. 0.1 mG peak-to-peak (0.035 mG rms) and less in the Bx, By, and Bz axismeasured at the future columns at 1 and 2 meters
 - 2. Shield will be compared to initial design, as described above.

3.7 PROTECTION

- A. General
 - 1. Protect the Work so it will not deteriorate or be damaged. Remove protection at time of Substantial Completion.

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END OF SECTION 13096

(*Add* #09) 04/25/13; Addendum No. 09





 DOOR, WHERE OCCURS REDUCER STRIP - CONT. STAINLESS STL ANGLE TRIM (3" X 1/16" THICK X REQD DEPTH) - SEALED CONCRETE

/2













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DRAWING NUMBER