February 5, 1999

Mr. Thomas Phillips
Federal Communications Commission
55 Oakland Mills Road
Columbia, MD

cc : Art Wall

Dear Mr. Phillips :

Since 1993, CKC Laboratories, Inc. has been investigating the use of fixed height free space chambers for use as radiated emissions certification facilities. Based on our research and similar work by CENELEC in Europe related to the development of a new European standard titled EN50147 Part 3, CKC is proposing that the FCC accept fixed height free space chamber measurements in addition to OATS measurements for radiated emissions approvals.

The primary advantages of these types of facilities over the OATS are as follows :

1. ***Zero Ambient Environment*** : Ambients force OATS laboratories located close to Metropolitan areas to often ignore important frequency bands where measurements can not be made, or to resort to using a "frequency list" method based on fixed height semi-anechoic measurements, a practice which can substantially increase the measurement uncertainty.
2. ***Lower Uncertainty / Better Test Repeatability than the OATS standard***: The variation in received signal from the EUT volume is lower in the free space chamber than a full scan height OATS, and significantly lower than a fixed height semi-anechoic measurement even though a fixed height is used in free space. This means that measurements in Free Space are less sensitive to cable and equipment placement. Furthermore, on the OATS it is technically not practical to truly vary antenna height and table angle simultaneously across all frequencies. In theory, on the OATS one needs to fully vary antenna height for small incremental angles of the turntable across the entire frequency range to achieve a complete result. The common practical compromise of fixing the antenna to a theoretical height, scanning frequency, selecting frequencies, then varying table angle (or some other sequence such as this) does not ensure that the maximum emissions at all frequencies will be obtained as well as a simple fixed height free space measurement where only table angle and frequency must be varied.
3. ***Affordable Cost*** : A fixed height 3 Meter free space chamber can be constructed for under $250,000 which is approximately 1/2 to 1/3 the cost of a full scan height 3 meter semi-anechoic room, and 1/10 to 1/20 the cost of a full scan height 10 meter room.
4. ***Improved Traceability*** : The free space definitions lend to improved traceability through standard reference instrumentation for electromagnetic field measurements than is presently offered available through ANSI or CISPR standards. This traceability can be achieved without the need for definition of a national reference ground plane or any new other reference devices as have been proposed by CISPR or others.

5. ***Improved Environment for Microwave and Millimeter Wave Testing*** : Testing of intentional and unintentional radiators is simplified by stating a free space environment for the test, particularly for frequencies above 1 GHz. Already, some international emissions standards, such as the ETSI group for intentional radiators, prefer a free space standard environment for testing of low power RF devices and cellphones. It has been our experience that the straight vertical 1-4m receive scan (at 3m distance) over a ground plane does not ensure that the maximum emissions will be obtained from the EUT and becomes very difficult at higher frequencies due to the need to keep cables between instrumentation and antennas very short. For measurements above 1 GHz, CKC is developing improved methods for free space that will require a 1 meter distance, and scan over the top hemisphere of the EUT (maintaining a 1 meter distance over the EUT either by tipping of the EUT, or a constant scan arc over the EUT). However, these future improvements we are investigating for testing above 1 GHz do not affect our conclusions that fixed height free space measurements from 30 MHz - 1 GHz yield the same or lower uncertainty as a full scan height OATS and therefore should be acceptable.

CKC presently has six free space facilities in use at this time for radiated emissions engineering and troubleshooting only (we perform all FCC and other certification tests on one of our 12 OATS sites at present). Our research into the applicability of the Free Space Chamber for final radiated emissions testing has resulted in the development of two CKC standards, now available to the public, which we have also included under our A2LA accredited ISO Guide 25 Quality System.

As part of our development of the CKC free space standards, CKC has developed a new chamber calibration method based on an isotropic field probe and RF power meter (both NIST traceable devices) as the primary reference instruments for calibration of all equipment that will be used for both radiated emissions and radiated immunity measurements. This includes the chamber, antenna, and fixed installed cabling of the measurement system. The calibration requires sampling of the electric field (with the isotropic probe and power meter) at 28 points in the volume to be occupied by the Equipment Under Test. Based on the population of sample points in each polarity (horizontal or vertical with respect to the EUT), the resulting average system gain over isotropic is computed for the system encompassing the facility, antennas, and cables. The measurement uncertainty is then calculated and expanded appropriately for the instrumentation used during the calibration. The required report of the measurement uncertainty, as detailed in our calibration standard, is in accordance with ISO guidelines for statement of measurement uncertainty, and NIST Technical Note 1297.

We have also examined the uncertainty of the fixed height Free Space measurement with empirical studies using actual table top EUT’s. The results of the empirical data support the conclusion that it is possible to measure radiated emissions in a free space chamber at a fixed height with the same or better measurement uncertainty as is possible between full 1-4 meter scan height OATS in the frequency range of 30 MHz – 1 GHz. At present, CKC has supporting empirical data for table top devices only, although the European EN50147 Part 3 standard will encompass both table top and floor standing equipment.

Under the FCC’s authority of 47 CFR, Part 2 (paragraphs 2.947 and 2.948) and paragraphs 15.31(b) and (d), CKC requests that our Fixed Height methods and facilities be considered sufficiently equivalent to OATS measurements for the purpose of radiated emissions investigations to demonstrate compliance with the FCC's rules under any of the authorization procedures contained in Part 2.

Furthermore, CKC suggests that the present language regarding "Precedence" of OATS either be removed or be replaced with a concept statement that places primary precedence on Accreditation of the laboratory making measurements and measurement uncertainty. The present language regarding precedence of OATS hampers the development and industry acceptance of improved technology that could yield lower measurement uncertainty. In practice, we usually find disputes are resolved between parties by further investigation of the equipment in question and a review or repeat of the measurements performed. However, if a precedence statement is needed, we suggest language similar to the following : "In cases of dispute, measurements made at an accredited test facility which can demonstrate lower measurement uncertainty, traceable to NIST, shall take precedence". We believe this would also further encourage NIST and the EMC community to focus even more on methods of determining and quantifying measurement uncertainty which is critical for the future of a credible EMC measurement industry.

To promote the use of free space measurements, CKC will provide a copy of any of the attached documentation to our customers or other interested parties. We do however, reserve the right to charge a fee for this documentation to recover research and development costs and costs associated with publication and duplication of these standards.

Please contact me if you have any questions, or if CKC can provide any additional information or assistance to the FCC on the development of an acceptable Free Space measurement technique.

Sincerely,

Chris M. Kendall
CKC Laboratories, Inc.

Attachments :

Attachment A : "Technical Justifications for Acceptance of Fixed Height Free Space Measurements" (5 pages)

Attachment B : "An Analytical Comparison of Radiated Emissions Test Facilities" by Clark Vitek, EMC Staff Engineer, CKC Laboratories, Inc. (4 pages)

Attachment C : "Comparison of 95% Confidence Measurement Uncertainty of Free Space Chambers, Calculated by Two Methods" by Clark Vitek, EMC Staff Engineer, CKC Laboratories, Inc. (5 pages).

Attachment D : Sample Facility Description and Calibration Report "FREE SPACE RADIATED ELECTROMAGNETIC FIELD MEASUREMENT SYSTEM : HILLSBORO, OREGON DECEMBER 1, 1998 " (28 pages).