Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Curtiss-Wright Controls Inc.	)	
	)	ET Docket No.10-167
Request for Waiver of Part 15 of the Commission's Rules Applicable to Ultra-Wideband Devices	)	
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MEMORANDUM OPINION AND ORDER

Adopted: August 9, 2013 **Released: August 9, 2013**

By the Chief, Office of Engineering and Technology:

I. INTRODUCTION

1. By this Memorandum Opinion and Order ("Order"), we modify the waiver previously granted to Curtiss-Wright Controls Inc. ("CWCI") of the Commission's ultra-wideband ("UWB") rules for a ground penetrating radar ("GPR") system known as 3d-Radar.[1] GPR devices are field disturbance sensors that detect buried objects, changes in material, and cracks in ground or in other subsurface structures, and they are typically used in the maintenance of highways and bridge infrastructures in the United States. GPR devices achieve these objectives by utilizing a very wide operational bandwidth that spans frequency bands that are also used by a broad array of other radio services.

2. In the *Waiver Order*, we waived the definitional requirement in Section 15.503(d), which specifies the minimum operational bandwidth of an UWB transmitter, and the UWB measurement procedure in Section 15.521(d). In this Order, we are allowing 3d-Radar to operate with stepped frequency modulation in 10 megahertz and 20 megahertz steps in addition to the 2 megahertz steps already permitted by the *Waiver Order*.[2] This action will permit CWCI to receive FCC equipment authorization under the modified conditions. We will require CWCI to comply with all other technical and operational requirements for unlicensed UWB GPR devices in Section 15.509. We find that granting this waiver modification request is in the public interest because it will improve the capability and safety of products that are used in conjunction with maintaining our nation's transportation infrastructure without increasing the potential for interference to authorized radio services.

[1] *Curtiss-Wright Controls Inc., Request for Waiver of Part 15 of the Commission's Rules Applicable to Ultra-Wideband Devices,* Order, ET-Docket No. 10-167, 27 FCC Rcd 234 (2010) ("*Waiver Order*").

[2] *See Waiver Order* at para. 24.

II. BACKGROUND

3. On June 10, 2010, CWCI filed a request for a waiver of the UWB minimum bandwidth requirement in Section 15.503(d) and the UWB measurement procedures in Section 15.521(d) of the Commission's rules to permit the marketing and operation of its stepped frequency GPR system known as 3d-Radar.[3] CWCI stated that its 3d-Radar system operates between 140 MHz and 3 GHz using stepped frequency modulation to achieve superior performance characteristics of deep signal penetration, high resolution imaging, and fast survey speeds. CWCI stated that to achieve deep signal penetration into the ground, a GPR device must operate at relatively low frequencies, generally below 1 GHz, and to achieve increased image resolution, the device must be able to operate over a very large frequency range, generally 2 GHz or more.[4] CWCI claimed that its device accomplishes these two objectives by placing an array of closely spaced antennas that transmit sequentially over a wide band of spectrum and gather a variety of data from underground structures in a single pass. The 3d-Radar system features an electronically-scanned 31-element antenna array that transmits over 1,431 frequencies in 2 megahertz steps between 140 MHz and 3 GHz with a scan/cycle rate of approximately 2.86 milliseconds. The antenna array is towed (or pushed) approximately 30 cm above the ground by survey vehicles traveling at normal highway speeds. The 3d-Radar system's design allows it to travel at high speeds and to eliminate the need for multiple passes. This results in less RF energy being transmitted at any one location, thereby minimizing any risk of potential interference to authorized services.[5] CWCI contended that the 3d-Radar system represents a leap in GPR technology that would increase the efficiency of subsurface imaging, lower the costs of infrastructure repair and improve safety conditions for both infrastructure workers and the general public. CWCI also stated that their 3d-Radar system has already been certified for use in the European Union.[6] CWCI sought a waiver as its 3d-Radar system does not satisfy the definitional requirement of Section 15.503(d) that an UWB transmitter "at any point in time" have a fractional bandwidth[7] equal to or greater than 0.20 or have an UWB bandwidth equal to or greater than 500 megahertz. It also sought a waiver of the Section 15.521(d) measurement procedure requirement that if pulse gating is used and the transmitter is quiescent for longer intervals than the nominal pulse repetition interval, measurements are made with the pulse train gated on.[8]

4. On January 11, 2012, the Office of Engineering and Technology ("OET") adopted the *Waiver Order*. OET concluded that a waiver of the UWB transmitter definition was warranted since the 3d-Radar device is functionally equivalent to UWB GPR devices and the risk of interference from the 3d-Radar device would be no greater than from UWB GPR devices; thus, a waiver would not undermine the intent of the 15.503(d) rules.[9] OET further concluded that there is good cause for waiving the 15.521(d) measurement procedure requirement and that such action would serve the public interest.[10] The *Waiver Order* contained the following conditions:

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[3] *See Curtiss-Wright Controls Inc., Request for Waiver of Part 15 of the Commission's Rules Applicable to Ultra-Wideband Devices*, ET Docket No. 10-167, filed June 10, 2010 ("CWCI Waiver Request"); *See also* 47 C.F.R §§ 15.503(d) and 15.521(d).

[4] *Id.* at 1.

[5] *Id.* at 2-3.

[6] *Id.* at 3.

[7] The factional bandwidth is the UWB bandwidth, i.e., the -10 dB bandwidth, divided by the center frequency. *See* 47 C.F.R. § 15.503(c).

[8] *See* CWCI Waiver Request*, supra* note 3, at 1.

[9] *See Waiver Order* at para. 14.

[10] *See Waiver Order* at para. 21.

- The 3d-Radar device shall be certified by the Commission. The device shall operate with stepped frequency modulation in 2 megahertz steps between 140 MHz and 3 GHz with a scan/cycle rate of approximately 3 milliseconds. The system may not use any single frequency longer than 2 microseconds in any 3 millisecond period of time.

- Measurements of emissions from the 3d-Radar device shall be conducted with the stepping function active.

- The 3d-Radar device shall not be sold in any hand-held configurations.

- The 3d-Radar device shall comply with all other technical and operational requirements applicable to UWB GPR devices under Part 15, Subpart F of the Commission's rules.

- The 3d-Radar device shall implement frequency notching to avoid placing intentional transmissions in the bands 608-614 MHz, 1400-1427 MHz, 1660.5-1668.4 MHz, and 2690-2700 MHz.[11]

5. On February 10, 2012, CWCI filed a Petition for Reconsideration and Clarification ("Petition")[12] and asks the Commission to modify the first waiver condition. CWCI argues that the condition that requires the device to hop in 2 megahertz steps will unnecessarily hinder deployment of 3d-Radar and will impede technological improvements in the 3d-Radar systems because this condition locks in a particular version of the 3d-Radar. CWCI states that it did not expect the *Waiver Order* to be narrowly tailored to the specific version of the 3d-Radar device that it described in its original waiver request, and that, during the pendency of its waiver request, it modified the 3d-Radar design to incorporate two new modulation schemes (one with 10 megahertz steps and one with 20 megahertz steps), faster scan/cycle (from 2.86 millisecond to 150 microsecond), and a shorter dwell time (from 2 to 1 microsecond).[13] Thus, CWCI requests that the Commission modify the first waiver condition as follows (new language in bold and underlined): "The device shall operate with stepped frequency modulation in **at least** 2 megahertz steps between 140 MHz and 3GHz with a scan cycle of **no more** than approximately 3 milliseconds. The system may not **continuously** use any single frequency longer than 2 microseconds in any 3 millisecond period of time."[14] In its Petition, CWCI argues that the modified waiver condition it now requests will allow 3d-Radar operation to be more like a conventional GPR, while continuing to comply with the emission limits and other operational requirements of the UWB rules.[15] CWCI also states that the Commission should encourage the evolution of the 3d-Radar device, and it would be unduly burdensome on both CWCI and the Commission to require a new waiver every time CWCI wants to make a change in one of the parameters set forth in the *Waiver Order*.[16]

6. On January 8, 2013, CWCI filed a Supplement to the Petition ("Supplement") in which it

[11] *Waiver Order*, 27 FCC Rcd at 242 (para. 24).

[12] *See In the Matter of Curtiss-Wright Controls Inc. Request for Waiver of Part 15 of the Commission's Rules Applicable to Ultra-Wideband Devices,* Petition for Reconsideration and Clarification, ET-Docket No. 10-167, filed February 10, 2012.

[13] *Id.* at 4-5.

[14] *Id.* at 2.

[15] *Id.*

[16] *Id.* at 9.

clarifies and more fully explains its request for a modification of the waiver.[17] Specifically, it requests that we permit the 3d-Radar device to operate with stepped frequency modulation in 2, 10 and/or 20 megahertz steps (including those that involve a frequency shift of 1 or 2 megahertz).[18] CWCI asserts that customers could improve the 3d-Radar's performance through minor software changes to the dwell time per step or the size of the step. For example, a 20 megahertz step device will cover the same operating spectrum ten times faster than a 2 megahertz step device assuming dwell time per step is the same, which means that the towing vehicle can go ten times faster and still obtain comparable survey results with the larger step device. CWCI states that devices traveling at faster speeds and using larger frequency steps are best suited for shallow depth survey jobs, whereas devices traveling at a slower travel speed and using smaller frequency steps may be more appropriate for deeper probes.[19]

7. After conducting additional software testing and analyzing survey results for both the 10 and 20 megahertz step size designs, CWCI requests that the Commission allow 10 and 20 megahertz steps under the conditions that the scan/cycle time take approximately 3 milliseconds and that no frequency step experience an accumulated dwell time of more than 2 microseconds for any given scan. CWCI states that by adhering to these two essential parameters, it will be able to ensure that its devices will always be programmed to operate in a manner that mitigates the risk of interference to licensed spectrum users.[20]

III. DISCUSSION

8. Under its rules, the Commission will entertain petitions for reconsideration in non-rulemaking proceedings when the petition relies on facts or arguments not previously presented for its consideration because: (a) those new facts occurred after the last opportunity to present such matters to the Commission, or (b) they were unknown to the petitioner until after his last opportunity to present them to the Commission and he could not through the exercise of ordinary diligence have learned of the facts or arguments prior to such opportunity.[21] The rules require that the petition specify how the previous action should be changed and cite the findings of fact or conclusions of law that were erroneous in the previous action.[22] The *Waiver Order* granted the relief CWCI sought in its original waiver request, *i.e*., we found that it was in the public interest to waive our rules for the 3d-Radar device as described in CWCI's request, because it would make available a product that would improve the safety of our nation's transportation infrastructure without increasing the potential for interference to authorized radio services.[23] Our analysis and findings were based on the technical description that CWCI provided to us. CWCI does not argue with the findings in the *Waiver Order*. Rather, CWCI argues that the waiver is too narrow because it does not allow it to manufacture and market a device with different technical parameters that it designed during the pendency of the waiver proceeding. Given these circumstances, we find that reconsideration or clarification of the *Waiver Order* is not warranted. Rather, we will consider CWCI's petition as a request to modify the previous waiver based on the newly provided information.

9. We are authorized to grant a waiver under Section 1.3 of the Commission's rules if the

[17] *See In the Matter of Curtiss-Wright Controls Inc. Request for Waiver of Part 15 of the Commission's Rules Applicable to Ultra-Wideband Devices,* Supplement to Petition for Consideration and Clarification ("Supplement"), ET-Docket No. 10-167, filed January 8, 2013.

[18] *Id*. at 7.

[19] *Id*. at 2-3.

[20] *Id.* at 3-4.

[21] 47 C.F.R. §1.106(c). The Commission also may entertain a petition when it determines that doing so is in the public interest.

[22] 47 C.F.R. § 1.106(d).

[23] *See Waiver Order,* 27 FCC Rcd at 234 (para. 2).

petitioner demonstrates good cause for such action.[24] Good cause, in turn, may be found and a waiver granted "where particular facts would make strict compliance inconsistent with the public interest."[25] To make this public interest determination, the waiver cannot undermine the purpose of the rule, and there must be a stronger public interest benefit in granting the waiver than in applying the rule.[26]

10. The UWB technical and operational standards in Sections 15.503(d) and 15.521(d) were adopted to ensure that UWB ground penetrating radar systems do not cause harmful interference to authorized radio services, including Federal services.[27] In this Order, we evaluate the potential for interference to authorized radio services under the new technical parameters requested by CWCI. As discussed below, the proposed modifications by CWCI to the conditions set forth in the *Waiver Order* would not increase the potential for harmful interference to authorized services, *i.e.*, the various 3d-Radar GPR designs pose no greater risk of harmful interference than any currently operating UWB GPR and will allow the marketing of new GPR devices that would increase efficiency in subsurface imaging, thereby potentially lowering costs of infrastructure repair and improving safety conditions for both infrastructure workers and the general public.

11. The new 3d-Radar designs involve operating modes where the transmitted frequency will be stepped through the operating frequency range multiple times. Each new pass will be shifted by either 1 megahertz or 2 megahertz, such that the device does not transmit on the same frequencies from one pass to the next. Transmission on any individual frequency will not be repeated until the device has stepped through every 1 megahertz or 2 megahertz step of the operating range. The maximum dwell time per step and cycle/scan rate set forth in the *Waiver Order* would act to limit potential interference by controlling the overall system duty cycle on any individual frequency.[28] For these reasons, we do not expect a system operating with 10 megahertz or 20 megahertz steps to provide any greater potential for interference than the system described in CWCI's original waiver request, as long as the duty cycle is not increased. Because the pulsewidth and scan/cycle times for each of the operating modes requested by CWCI may result in a slightly different duty cycle, we will modify the waiver conditions by specifying the maximum duty cycle rather than specific pulsewidth and cycle/scan rate combinations for the 3d-Radar system. The individual frequency duty cycle of the GPR system described in CWCI's original waiver request is 0.07 percent,[29] so we will specify duty cycle as not to exceed 0.07 percent. The measurement time for the duty cycle determination will remain at a maximum of 3 milliseconds.[30] Under these parameters, CWCI will

[24] 47 C.F.R. § 1.3. *See also WAIT Radio v. FCC*, 418 F.2d 1153 (D.C. Cir. 1969) (*WAIT Radio*); *Northeast Cellular Telephone Co. v. FCC*, 897 F.2d 1164 (D.C. Cir. 1990) (*Northeast Cellular*); *ICO Global Communications (Holdings) Limited v. FCC*, 428 F.3d 264 (D.C. Cir. 2005) (*ICO Global Communications*).

[25] *Northeast Cellular*, 897 F.2d at 1166; *see also ICO Global Communications*, 428 F.3d at 269 (quoting *Northeast Cellular*); *WAIT Radio*, 418 F.2d at 1157-59.

[26] *See, e.g.*, *WAIT Radio*, 418 F.2d at 1157 (stating that even though the overall objectives of a general rule have been adjudged to be in the public interest, it is possible that application of the rule to a specific case may not serve the public interest if an applicant's proposal does not undermine the public interest policy served by the rule); *Northeast Cellular*, 897 F.2d at 1166 (stating that in granting a waiver, an agency must explain why deviation from the general rule better serves the public interest than would strict adherence to the rule).

[27] *See First Report and Order* in ET Docket No. 98-153, 17 FCC Rcd 7435 (2002). An Erratum to the *First Report and Order* was adopted on May 30, 2002. See Erratum in ET Docket No. 98-153, 17 FCC Rcd 10505 (2002).

[28] Duty cycle is calculated by dividing the pulse width by the scan/cycle time.

[29] As noted above, duty cycle is calculated by dividing the pulse width by the scan/cycle time. Accordingly, for the GPR system described in CWCI's original waiver request, duty cycle would be: (2 microseconds) / (2.86 milliseconds) = 0.0006993 (or approximately 0.07 percent).

[30] *Waiver Order, supra* at 240; *see also* Supplement*, supra*, at 4-6 and Exhibit A.

be permitted to use whatever pulsewidth is necessary based on its scan/cycle time to meet the total duty cycle requirement. Finally, we will maintain the requirement to notch out the frequencies indicated by the *Waiver Order*.[31]

12. We conclude that a modification of the *Waiver Order* is warranted in this case. We find that a 3d-Radar device operating with either 2, 10 or 20 megahertz steps under the conditions adopted in this Order will improve the function of the device and benefit public safety and that the risk of interference will be no greater than what we had permitted under the *Waiver Order* or from other UWB GPR devices; thus, a modification to the waiver will not undermine the intent of the Commission's rules. In the *Waiver Order*, we found generally that permitting operation of CWCI's 3d-Radar provides a strong public interest benefit.[32] In this order, we find that CWCI has adequately demonstrated that modifying the *Waiver Order* conditions should allow CWCI to continue to develop 3d-Radar in ways that further improve the efficiency in subsurface imaging and, consequently, should provide additional public interest benefits by enhancing public safety. For example, if limited to 2 megahertz frequency steps, highway speeds for 3d-Radar operation are achievable only by reducing the horizontal sample density (increased spacing between samples across antenna and along motion direction), which impacts data quality. Ten or 20 megahertz steps allows the systems to maintain the safety of highway speeds and have improved data quality. Devices operating with 20 megahertz frequency steps will be suitable for shallow depths in combination with high resolution (*e.g.*, asphalt, concrete damage detection, and void detection in shallow to medium base layers). Devices operating with 10 megahertz frequency steps can be optimal where more depth is needed (*e.g.*, void detection in deep base layers). This design flexibility will allow the user—including Federal, state and local transportation authorities—to configure the device for different conditions to obtain the specific information they need to improve highway and bridge infrastructures.

13. In conclusion, modifying the conditions on CWCI's waiver as set forth in its Petition and Supplement furthers the public interest without undermining the purpose of the UWB rules. Therefore, we are modifying the terms in the *Waiver Order* by allowing stepped frequency modulation in 2, 10, or 20 megahertz steps, and by changing the original pulse width requirements to a duty cycle requirement. The waiver as modified is subject to the following conditions:

- The 3d-Radar device shall be certified by the Commission in each mode of operation. The device shall operate with stepped frequency modulation in 2, 10, or 20 megahertz steps between 140 MHz and 3 GHz with a scan/cycle rate of approximately 3 milliseconds.
- The system total duty cycle on any individual frequency may not exceed 0.07 percent. The time period for measuring the maximum duty cycle cannot exceed 3 milliseconds.
- For certification testing, the measurement of emissions from the 3d-Radar device shall be conducted with the stepping function active for all possible frequency step sizes.
- The 3d-Radar device shall not be sold in any hand-held configurations.
- The 3d-Radar device shall comply with all other technical and operational requirements applicable to UWB GPR devices under Part 15, Subpart F of the Commission's rules.
- The 3d-Radar device shall implement frequency notching to avoid placing intentional transmissions in the bands 608-614 MHz, 1400-1427 MHz, 1660.5-1668.4 MHz, and 2690-2700 MHz.

[31] *See Waiver Order* at para. 24.

[32] *See Waiver Order* at para. 8.

IV. ORDERING CLAUSES

14. Accordingly, pursuant to authority in Sections 0.31, 0.241, and 1.3 of the Commission's rules, 47 C.F.R. §§ 0.31, 0.241, and 1.3, and Sections 4(i), 302, 303(e), and 303(r) of the Communications Act of 1934, as amended, 47 U.S.C. §§ 154(i), 302a, 303(e), and 303(r), IT IS ORDERED that the Petition for Reconsideration and Clarification filed by Curtiss-Wright Controls Inc. IS DENIED.

15. IT IS FURTHER ORDERED that the waiver granted to Curtiss-Wright Controls, Inc. on January 11, 2012, IS MODIFIED, consistent with the terms of this Memorandum Opinion and Order. This action is effective upon release of this Memorandum Opinion and Order**.**

FEDERAL COMMUNICATIONS COMMISSION

Julius P. Knapp
Chief, Office of Engineering and Technology