RF Exposure Report

Product Name: pico Remote Radio Unit

Product Model: pRRU3911+WIFI

Report Number: SYBH(R)02376164EB-2

FCC ID: QISPRU11WIFI

IC: 6369A-PRU11WIFI

Reliability Laboratory of Huawei Technologies Co., Ltd.

(Global Compliance and Testing Center of Huawei Technologies Co., Ltd.)

Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District, Shenzhen, 518129, P.R.C

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Notice

1. The laboratory has passed the accreditation by China National Accreditation Service for Conformity Assessment (CNAS). The accreditation number is L0310.

2. The laboratory has passed the accreditation by The American Association for Laboratory Accreditation (A2LA). The accreditation number is 2174.01.

3. The laboratory has been listed by the US Federal Communications Commission to perform electromagnetic emission measurements.

- The recognition number for the test site located in Shenzhen is 97456.
- The recognition number for the test site located in Shanghai is 684868.
- The recognition number for the test site located in Chengdu is 216797.

4. The laboratory has been listed by Industry Canada to perform electromagnetic emission measurements.

- The recognition number for the test site located in Shenzhen is 6369A-1.
- The recognition numbers for the test site located in Shanghai is 6369D, which contains 6369D-1 (3m chamber) and 6369D-2 (10m chamber).
- The recognition number for the test site located in Chengdu is 6369E-1.

5. The laboratory (Reliability Laboratory of Huawei Technologies Co., Ltd.) is also named as "Global Compliance and Testing Center of Huawei Technologies Co., Ltd."; the both names have coexisted since 2009.

6. The test report is invalid if not marked with the signatures of the persons responsible for preparing and approving the test report.

7. The test report is invalid if there is any evidence of erasure and/or falsification.

8. The test report is only valid for the test samples.

9. Content of the test report, in part or in full, cannot be used for publicity and/or promotional purposes without prior written approval from the laboratory.

Applicant:	Huawei Technologies Co., Ltd.
Address:	Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District, Shenzhen, 518129, P.R.C
Product Name:	pico Remote Radio Unit
Product Model:	pRRU3911+WIFI

Date of Receipt Sample:	2016-04-19
Start Date of Test:	2016-04-19
End Date of Test:	2016-05-18

Test Result: Pass

Approved by Senior Engineer:	2016-05-18	Ren Huasheng	
	Date	Name	Signature

Prepared by:	2016-05-18	Hu Wei	
	Date	Name	Signature

Modification Record

No.	Last Report No.	Modification Description
1	---	First report.

CONTENT

1 General Information

1.1 Applied Standard

- FCC Part 1
- FCC OET Bulletin 65

- RSS-102 (Issue 5, March 2015)

1.2 Test Location

Test Location 1 (TL1):	Global Compliance and Testing Center of Huawei Technologies Co., Ltd. (Reliability Laboratory of Huawei Technologies Co., Ltd.)
Address:	Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District, Shenzhen, 518129, P.R.C

1.3 Test Environment Condition

Ambient Temperature:	15 to 30 °C
Ambient Relative Humidity:	20 to 85 %
Atmospheric Pressure:	Not applicable

2 RF Exposure Requirements

NOTE: Unless stated otherwise, all requirements in the report are for the separation distance between the user and/or bystander and the product's radiating element is greater than 20 cm, or for non-portable devices.

2.1 FCC Part §1.1310(e) – Maximum permissible exposure

According to FCC Part §1.1310(e), the maximum permissible exposure (MPE) to radiofrequency electromagnetic fields are:

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3–3.0	614	1.63	*100	6
3.0–30	1842/f	4.89/f	$*900/f^2$	6
30–300	61.4	0.163	1.0	6
300–1,500	.....	.....	f/300	6
1,500–100,000	.....	.....	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*100	30
1.34–30	824/f	2.19/f	$*180/f^2$	30
30–300	27.5	0.073	0.2	30
300–1,500	.....	.....	f/1500	30
1,500–100,000	.....	.....	1.0	30

f = frequency in MHz * = Plane-wave equivalent power density

2.2 RSS-102 – RF exposure compliance of radio-communication apparatus for all frequency bands

According to §4 of RSS-102, the RF field strength limits for devices used by the general public (uncontrolled environment) are:

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Reference Period (minutes)
0.003-10[21]	83	90	-	Instantaneous*
0.1-10	-	$0.73/f$	-	6**
1.1-10	$87/f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	$58.07/f^{0.25}$	$0.1540/f^{0.25}$	$8.944/f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142 f^{0.3417}$	$0.008335 f^{0.3417}$	$0.02619 f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158 f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000/f^{1.2}$

Note: f is frequency in MHz.
*Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

3 RF Exposure Evaluation

NOTE: Unless stated otherwise, all evaluations in the report are for general public/uncontrolled exposure.

3.1 FCC Part §1.1310(d), FCC OET Bulletin 65 – Non-portable device

NOTE 1): According to FCC Part §1.1310(d)(2), At operating frequencies less than or equal to 6 GHz, the limits for MPE, derived from whole-body SAR limits, may be used instead of whole-body SAR limits to evaluate the environmental impact of human exposure to RF radiation.

NOTE 2): According to FCC Part §1.1310(d)(3), At operating frequencies above 6 GHz, the MPE limits shall be used in all cases to evaluate the environmental impact of human exposure to RF radiation.

NOTE 3): According to FCC Part §1.1310(d)(4), Detailed information on our policies regarding procedures for evaluating compliance with all of these exposure limits can be found in the FCC's OET Bulletin 65.

The compliance is demonstrated based on the following calculation model assessment:

1. The power density according to far-field model is:

$$S = \frac{P \times G_{(\theta,\phi)}}{4 \times \pi \times R^2}$$

Where:

P = input power of the antenna.

G = antenna gain relative to an isotropic antenna.

θ, ϕ = elevation and azimuth angles.

R = distance from the antenna to the point of investigation.

2. For single or multiple RF sources, the calculated power density should comply with following:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

Where:

S_i = the power density when the f is i.

$S_{Limit,i}$ = the reference level requirement for power density when f is i.

f = operating frequency.

3. The calculation of the power density or safe distance is:

Note 1: The RF exposure evaluation is base on the far-field and the radiation exposure is over-estimated.

Note 2: The maximum output power level is taken into account as a worst case for the purpose of the calculation of power density or safe distance.

Note 3: The minimum antenna feed cable loss (assumed no cable loss) is taken into account as a worst case for the purpose of the calculation of power density or safe distance.

Note 4: The maximum antenna radiation exposure orientation and maximum antenna gain is taken into account as a worst case for the purpose of the calculation of power density or safe distance.

WIFI 2.4G:

RF Source	Calculation for Individual Source		
RF Source #1	f	=	2400 to 2483.5 MHz
	$S_{Limit,i}$	=	10 W/m^2
	P , $G_{(\theta,\phi)}$	=	☐ $EIRP(=P\times G_{(\theta,\phi)})$: $EIRP^{(*)}$ = _____ W (=_____ dBm, all ports) ☒ $P\times G_{(\theta,\phi)}$: $P^{(*)}$= 0.141 W (=21.5 dBm) (two ports, total rated power: 19dBm, tolerance: +/-2.5dB) _____ W (calculated) $G_{(\theta,\phi)}$ = 3.16 (=5 dBi) (*): The value is from: ☐ measured max (See relevant RF report), ☒ rated + declared tolerance, ☐ max allowed by RF standard. And, the transmission duty cycle is: ☐ ignored, ☒ used, that is: 100 %.
	θ,ϕ	=	The worst condition is considered, i.e. the max G is used.
	S_i	=	$\frac{P\times G_{(\theta,\phi)}}{4\times\pi}/R^2$ = 0.03546 $/R^2$ W/m^2
	$\frac{S_i}{S_{Limit,i}}$	=	0.003546 / R^2

WIFI 5G:

RF Source	Calculation for Individual Source		
RF Source #1	f	=	5150 to 5850 MHz
	$S_{Limit,i}$	=	10 W/m^2
	P , $G_{(\theta,\phi)}$	=	☐ $EIRP(=P\times G_{(\theta,\phi)})$: $EIRP^{(*)}$ = _____ W (=_____ dBm, all ports) ☒ $P\times G_{(\theta,\phi)}$: $P^{(*)}$= 0.251 W (=24 dBm) (three ports, total rated power: 21dBm, tolerance: +/-3dB) _____ W (calculated) $G_{(\theta,\phi)}$ = 7.94 (=9 dBi)

			(*): The value is from: ☐ measured max (See relevant RF report), ☒ rated + declared tolerance, ☐ max allowed by RF standard. And, the transmission duty cycle is: ☐ ignored, ☒ used, that is: 100 %.
	θ, ϕ	=	The worst condition is considered, i.e. the max G is used.
	S_i	=	$\frac{P \times G_{(\theta,\phi)}}{4 \times \pi} / R^2$ = 0.1586 $/ R^2$ W/m^2
	$\frac{S_i}{S_{Limit,i}}$	=	0.01586 / R^2

Cellular Band:

RF Source	Calculation for Individual Source		
RF Source #1	f	=	869 to 894 MHz
	$S_{Limit,i}$	=	5.79 W/m^2
	P , $G_{(\theta,\phi)}$	=	☐ $EIRP (= P \times G_{(\theta,\phi)})$: $EIRP^{(*)}$ = _____ W (=_____ dBm, all ports) ☒ $P \times G_{(\theta,\phi)}$: $P^{(*)}$= 0.355 W (=25.5 dBm) (two ports, total rated power: 23dBm, tolerance: +/-2.5dB) _____ W (calculated) $G_{(\theta,\phi)}$ = 2.24 (=3.5 dBi) (*): The value is from: ☐ measured max (See relevant RF report), ☒ rated + declared tolerance, ☐ max allowed by RF standard. And, the transmission duty cycle is: ☐ ignored, ☒ used, that is: 100 %.
	θ, ϕ	=	The worst condition is considered, i.e. the max G is used.
	S_i	=	$\frac{P \times G_{(\theta,\phi)}}{4 \times \pi} / R^2$ = 0.0633 $/ R^2$ W/m^2
	$\frac{S_i}{S_{Limit,i}}$	=	0.0109 / R^2

PCS Band:

RF Source	Calculation for Individual Source		
RF Source #1	f	=	1930 to 1990 MHz
	$S_{Limit,i}$	=	10 W/m^2

	P , $G_{(\theta,\phi)}$	=	☐ $EIRP(=P\times G_{(\theta,\phi)})$: $EIRP^{(*)}$ = _____ W (=_____ dBm, all ports) ☒ $P\times G_{(\theta,\phi)}$: $P^{(*)}$= 0.355 W (=25.5 dBm) (two ports, total rated power: 23dBm, tolerance: +/-2.5dB) _____ W (calculated) $G_{(\theta,\phi)}$ = 2.51 (=4 dBi) (*): The value is from: ☐ measured max (See relevant RF report), ☒ rated + declared tolerance, ☐ max allowed by RF standard. And, the transmission duty cycle is: ☐ ignored, ☒ used, that is: 100 %.
	θ,ϕ	=	The worst condition is considered, i.e. the max G is used.
	S_i	=	$\frac{P\times G_{(\theta,\phi)}}{4\times\pi}/R^2$ = 0.0709 $/R^2$ $\mathrm{W/m^2}$
	$\frac{S_i}{S_{Limit,i}}$	=	0.00709 / R^2

AWS Band:

RF Source	Calculation for Individual Source		
RF Source #1	f	=	2110 to 2155 MHz
	$S_{Limit,i}$	=	10 $\mathrm{W/m^2}$
	P , $G_{(\theta,\phi)}$	=	☐ $EIRP(=P\times G_{(\theta,\phi)})$: $EIRP^{(*)}$ = _____ W (=_____ dBm, all ports) ☒ $P\times G_{(\theta,\phi)}$: $P^{(*)}$= 0.355 W (=25.5 dBm) (two ports, total rated power: 23dBm, tolerance: +/-2.5dB) _____ W (calculated) $G_{(\theta,\phi)}$ = 2.51 (=4 dBi) (*): The value is from: ☐ measured max (See relevant RF report), ☒ rated + declared tolerance, ☐ max allowed by RF standard. And, the transmission duty cycle is: ☐ ignored,

			☒ used, that is: 100 %.
	θ,ϕ	=	The worst condition is considered, i.e. the max G is used.
	S_i	=	$\frac{P\times G_{(\theta,\phi)}}{4\times\pi}/R^2$ = 0.0709 $/R^2$ $\mathrm{W/m^2}$
	$\frac{S_i}{S_{Limit,i}}$	=	0.00709 / R^2

BRS&EBS Band:

RF Source	Calculation for Individual Source		
RF Source #1	f	=	2620 to 2690 MHz
	$S_{Limit,i}$	=	10 $\mathrm{W/m^2}$
	P , $G_{(\theta,\phi)}$	=	☐ $EIRP(=P\times G_{(\theta,\phi)})$: $EIRP^{(*)}$ = _____ W (=_____ dBm, all ports) ☒ $P\times G_{(\theta,\phi)}$: $P^{(*)}$= 0.355 W (=25.5 dBm) (two ports, total rated power: 23dBm, tolerance: +/-2.5dB) _____ W (calculated) $G_{(\theta,\phi)}$ = 2.82 (=4.5 dBi) (*): The value is from: ☐ measured max (See relevant RF report), ☒ rated + declared tolerance, ☐ max allowed by RF standard. And, the transmission duty cycle is: ☐ ignored, ☒ used, that is: 100 %.
	θ,ϕ	=	The worst condition is considered, i.e. the max G is used.
	S_i	=	$\frac{P\times G_{(\theta,\phi)}}{4\times\pi}/R^2$ = 0.0797 $/R^2$ $\mathrm{W/m^2}$
	$\frac{S_i}{S_{Limit,i}}$	=	0.00797 / R^2

Whole Product	Calculation for Whole Product		
Whole Product	$\sum_i \frac{S_i}{S_{Limit,i}}$	=	0.052456 / $R^2 \le 1$
	R	≥	0.229 m (the minimum Safe Distance)
	NOTE: The result is the worst case of each individual source and simultaneous transmission sources (if applicable).		

3.2 RSS-102 – RF exposure evaluation

NOTE 1): According to §2.5.2 of RSS-102, RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm.

NOTE 2): According to §3.2 of RSS-102, a device requiring an RF exposure evaluation shall be made in accordance with the latest version of IEEE C95.3.

The compliance is demonstrated based on the following calculation model assessment:

1. The power density according to far-field model is:

$$S = \frac{P \times G_{(\theta,\phi)}}{4 \times \pi \times R^2}$$

Where:

P = input power of the antenna.

G = antenna gain relative to an isotropic antenna.

θ, ϕ = elevation and azimuth angles.

R = distance from the antenna to the point of investigation.

2. For single or multiple RF sources, the calculated power density should comply with following:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

Where:

S_i = the power density when the f is i.

$S_{Limit,i}$ = the reference level requirement for power density when f is i.

f = operating frequency.

3. The calculation of the power density or safe distance is:

Note 1: The RF exposure evaluation is base on the far-field and the radiation exposure is over-estimated.

Note 2: The maximum output power level is taken into account as a worst case for the purpose of the calculation of power density or safe distance.

Note 3: The minimum antenna feed cable loss (assumed no cable loss) is taken into account as a worst case for the purpose of the calculation of power density or safe distance.

Note 4: The maximum antenna radiation exposure orientation and maximum antenna gain is taken into account as a worst case for the purpose of the calculation of power density or safe distance.

WIFI 2.4G:

RF Source	Calculation for Individual Source		
RF Source #1	f	=	2400 to 2483.5 MHz

	$S_{Limit,i}$	=	0.02619*f$^{0.6834}$ = 5.35 W/m^2
	P , $G_{(\theta,\phi)}$	=	☐ $EIRP(=P\times G_{(\theta,\phi)})$: $EIRP^{(*)}$ = _____ W (=_____ dBm, all ports) ☒ $P\times G_{(\theta,\phi)}$: $P^{(*)}$= 0.141 W (=21.5 dBm) (two ports, total rated power: 19dBm, tolerance: +/-2.5dB) _____ W (calculated) $G_{(\theta,\phi)}$ = 3.16 (=5 dBi) (*): The value is from: ☐ measured max (See relevant RF report), ☒ rated + declared tolerance, ☐ max allowed by RF standard. And, the transmission duty cycle is: ☐ ignored, ☒ used, that is: 100 %.
	θ,ϕ	=	The worst condition is considered, i.e. the max G is used.
	S_i	=	$\frac{P\times G_{(\theta,\phi)}}{4\times\pi}/R^2$ = 0.03546 $/R^2$ W/m^2
	$\frac{S_i}{S_{Limit,i}}$	=	0.0066 / R^2

WIFI 5G:

RF Source	Calculation for Individual Source		
RF Source #1	f	=	5150 to 5850 MHz
	$S_{Limit,i}$	=	0.02619*f$^{0.6834}$ = 9.01 W/m^2
	P , $G_{(\theta,\phi)}$	=	☐ $EIRP(=P\times G_{(\theta,\phi)})$: $EIRP^{(*)}$ = _____ W (=_____ dBm, all ports) ☒ $P\times G_{(\theta,\phi)}$: $P^{(*)}$= 0.251 W (=24 dBm) (three ports, total rated power: 21dBm, tolerance: +/-3dB) _____ W (calculated) $G_{(\theta,\phi)}$ = 7.94 (=9 dBi) (*): The value is from: ☐ measured max (See relevant RF report), ☒ rated + declared tolerance,

			☐ max allowed by RF standard. And, the transmission duty cycle is: ☐ ignored, ☒ used, that is: 100 %.
	θ,ϕ	=	The worst condition is considered, i.e. the max G is used.
	S_i	=	$\frac{P\times G_{(\theta,\phi)}}{4\times\pi}/R^2$ = 0.1586 $/R^2$ W/m^2
	$\frac{S_i}{S_{Limit,i}}$	=	0.0176 / R^2

Cellular Band:

RF Source	Calculation for Individual Source		
RF Source #1	f	=	869 to 894 MHz
	$S_{Limit,i}$	=	0.02619*f$^{0.6834}$ = 2.67 W/m^2
	P , $G_{(\theta,\phi)}$	=	☐ $EIRP(=P\times G_{(\theta,\phi)})$: $EIRP^{(*)}$ = _____ W (=_____ dBm, all ports) ☒ $P\times G_{(\theta,\phi)}$: $P^{(*)}$= 0.355 W (=25.5 dBm) (two ports, total rated power: 23dBm, tolerance: +/-2.5dB) _____ W (calculated) $G_{(\theta,\phi)}$ = 2.24 (=3.5 dBi) (*): The value is from: ☐ measured max (See relevant RF report), ☒ rated + declared tolerance, ☐ max allowed by RF standard. And, the transmission duty cycle is: ☐ ignored, ☒ used, that is: 100 %.
	θ,ϕ	=	The worst condition is considered, i.e. the max G is used.
	S_i	=	$\frac{P\times G_{(\theta,\phi)}}{4\times\pi}/R^2$ = 0.0633 $/R^2$ W/m^2
	$\frac{S_i}{S_{Limit,i}}$	=	0.0237 / R^2

PCS Band:

RF Source	Calculation for Individual Source		
RF Source #1	f	=	1930 to 1990 MHz
	$S_{Limit,i}$	=	0.02619*f$^{0.6834}$ = 4.61 W/m^2
	P , $G_{(\theta,\phi)}$	=	☐ $EIRP(=P\times G_{(\theta,\phi)})$:

			$EIRP^{(*)}$ = _____ W (=_____ dBm, all ports) ☒ $P \times G_{(\theta,\phi)}$: $P^{(*)}$= 0.355 W (=25.5 dBm) (two ports, total rated power: 23dBm, tolerance: +/-2.5dB) _____ W (calculated) $G_{(\theta,\phi)}$ = 2.51 (=4 dBi) (*): The value is from: ☐ measured max (See relevant RF report), ☒ rated + declared tolerance, ☐ max allowed by RF standard. And, the transmission duty cycle is: ☐ ignored, ☒ used, that is: 100 %.
	θ, ϕ	=	The worst condition is considered, i.e. the max G is used.
	S_i	=	$\frac{P \times G_{(\theta,\phi)}}{4 \times \pi} / R^2$ = 0.0709 $/ R^2$ W/m^2
	$\frac{S_i}{S_{Limit,i}}$	=	0.0154 / R^2

AWS Band:

RF Source	Calculation for Individual Source		
RF Source #1	f	=	2110 to 2155 MHz
	$S_{Limit,i}$	=	0.02619*f$^{0.6834}$ = 4.90 W/m^2
	P , $G_{(\theta,\phi)}$	=	☐ $EIRP$(= $P \times G_{(\theta,\phi)}$): $EIRP^{(*)}$ = _____ W (=_____ dBm, all ports) ☒ $P \times G_{(\theta,\phi)}$: $P^{(*)}$= 0.355 W (=25.5 dBm) (two ports, total rated power: 23dBm, tolerance: +/-2.5dB) _____ W (calculated) $G_{(\theta,\phi)}$ = 2.51 (=4 dBi) (*): The value is from: ☐ measured max (See relevant RF report), ☒ rated + declared tolerance, ☐ max allowed by RF standard. And, the transmission duty cycle is: ☐ ignored, ☒ used, that is: 100 %.
	θ, ϕ	=	The worst condition is considered, i.e. the max G is used.

	S_i	=	$\frac{P \times G_{(\theta,\phi)}}{4 \times \pi} / R^2$ = 0.0709 / R^2 W/m^2
	$\frac{S_i}{S_{Limit,i}}$	=	0.0145 / R^2

BRS&EBS Band:

RF Source	Calculation for Individual Source		
RF Source #1	f	=	2620 to 2690 MHz
	$S_{Limit,i}$	=	0.02619*f$^{0.6834}$ = 5.68 W/m^2
	P , $G_{(\theta,\phi)}$	=	☐ $EIRP$(= $P \times G_{(\theta,\phi)}$): $EIRP^{(*)}$ = _____ W (=_____ dBm, all ports) ☒ $P \times G_{(\theta,\phi)}$: $P^{(*)}$= 0.355 W (=25.5 dBm) (two ports, total rated power: 23dBm, tolerance: +/-2.5dB) _____ W (calculated) $G_{(\theta,\phi)}$ = 2.82 (=4.5 dBi) (*): The value is from: ☐ measured max (See relevant RF report), ☒ rated + declared tolerance, ☐ max allowed by RF standard. And, the transmission duty cycle is: ☐ ignored, ☒ used, that is: 100 %.
	θ, ϕ	=	The worst condition is considered, i.e. the max G is used.
	S_i	=	$\frac{P \times G_{(\theta,\phi)}}{4 \times \pi} / R^2$ = 0.0797 / R^2 W/m^2
	$\frac{S_i}{S_{Limit,i}}$	=	0.0140 / R^2

Whole Product	Calculation for Whole Product		
Whole Product	$\sum_i \frac{S_i}{S_{Limit,i}}$	=	0.0918 / $R^2 \leq 1$
	R	≥	0.303 m (the minimum Safe Distance)
	NOTE: The result is the worst case of each individual source and simultaneous transmission sources (if applicable).		

4 Conclusion

Based on the specified distance or calculated safe distance, or exempted RF exposure evaluation, as showed above, considering the lower RF field exposure levels and relevant research results collected to date by international organizations, there is no convincing scientific evidence that the RF signals from this product cause adverse effects on human health.

END