Environmental evaluation and exposure limit according to FCC CFR 47part 1, §1.1307, §1.1310

The NEXUS control unit contains

1) single modular Wi-Fi module FCC ID: Z9W-HAB of 8Devices manufacturer certified and uses as Multiply Input Multiply Output device. Evaluated for 2 transmitted signals.
2) single modular approved transmitter FCC ID: N7NEM75T. Evaluated for 1 transmitted and 1 receiver signals.
3) single modular approved transmitter FCC ID: N7NWP76B. Evaluated for 1 transmitted and 1 receiver signals.
4) single modular approved transmitter FCC ID: 2AC7Z-ESP32WROOM32U used for receive mode only. Evaluated for 1 receiver signal. Does not operate concurrently with 3 other modules.
5) single modular approved transmitter FCC ID: 2AC7Z-ESP32WROOM32U used for receive mode only. Evaluated for 2 transmitted signals. Does not operate concurrently with 3 other modules.

The NEXUS control unit is classified as fixed device. The simultaneous transmission of 3 first above mentioned modules is evaluated.

Limit for power density for general population/uncontrolled exposure is 1 mW/cm^2 for 1500 - 100000 MHz frequency range:

The power density is $\mathbf{P\ (mW/cm^2) = P_T / 4\pi r^2}$

1) Wi-Fi module (2.4 GHz) –reference to MPE information from FCC database, FCC ID: Z9W-HAB
   P_T is the transmitted total power, which is equal to the peak transmitter output power 221.31 mW that is equivalent to 23.45 dBm with taken in to account that device transmit 2 correlated signals so maximum total conducted power across all elements will be the conducted power at individual connector plus 10*log (# of elements).

   Maximum antenna gain 4.3 dBi, the maximum equivalent isotopically radiated power EIRP is
   P_T = 23.45 dBm + 2.8 dBi = 26.25 dBm = 421.69 mW.
   The power density at 20 cm (minimum safe distance, required for mobile devices), calculated as follows:
   421.69 mW / 4π (20 cm) ^{2} = 0.083 mW/cm^2 << 1 mW/cm^2

2) Wi-Fi module (5 GHz) –reference to MPE information from FCC database, FCC ID: Z9W-HAB
   P_T is the transmitted total power, which is equal to the peak transmitter output power 167.5 mW that is equivalent to 22.24 dBm with taken in to account that device transmit 2 correlated signals so maximum total conducted power across all elements will be the conducted power at individual connector plus 10*log (# of elements).

   Maximum antenna gain 6.8 dBi, the maximum equivalent isotopically radiated power EIRP is
   P_T = 22.24 dBm + 4.1 dBi = 26.34 dBm = 430.52 mW.
   The power density at 20 cm (minimum safe distance, required for mobile devices), calculated as follows:
   430.52 mW / 4π (20 cm) ^{2} = 0.086 mW/cm^2 << 1 mW/cm^2

The WiFi 2.4 GHz and WiFi 5 GHz can't work simultaneously

3) Limit for power density for general population/uncontrolled exposure is f/1500 mW/cm2 for 300 – 1500 MHz frequency range.

The power density is $\mathbf{P\ (mW/cm^2) = P_T / 4\pi r^2}$

The worst-case limit is 0.442mW/cm^2 for lowest band 71 (663-698 MHz).

Maximum conducted power given in FCC ID: N7NEM75T module grant for band 71 is 221.3 mW (23.45dBm).

The gain of antenna used with the module is -0.5dBi.

The maximum equivalent isotropic radiated power EIRP is for band 71:

PT = 23.45dBm + -0.5dBi = 22.95 dBm = 197.24 mW

The power density at 20 cm (minimum safe distance, required for mobile devices), calculated as follows:

197.24 mW / 4π (20 cm) ^{2} = 0.039 mW/cm^2 << 0.442 mW/cm^2

4) Limit for power density for general population/uncontrolled exposure is f/1500 mW/cm2 for 300 – 1500 MHz frequency range.

The power density is $\mathbf{P\ (mW/cm^2) = P_T / 4\pi r^2}$

The worst-case limit is 0.442mW/cm^2 for lowest band 71 (663-698 MHz).

Maximum conducted power given in FCC ID: N7NWP76B module grant for band 71 is 236.6 mW (23.74dBm).

The gain of antenna used with the module is -0.5dBi.

The maximum equivalent isotropic radiated power EIRP is for band 71:

PT = 23.74dBm + -0.5dBi = 23.24 dBm = 210.86 mW

The power density at 20 cm (minimum safe distance, required for mobile devices), calculated as follows:

210.86 mW / 4π (20 cm) ^{2} = 0.042 mW/cm^2 << 0.442 mW/cm^2

Summation

When all the antennas are at least 20 cm away from the user but individual antennas cannot be separated by 20 cm from each other, the following equation shall be fulfilled

S1/Limit + S2/Limit < 1, i.e.
0.086 mW/cm^2 /1 mW/cm^2 + 0.039 mW/cm^2 /0.442 mW/cm^2 + 0.042 mW/cm^2 /0.442 mW/cm^2 = 0.086 + 0.088 + 0.095 = 0.269 < 1

Therefore, the NEXUS control unit including 5 approved modules complies with FCC RF exposure limit for general population.