Are the candcnc.com 620 in-oz motors large enough to drive a 150lb PPLLC HDD Gantry?

In order to determine the force required, you need to know the weight of the gantry and the acceleration rate required for good plasma cutting.

The weight of a 6' gantry with motors and torch can be as high as 150 lbs.
The acceleration rate required for good plasma cutting is 35 in/sec/sec

Force = mass x acceleration

When using English units, force has the units of pound force and mass has the units of pound mass.

Looking at the right hand side of the equation,
150 lbm x 35 in/sec/sec = 5250 lbm x in/sec/sec
Since there is 12 inches per foot, we need to divide by 12
5250 / 12 = 437.5 lbm x ft/sec/sec

The relationship between pound force and pound mass is:
1 lbf = 1 lbm X gravity
Gravity is 32.174049 ft/sec/sec
Lbf = 437.5 lbm ft/sec/sec / 32.174049 ft/sec/sec
Force required (lbf) = **13.5979 lbf**

This is assuming that the linear bearings are frictionless, which they are not.

Next, we need to know the force generated by the motors driving the gears on the gear rack.

Information needed:
Stepper motor torque 620 in-oz
Gear pitch diameter .65" PD
Gear rack pressure angle 20 degree

Since there are 16 ozf per lbf 620 / 16 = 38.75 in-lb torque motor
Since the Gear has a .65" PD, the line of force is .65/2" = .325" from the center of the shaft to the gear rack. 38.75 in-lb / .325 in = 119.23 lbf

The pressure angle between the gear and rack now needs to be factored in. Since the pressure angle is 20 degrees, the linear force is 119.23 x cosine 20 = 119.23 x .93969 = **112.04 lbf**. If you wanted to know the force pushing the gear away from the rack, it would be 119.23 x sine 20 = 119.25 x .342 = 40.78 lbs. This is why a pivoting bracket and spring is not used on our gantry kits. A spring pressure of 41 lbs would be required at all times to handle the force of accelerating the gantry if 100% of the motor torque was used.

Since the gantry has 2 motors driving the 150lb gantry, the maximum force of the motor direct drive is 112.04 lbf x 2 = **224.08 lbf**. Since the required torque is **13.5979 lbf**, that leaves us with a safety factor of 224.08 / 13.5979 = **16.48 x what is required.**

Even when factoring in bearing resistance and gearing efficiency, the motors are many times more powerful than required. That is why the stepper motors work very well in the application and do not lose steps.