2A. Addendum to NEPS Blog # 2 (14 July 2020):

Blog 2 indicated, under one of the tables, that heat could be produced by absorption of energies from helium-3 and neutrons (He-3 and n), from tritium and protons (T-3 and p), from helium-4 and neutrons (He-4 and n), and by gamma radiation from excited He-3 and He-4. It should be noted that gamma radiation can be expected from excited He-3; but, this is not the case for excited He-4.

Radiation from He-3 was discussed by D.H. Wilkinson of the Cavendish Laboratory in "A Source of Plane-polarized Gamma-rays of Variable Energy above 5.5 MeV," Philosophical Magazine, vol. 43, page 659, June 1952. The paper indicated that a (p,d) interaction, rather than forming a compound nucleus, involves a direct radiative transition where the gammas are emitted perpendicular to the path between the proton and deuteron. The paper also indicated that gamma ray energy can be increased from 5.5 MeV by increasing energy of the bombarding protons; and, that the gammas produced can cause other deuterons to disintegrate, with the resulting protons emitted along the electric vector. The effect of gamma rays on deuterium is also discussed in "Polarization of Bremsstrahlung," by E.G. Muirhead and K.B. Mather, Australian Journal of Physics, 7, pp. 527-529, 1954.

By comparison, past studies have shown that there is little-to-no possibility for gamma radiation to be produced by excited He-4 where the spin and angular momentum are the same as the spin of He-4 in the ground state with zero angular momentum (e.g., reference "Energy Levels of Light Nuclei. IV," by F. Ajzenberg and T. Lauritsen, Reviews of Modern Physics, vol. 24, page 321, October 1952; and, "Charge Independence of Nuclear Forces on Electromagnetic Transitions," by L.A. Radicati, Physical Review, vol. 87 pages 521-521, 1952). For further discussion, please reference pages 122-135 in "Elements of Nuclear Physics," by Walter E. Meyerhof, McGraw-Hill, 1967.

Another important (and independent) way for a nucleus to lose energy, however, and transition from the excited to the ground state, is by internal conversion. Energy in the nucleus is imparted to the atom's own atomic electrons. Additionally, electron-positron pairs can be created if the transition energy is high enough (ref. "Internal Pair Production,", by M.E. Rose, Physical Review, vol. 76, page 678, 1949). Internal pair creation is important for high transition energy and low-Z elements, and is particularly important for even-even elements such as helium-4 and oxygen-16 (ref. "Life-time for Pair Emission by Spherical Excited State of the O16 Nucleus," by S. Devons, H.G. Hereward and G.R. Lindsey, Nature, vol. 164, page 586, 1949); and, "Electron Pair Creation by a Spherically

Symmetrical Field," by S. Devon and G.R. Lindsey, Nature, vol. 164, pages 539-540, 1949).

In (d,d) fusion, although excited He-4 is produced, there would be little-to-no possibility for gamma radiation to be emitted from the excited He-4. Instead, the energy could be released by internal conversion electrons and pair production electrons. Energy from these electrons may be absorbed by cathodes in cold fusion experiments.

The statement in Blog #2 would, therefore, be more accurate if it said: "heat could be produced by absorption of energies from helium-3 and neutrons (He-3 and n), from tritium and protons (T-3 and p), from helium-4 and neutrons (He-4 and n), by gamma radiation from excited He-3 and internal conversion and pair production electrons from excited He-4".