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Article

Exploring the Possibility of Running an Electric Locomotive with Cold Nuclear Fusion by Considering Iron-56 or Magnesium-24 as Nuclear Fuels

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Abstract: In our recently published papers, we have proposed a clear-cut mechanism for understanding and implementing cold nuclear fusion technology pertaining to fusion of hydrogen with medium and heavy metals. In this contribution, we are making an attempt to understand the possibility of running a locomotive with cold nuclear fusion technology. We are confident to say that Iron-56 and Magnesium-24 can be considered as cold nuclear fuels operating at a temperature range of 500 to 1500 °C. In this context, we would like to stress the point that, cold nuclear fusion can be considered as the next stage of metallic hydrides and cold fusion of hydrogen can be understood as a phenomenon of weak interaction fusing neutron to the nucleus of the base atom and fusing electron to the electronic orbits of the base atom. With reference to the maximum binding energy per nucleon, liberated safe and controllable thermal energy can be estimated with a simple relation of the form, [8.8–(BE2–BE1)] MeV, where BE1 and BE2 are the nuclear binding energies of initial and final atomic nuclides. It is the order of (1 to 3) MeV per atom against 200 MeV pertaining to the dangerous and unsafe nuclear fission of one Uranium atom. As the whole world is having a huge scarcity of electric power and severe environmental pollution issues, our proposal can be given a chance. It needs funding for conducting long run experiments and pilot projects.

Keywords: Cold Nuclear Fusion; Iron-56; Magnesium-24; 5000 kW Electric Locomotive

1. Introduction

Nowadays, the whole world is running behind electric power coming from green energy technology in view of pollution issues, scarcity of fossil fuels and ease in control and handling of electric power. In this context, majority of scientists are seriously working on various green energy sources like hydroelectric power, hydrogen engines including fuel cells, wind power, sea tidal power and solar power. All these power sources are having their own advantages and disadvantages. Hot nuclear fusion technology operating at a temperature of one million °C seems to be the most advanced green energy technology and at present it is in its construction phase [1]. It needs a very critical follow up for its possible implementation in 2030. It may also be noted that, day-by-day, its construction cost is increasing beyond expectation. One very new and emerging green energy source is Cold Nuclear Fusion (CNF) or

Low Energy Nuclear Reaction (LENR) operating at a temperature of 1000 to 3000 deg. C [2]. Based on the liberation of energy, this new energy source can be called as, Cold Nuclear Low Energy Reactions (CNLER). It is in its budding stage and world famous organizations like NASA are seriously working on developing technological models like CNF/LENR [3]. Based on CNLER, we have developed a mechanism for preparing elements like Gold from Tungsten [4]. In our recently published paper [5], we have developed a simple and workable mechanism for understanding and implementing CNLER with Iron-56 as a possible nuclear fuel. Second possible cold nuclear fuel seems to be Magnesium-24. Considering one gram of Iron-56 or Magnesium-24, there is a scope for producing One Giga Watt of electric power with 50% efficiency. In this paper, we make an attempt to understand and develop a theoretical frame work for running a 5000 KW locomotive with CNLER technology. We wish to call such a locomotive as Cold Nuclear Locomotive (CNL).

2. General Mechanism of 'Cold Nuclear Low Energy Reactions' (CNLER)

For understanding the mechanism of CNLER, we propose our views in the following way [5]. It needs a review and refinement. At 1000 to 2000 deg. C, one hydrogen atom combines with one heavy atomic nuclide (HAN). Fusion of hydrogen atom can be considered as a case of a fusion of one neutron with one heavy atomic nuclide.

During CNLER, neutron gives a minimum 8.8 MeV to HAN. The maximum energy that can be given by any neutron depends on its kinetic energy. By absorbing neutron, HAN becomes its next stage isotope. HAN can be called as base isotope, and its next isotope can be called as NIHAN. During the absorption of one neutron having a rest energy of 939.5654 MeV, 8.8 MeV is distributed among all the nucleons of HAN in two modes.

First mode can be seen as an increase in internal kinetic energy of nucleons of HAN. The second mode can be seen as liberation of thermal energy = 8.8 MeV – Difference in isotopic binding energy of NIHAN and HAN. Increased kinetic energy of neutron helps in increasing possibility of isotopic transformation of HAN and increased liberation of thermal energy. Keeping on absorbing neutrons, HAN becomes NIHAN_1, NIHAN_2 and ....NIHAN_X. Due to the increasing heaviness, NIHAN_X transforms to its next stage periodic element via isobar formation.

3. Possible Occurrence and Present Status of 'CNLER'

Important points to be noted are as follows:

(1) To understand the potential benefits of cold nuclear interactions, one can go through the lectures given by Prof. David Nagel (https://www.youtube.com/watch?v=qO7abL7RyUE&t=216s).

(2) Considering the interaction of deuterium with molybdenum and palladium wires, in an experimental approach, one can find the increasing concentrations of Helium 3 and 4 along with increasing temperatures [6].

(3) In a technical paper published in 'Physical review C', recently, Ramkumar et al. clearly showed the possibility of occurrence of cold nuclear interactions via weak interactions [7].

(4) Considering nanotechnology, a recent technical paper published by Nurlan Bakranov et al. in 'Frontiers in Materials' explores the possibility of occurrence of cold nuclear interactions with improved nano techniques and nanomaterials that help in enhancing the absorbing capacity of hydrogen [8].

(5) To have a possible occurrence of cold nuclear fusion, it seems important to overcome the coulombic repulsions at low temperatures. In this context, compared to currently believed nuclear Semi empirical mass formulae (SEMF), considering our proposed Strong and Electroweak Mass Formula (SEWMF), one can understand the insignificant role of coulombic repulsions in nuclear binding energy scheme [9]. See the following section.

(6) In our opinion, the occurrence of CNLER is possible because of the mutual attractive nature of heavy atomic nuclide and neutron under strong nuclear attractive forces and weak interactions.

(7) Compared to hot nuclear fusion, in CNLER, nuclear density is of the order of 10^{22} nucleons per cubic centimeter and is far better than the density obtained by hot fusion. It is always a worrying issue to maintain one million deg. K round the day and round the year.

(8) CNLER is a low energy nuclear reaction compared to nuclear fission and hot nuclear fusion. Thermal energy

liberated in CNLER is of the order of 1 MeV whereas energy liberated in nuclear fission and hot fusion is around 200 MeV and 15 MeV respectively.

(9) Melting point of Magnesium is 650 deg C and the melting point of Iron is 1538 deg C. Either by considering super fine powders or semi liquid forms of Iron and Magnesium, it seems possible to absorb one hydrogen atom under suitable pressure and temperature.

(10) Following the concept of CNLER, we have tried to develop theoretical concepts for preparing costly elements like Gold, converting high level nuclear radioactive waste and preparing medical isotopes [10].

(11) NASA team is seriously working on Lattice Confinement Technique associated with Erbium atoms turning into Thulium atoms at ambient temperatures [3,11].

(12) Russian scientists experimentally confirmed the energy emission mechanism proposed by Andrea Rossi's Energy Catalyzer (E-Cat) [12,13].

(13) All collaborative long run experiments conducted by Japanese scientists pertaining to CNF experiments associated with specially prepared palladium-nickel-zirconium and copper-nickel-zirconium verified the continuous generation of excess heat [14,15]. It has been confirmed that, total amounts of energies released per atom were larger per atom by a factor of two to several hundreds.

(14) United States and European countries are planning to run most advanced CNLER experiments with million-dollar funding.

4. Strong and Electroweak Mass Formula (SEWMF) and the Coulombic Contribution (CC)

Our proposed Strong and Electroweak Mass Formula (SEWMF) for estimating nuclear binding energy is very simple and very easy to understand [9]. We are working in all possible ways to improve the accuracy. With a marginal error, starting form Z = 3 to 118 and N ≥ Z,

$$BE \cong \left\{A - [1 + 0.0008(Z^2 + A^2)] - A^{1/3} - \frac{(A_s - A)^2}{A_s}\right\} 10.1\text{MeV} \quad (1)$$

where A = Mass number, Z = Proton number

$A_s \cong 2Z + 0.001605(2Z)^2 \cong 2Z + 0.0064Z^2$ ≅Estimate mass number close to stable mass number and 0.0008 is a number equal to half of the electroweak coefficient, 0.001605 [9].

For further information on this formula, readers are encouraged to refer our recently published paper [9] and references therein. The electroweak coefficient 0.001605 is defined as the ratio of geometric mean mass of pions to the geometric mean mass of weak bosons. Here we would like to emphasize the point that, based on the proton number, contribution of coulombic repulsion can be understood with the ratio,

$$\text{Coulombic contribution}, CC \cong \frac{0.0008Z^2}{A} \quad (2)$$

Based on the above formula, it can be shown that, for Nickel and Palladium, Coulombic energy shares are around 1.03% and 1.07% of their volume energies respectively. See **Table 1** for the estimated nuclear binding energy and coulombic contribution close to the stable mass numbers of Z = 6 to 118. In **Table 1**,

Column 1 represents the Proton number.

Column 2 represents the Nucleon number.

Column 3 represents the Neutron number.

Column 4 represents the estimated mass number close to the stable mass number of Z.

Column 5 represents the excess neutron number.

Column 6 represents the proposed electroweak term or number of free nucleons, A_free.

Column 7 represents the proposed Coulombic contribution percentage.

Column 8 represents the estimated binding energy (EBE).

Column 9 represents the reference binding energy (RBE) [16].

Column 10 represents the % of difference of binding energy.

Table 1. Estimated Binding Energy and Coulombic Contribution% Near to Stable Mass Numbers: Relations (1) and (2).

Z	A	N	As	A-2Z	A_free	CC%	EBE (MeV)	RBE (MeV)	%Error in BE (MeV)
6	12	6	12	0	1.14	0.24	86.52	85.36	−1.36
7	15	8	15	1	1.22	0.26	114.28	109.43	−4.43
8	16	8	16	0	1.26	0.32	123.46	122.04	−1.17
9	19	10	19	1	1.35	0.34	151.28	147.28	−2.72
10	22	12	22	2	1.47	0.36	179.08	176.63	−1.39
11	23	12	23	1	1.52	0.42	188.22	185.06	−1.71
12	26	14	26	2	1.66	0.44	215.95	214.8	−0.54
13	27	14	27	1	1.72	0.5	225.04	222.61	−1.09
14	30	16	30	2	1.88	0.52	252.66	252.59	−0.03
15	31	16	31	1	1.95	0.58	261.69	259.82	−0.72
16	34	18	34	2	2.13	0.6	289.17	289.94	0.27
17	37	20	37	3	2.33	0.62	316.55	315.82	−0.23
18	38	20	38	2	2.41	0.68	325.46	326.81	0.41
19	41	22	41	3	2.63	0.7	352.67	352.9	0.06
20	44	24	44	4	2.87	0.73	379.77	382.08	0.61
21	45	24	45	3	2.97	0.78	388.55	389.4	0.22
22	48	26	48	4	3.23	0.81	415.47	418.6	0.75
23	49	26	49	3	3.34	0.86	424.17	425.32	0.27
24	52	28	52	4	3.62	0.89	450.9	454.5	0.79
25	55	30	55	5	3.92	0.91	477.5	479.99	0.52
26	56	30	56	4	4.05	0.97	486.06	489.79	0.76
27	59	32	59	5	4.37	0.99	512.46	515.32	0.55
28	62	34	62	6	4.7	1.01	538.73	543.63	0.9
29	63	34	63	5	4.85	1.07	547.15	550.01	0.52
30	66	36	66	6	5.2	1.09	573.21	578.25	0.87
31	69	38	69	7	5.58	1.11	599.14	603.11	0.66
32	72	40	72	8	5.97	1.14	624.92	630.65	0.91
33	73	40	73	7	6.13	1.19	633.13	637.06	0.62
34	76	42	76	8	6.55	1.22	658.71	664.51	0.87
35	79	44	79	9	6.97	1.24	684.14	688.75	0.67
36	80	44	80	8	7.16	1.3	692.2	697.71	0.79
37	83	46	83	9	7.61	1.32	717.42	721.9	0.62
38	86	48	86	10	8.07	1.34	742.49	748.63	0.82
39	89	50	89	11	8.55	1.37	767.41	772.29	0.63
40	90	50	90	10	8.76	1.42	775.26	781.01	0.74
41	93	52	93	11	9.26	1.45	799.97	804.59	0.57
42	96	54	96	12	9.78	1.47	824.54	830.66	0.74
43	99	56	99	13	10.32	1.49	848.94	853.75	0.56
44	100	56	100	12	10.55	1.55	856.58	862.18	0.65
45	103	58	103	13	11.11	1.57	880.77	885.19	0.5
46	106	60	106	14	11.68	1.6	904.82	910.61	0.64
47	109	62	109	15	12.27	1.62	928.71	933.17	0.48
48	112	64	112	16	12.88	1.65	952.44	958.12	0.59
49	113	64	113	15	13.14	1.7	959.8	963.71	0.41
50	116	66	116	16	13.76	1.72	983.32	988.53	0.53
51	119	68	119	17	14.41	1.75	1006.68	1010.56	0.38
52	122	70	122	18	15.07	1.77	1029.9	1034.93	0.49
53	125	72	125	19	15.75	1.8	1052.95	1056.56	0.34
54	128	74	128	20	16.44	1.82	1075.86	1080.51	0.43
55	129	74	129	19	16.73	1.88	1082.87	1085.95	0.28
56	132	76	132	20	17.45	1.9	1105.55	1109.75	0.38
57	135	78	135	21	18.18	1.93	1128.08	1130.9	0.25
58	138	80	138	22	18.93	1.95	1150.45	1154.3	0.33
59	141	82	141	23	19.69	1.98	1172.67	1175.08	0.21
60	144	84	144	24	20.47	2	1194.73	1198.11	0.28
61	147	86	147	25	21.26	2.03	1216.63	1218.54	0.16
62	150	88	150	26	22.08	2.05	1238.38	1241.2	0.23
63	151	88	151	25	22.42	2.1	1244.92	1246.45	0.12
64	154	90	154	26	23.25	2.13	1266.44	1268.96	0.2
65	157	92	157	27	24.1	2.15	1287.81	1288.93	0.09
66	160	94	160	28	24.96	2.18	1309.02	1311.09	0.16
67	163	96	163	29	25.85	2.2	1330.08	1330.74	0.05
68	166	98	166	30	26.74	2.23	1350.98	1352.56	0.12
69	169	100	169	31	27.66	2.25	1371.72	1371.9	0.01
70	172	102	172	32	28.59	2.28	1392.3	1393.38	0.08
71	175	104	175	33	29.53	2.3	1412.72	1412.42	−0.02
72	178	106	178	34	30.49	2.33	1432.99	1433.59	0.04
73	181	108	181	35	31.47	2.36	1453.1	1452.34	−0.05
74	184	110	184	36	32.47	2.38	1473.05	1473.2	0.01
75	187	112	187	37	33.48	2.41	1492.84	1491.66	−0.08
76	190	114	190	38	34.5	2.43	1512.48	1512.22	−0.02
77	193	116	193	39	35.54	2.46	1531.95	1530.41	−0.1
78	196	118	196	40	36.6	2.48	1551.27	1550.67	−0.04
79	199	120	199	41	37.67	2.51	1570.43	1568.58	−0.12
80	202	122	202	42	38.76	2.53	1589.43	1588.56	−0.05

Table 1. *Cont.*

Z	A	N	As	A-2Z	A_free	CC%	EBE (MeV)	RBE (MeV)	%Error in BE (MeV)
81	205	124	205	43	39.87	2.56	1608.27	1606.21	−0.13
82	208	126	208	44	40.99	2.59	1626.95	1625.9	−0.06
83	211	128	211	45	42.13	2.61	1645.48	1643.29	−0.13
84	214	130	214	46	43.28	2.64	1663.84	1662.71	−0.07
85	217	132	217	47	44.45	2.66	1682.05	1679.84	−0.13
86	220	134	220	48	45.64	2.69	1700.1	1698.99	−0.07
87	223	136	223	49	46.84	2.72	1717.98	1715.87	−0.12
88	226	138	226	50	48.06	2.74	1735.71	1734.75	−0.06
89	229	140	229	51	49.29	2.77	1753.28	1751.38	−0.11
90	232	142	232	52	50.54	2.79	1770.69	1770	−0.04
91	235	144	235	53	51.8	2.82	1787.94	1786.39	−0.09
92	238	146	238	54	53.09	2.85	1805.04	1804.75	−0.02
93	241	148	241	55	54.38	2.87	1821.97	1820.9	−0.06
94	246	152	246	58	56.48	2.87	1850.85	1850.1	−0.04
95	249	154	249	59	57.82	2.9	1867.37	1865.93	−0.08
96	252	156	252	60	59.18	2.93	1883.73	1883.72	0
97	255	158	255	61	60.55	2.95	1899.93	1899.33	−0.03
98	258	160	258	62	61.93	2.98	1915.96	1916.87	0.05
99	261	162	261	63	63.34	3	1931.84	1932.25	0.02
100	264	164	264	64	64.76	3.03	1947.56	1949.55	0.1
101	267	166	267	65	66.19	3.06	1963.12	1964.71	0.08
102	272	170	272	68	68.51	3.06	1989.8	1991.93	0.11
103	275	172	275	69	69.99	3.09	2004.95	2006.81	0.09
104	278	174	278	70	71.48	3.11	2019.93	2023.59	0.18
105	281	176	281	71	72.99	3.14	2034.76	2038.24	0.17
106	284	178	284	72	74.51	3.17	2049.42	2054.79	0.26
107	287	180	287	73	76.05	3.19	2063.93	2069.23	0.26
108	292	184	292	76	78.54	3.2	2088.92	2095.04	0.29
109	295	186	295	77	80.12	3.22	2103	2109.22	0.29
110	298	188	298	78	81.72	3.25	2116.93	2125.27	0.39
111	301	190	301	79	83.34	3.27	2130.7	2139.24	0.4
112	304	192	304	80	84.97	3.3	2144.31	2155.06	0.5
113	309	196	309	83	87.6	3.31	2167.86	2177.77	0.46
114	312	198	312	84	89.27	3.33	2181.05	2193.34	0.56
115	315	200	315	85	90.96	3.36	2194.08	2206.86	0.58
116	318	202	318	86	92.66	3.39	2206.95	2222.21	0.69
117	323	206	323	89	95.41	3.39	2229.32	2244.02	0.66
118	326	208	326	90	97.16	3.42	2241.77	2259.13	0.77

Considering the basics of 'Liquid drop model' of nuclear binding energy, we have developed another interesting formula.

$$BE \cong \left\{ \begin{array}{l} A - \left[\dfrac{1}{2} + \gamma_z \left((Z + Z^{2/3} + Z^{1/3})^2 + (N + N^{2/3} + N^{1/3})^2 + \left(\dfrac{Z}{N} \right) Z^2 \right) \right] \\ - A^{1/3} - \beta \dfrac{(A_s - A)^2}{A_s} \end{array} \right\} 10.1 \text{ MeV} \quad (3)$$

Here in this expression,

A = Mass number, Z = Proton number, N = Neutron number.

$A_s \cong 2Z + 0.0064Z^2$ = Estimated mass number close to stable mass number.

$\gamma_Z \cong 0.000935(1 + 0.000935Z)$ and $0.000935 \cong \sqrt{\frac{e}{e_n}} \times 0.001605$.

e = Elementary charge and e_n = proposed nuclear elementary charge.

$(Z + Z^{2/3} + Z^{1/3})$ = 'Z' dependent Liquid drop model of volume, surface and radial terms.

$(N + N^{2/3} + N^{1/3})$ = 'N' dependent Liquid drop model of volume, surface and radial terms.

$\beta \cong 1 - \left(\frac{N-Z}{A}\right)^2$ = Defined number associated with isospin.

Common and unified energy coefficient = 10.1 MeV.

In this formula, the second term (assumed to be associated with electroweak interaction and number of free nucleons) seems to depend on volume, surface area and radius of the nucleus. We are working on it for its better understanding. Coefficient 0.000935 is having its link with the proposed nuclear elementary charge [9] $e_n \cong 2.9464e$. Asymmetry point of view, fourth term seems to depend on the isospin factor, $\left(\frac{N-Z}{A}\right)$. Here we would like to emphasize the point that, based on the proton number, contribution of coulombic repulsion can be understood with the ratio,

$$\text{Coulombic Contribution,} CC \cong \frac{0.000935(Z + Z^{2/3} + Z^{1/3})^2}{A} \quad (4)$$

For Iron, having Z = 26 and A = 56, coulombic contribution seems to be, $CC \cong 0.0238 \cong 2.38\%$. Considering the trailing part of the second term, $\left(\frac{Z}{N}\right) Z^2 \cong \frac{Z^3}{N}$, we are working on it for understanding its significance in terms of decreasing coulombic interaction by increasing number of neutrons. See **Table 2** for the estimated nuclear binding energy and coulombic contribution close to the stable mass numbers of Z = 6 to 118. In **Table 2**,

Column 1 represents the Proton number.

Column 2 represents the Nucleon number.

Column 3 represents the Neutron number.

Column 4 represents the estimated mass number close to the stable mass number of Z.

Column 5 represents the proposed Gamma factor.

Column 6 represents the proposed Beta factor.

Column 7 represents the proposed electroweak term or number of free nucleons, A_free.

Column 8 represents the proposed Coulombic contribution percentage.

Column 9 represents the estimated binding energy (EBE).

Column 10 represents the reference binding energy (RBE) [16].

Column 11 represents the % of difference of binding energy.

Table 2. Estimated Binding Energy and Coulombic Contribution% Near to Stable Mass Numbers: Relations (3) and (4).

Z	A	N	As	Gamma	Beta	A_free	CC%	EBE (MeV)	RBE (MeV)	%Error in BE (MeV)
6	12	6	12	0.00094	1.000000	0.77	0.96	90.34	85.36	−5.83
7	15	8	15	0.000941	0.995560	0.87	0.99	117.77	109.43	−7.62
8	16	8	16	0.000942	1.000000	0.93	1.15	126.76	122.04	−3.87
9	19	10	19	0.000943	0.997230	1.06	1.17	154.26	147.28	−4.74
10	22	12	22	0.000944	0.991740	1.2	1.2	181.73	176.63	−2.89
11	23	12	23	0.000945	0.998110	1.28	1.34	190.68	185.06	−3.03
12	26	14	26	0.000945	0.994080	1.44	1.37	218.09	214.8	−1.53
13	27	14	27	0.000946	0.998630	1.53	1.51	226.96	222.61	−1.95
14	30	16	30	0.000947	0.995560	1.72	1.54	254.29	252.59	−0.67
15	31	16	31	0.000948	0.998960	1.81	1.67	263.07	259.82	−1.25
16	34	18	34	0.000949	0.996540	2.02	1.7	290.28	289.94	−0.12
17	37	20	37	0.00095	0.993430	2.24	1.73	317.38	315.82	−0.49
18	38	20	38	0.000951	0.997230	2.36	1.86	326.05	326.81	0.23
19	41	22	41	0.000952	0.994650	2.6	1.89	353.01	352.9	−0.03
20	44	24	44	0.000952	0.991740	2.86	1.92	379.86	382.08	0.58
21	45	24	45	0.000953	0.995560	2.99	2.04	388.4	389.4	0.26
22	48	26	48	0.000954	0.993060	3.27	2.08	415.09	418.6	0.84
23	49	26	49	0.000955	0.996250	3.41	2.2	423.53	425.32	0.42
24	52	28	52	0.000956	0.994080	3.71	2.23	450.07	454.5	0.97
25	55	30	55	0.000957	0.991740	4.02	2.26	476.48	479.99	0.73
26	56	30	56	0.000958	0.994900	4.18	2.38	484.78	489.79	1.02
27	59	32	59	0.000959	0.992820	4.51	2.41	511.02	515.32	0.83
28	62	34	62	0.000959	0.990630	4.86	2.44	537.13	543.63	1.2
29	63	34	63	0.00096	0.993700	5.03	2.56	545.29	550.01	0.86
30	66	36	66	0.000961	0.991740	5.4	2.59	571.23	578.25	1.21
31	69	38	69	0.000962	0.989710	5.79	2.62	597.03	603.11	1.01
32	72	40	72	0.000963	0.987650	6.19	2.66	622.7	630.65	1.26
33	73	40	73	0.000964	0.990810	6.38	2.77	630.67	637.06	1
34	76	42	76	0.000965	0.988920	6.8	2.8	656.17	664.51	1.26
35	79	44	79	0.000966	0.987020	7.23	2.84	681.52	688.75	1.05
36	80	44	80	0.000966	0.990000	7.44	2.95	689.34	697.71	1.2
37	83	46	83	0.000967	0.988240	7.89	2.98	714.52	721.9	1.02
38	86	48	86	0.000968	0.986480	8.36	3.02	739.55	748.63	1.21
39	89	50	89	0.000969	0.984720	8.85	3.05	764.44	772.29	1.02
40	90	50	90	0.00097	0.987650	9.08	3.16	772.07	781.01	1.14
41	93	52	93	0.000971	0.986010	9.58	3.19	796.78	804.59	0.97
42	96	54	96	0.000972	0.984380	10.1	3.23	821.35	830.66	1.12
43	99	56	99	0.000973	0.982760	10.63	3.26	845.78	853.75	0.93
44	100	56	100	0.000973	0.985600	10.88	3.37	853.21	862.18	1.04
45	103	58	103	0.000974	0.984070	11.44	3.4	877.45	885.19	0.87
46	106	60	106	0.000975	0.982560	12.01	3.44	901.55	910.61	1
47	109	62	109	0.000976	0.981060	12.59	3.47	925.5	933.17	0.82
48	112	64	112	0.000977	0.979590	13.19	3.51	949.3	958.12	0.92
49	113	64	113	0.000978	0.982380	13.46	3.61	956.49	963.71	0.75
50	116	66	116	0.000979	0.980980	14.08	3.65	980.11	988.53	0.85

Table 2. *Cont.*

Z	A	N	As	Gamma	Beta	A_free	CC%	EBE (MeV)	RBE (MeV)	%Error in BE (MeV)
51	119	68	119	0.00098	0.979590	14.72	3.68	1003.59	1010.56	0.69
52	122	70	122	0.00098	0.978230	15.37	3.72	1026.91	1034.93	0.77
53	125	72	125	0.000981	0.976900	16.03	3.76	1050.09	1056.56	0.61
54	128	74	128	0.000982	0.975590	16.71	3.79	1073.13	1080.51	0.68
55	129	74	129	0.000983	0.978310	17.01	3.89	1080.02	1085.95	0.55
56	132	76	132	0.000984	0.977040	17.71	3.93	1102.87	1109.75	0.62
57	135	78	135	0.000985	0.975800	18.43	3.96	1125.56	1130.9	0.47
58	138	80	138	0.000986	0.974590	19.16	4	1148.11	1154.3	0.54
59	141	82	141	0.000987	0.973390	19.9	4.04	1170.51	1175.08	0.39
60	144	84	144	0.000987	0.972220	20.66	4.08	1192.76	1198.11	0.45
61	147	86	147	0.000988	0.971080	21.44	4.11	1214.86	1218.54	0.3
62	150	88	150	0.000989	0.969960	22.23	4.15	1236.82	1241.2	0.35
63	151	88	151	0.00099	0.972590	22.57	4.25	1243.32	1246.45	0.25
64	154	90	154	0.000991	0.971500	23.38	4.28	1265.08	1268.96	0.31
65	157	92	157	0.000992	0.970420	24.21	4.32	1286.69	1288.93	0.17
66	160	94	160	0.000993	0.969370	25.05	4.36	1308.15	1311.09	0.22
67	163	96	163	0.000994	0.968350	25.91	4.4	1329.46	1330.74	0.1
68	166	98	166	0.000994	0.967340	26.78	4.44	1350.62	1352.56	0.14
69	169	100	169	0.000995	0.966350	27.67	4.47	1371.63	1371.9	0.02
70	172	102	172	0.000996	0.965390	28.57	4.51	1392.48	1393.38	0.06
71	175	104	175	0.000997	0.964440	29.49	4.55	1413.19	1412.42	−0.05
72	178	106	178	0.000998	0.963510	30.42	4.59	1433.75	1433.59	−0.01
73	181	108	181	0.000999	0.962610	31.37	4.63	1454.15	1452.34	−0.12
74	184	110	184	0.001	0.961720	32.33	4.67	1474.41	1473.2	−0.08
75	187	112	187	0.001001	0.960850	33.31	4.7	1494.51	1491.66	−0.19
76	190	114	190	0.001001	0.960000	34.3	4.74	1514.46	1512.22	−0.15
77	193	116	193	0.001002	0.959170	35.31	4.78	1534.26	1530.41	−0.25
78	196	118	196	0.001003	0.958350	36.34	4.82	1553.9	1550.67	−0.21
79	199	120	199	0.001004	0.957550	37.38	4.86	1573.39	1568.58	−0.31
80	202	122	202	0.001005	0.956770	38.44	4.9	1592.73	1588.56	−0.26
81	205	124	205	0.001006	0.956000	39.51	4.94	1611.92	1606.21	−0.36
82	208	126	208	0.001007	0.955250	40.6	4.98	1630.95	1625.9	−0.31
83	211	128	211	0.001008	0.954520	41.7	5.02	1649.83	1643.29	−0.4
84	214	130	214	0.001008	0.953800	42.82	5.05	1668.55	1662.71	−0.35
85	217	132	217	0.001009	0.953090	43.95	5.09	1687.12	1679.84	−0.43
86	220	134	220	0.00101	0.952400	45.1	5.13	1705.53	1698.99	−0.38
87	223	136	223	0.001011	0.951720	46.26	5.17	1723.79	1715.87	−0.46
88	226	138	226	0.001012	0.951050	47.44	5.21	1741.89	1734.75	−0.41
89	229	140	229	0.001013	0.950400	48.64	5.25	1759.84	1751.38	−0.48
90	232	142	232	0.001014	0.949760	49.85	5.29	1777.63	1770	−0.43
91	235	144	235	0.001015	0.949140	51.08	5.33	1795.26	1786.39	−0.5
92	238	146	238	0.001015	0.948520	52.32	5.37	1812.74	1804.75	−0.44
93	241	148	241	0.001016	0.947920	53.58	5.41	1830.06	1820.9	−0.5
94	246	152	246	0.001017	0.944410	55.64	5.4	1859.38	1850.1	−0.5
95	249	154	249	0.001018	0.943860	56.94	5.44	1876.28	1865.93	−0.55
96	252	156	252	0.001019	0.943310	58.26	5.48	1893.03	1883.72	−0.49
97	255	158	255	0.00102	0.942780	59.59	5.52	1909.62	1899.33	−0.54
98	258	160	258	0.001021	0.942250	60.94	5.56	1926.05	1916.87	−0.48
99	261	162	261	0.001022	0.941740	62.3	5.6	1942.32	1932.25	−0.52
100	264	164	264	0.001022	0.941230	63.68	5.64	1958.44	1949.55	−0.46
101	267	166	267	0.001023	0.940730	65.08	5.68	1974.39	1964.71	−0.49
102	272	170	272	0.001024	0.937500	67.36	5.68	2001.39	1991.93	−0.47
103	275	172	275	0.001025	0.937040	68.8	5.72	2016.92	2006.81	−0.5
104	278	174	278	0.001026	0.936600	70.26	5.76	2032.3	2023.59	−0.43
105	281	176	281	0.001027	0.936160	71.73	5.8	2047.51	2038.24	−0.45
106	284	178	284	0.001028	0.935730	73.21	5.84	2062.56	2054.79	−0.38
107	287	180	287	0.001029	0.935300	74.72	5.87	2077.45	2069.23	−0.4
108	292	184	292	0.001029	0.932260	77.18	5.87	2102.65	2095.04	−0.36
109	295	186	295	0.00103	0.931870	78.73	5.91	2117.11	2109.22	−0.37
110	298	188	298	0.001031	0.931490	80.29	5.95	2131.42	2125.27	−0.29
111	301	190	301	0.001032	0.931120	81.87	5.99	2145.56	2139.24	−0.3
112	304	192	304	0.001033	0.930750	83.46	6.03	2159.54	2155.06	−0.21
113	309	196	309	0.001034	0.927850	86.08	6.03	2183.18	2177.77	−0.25
114	312	198	312	0.001035	0.927510	87.72	6.07	2196.73	2193.34	−0.15
115	315	200	315	0.001036	0.927190	89.37	6.11	2210.12	2206.86	−0.15
116	318	202	318	0.001036	0.926860	91.04	6.15	2223.34	2222.21	−0.05
117	323	206	323	0.001037	0.924080	93.79	6.15	2245.69	2244.02	−0.07
118	326	208	326	0.001038	0.923780	95.51	6.19	2258.48	2259.13	0.03

5. Energy Liberation Mechanism in Iron-56 and Magnesium-24

Output power of the 1999 model locomotive, WAP-7, [7th generation broad gauge, AC Current, Passenger traffic] locomotive is 4740 kW [17,18]. Roughly it is 5000 kW. To derive/generate such power, we propose the following points.

5.1. Isotopic Conversion of Iron-56 to Iron-57

Nuclear binding energies of iron-56 and Iron-57 are 492.26 MeV and 499.91 MeV respectively. Hence expected or liberated thermal energy can be given as, 8.8 – (499.91 – 492.26) = 1.15 MeV. Nuclear binding energies of Magnesium-24 and Magnesium-25 are 198.26 MeV and 205.59 MeV respectively. Hence liberated thermal energy can be given as, 8.8 – (205.59 – 198.26) = 1.47 MeV. Thus, considering the isotopic conversion of ^{56}Fe to ^{57}Fe, as the abundance of ^{56}Fe is very high, selecting one gram of ^{56}Fe and considering a suitable catalyst, there is a scope for generating thermal energy.

Expected number of atoms in one gram of ^{56}Fe seems to be around 1.08×10^{22}. Corresponding thermal energy liberation seems to be around $1.08 \times 10^{22} \times 1.15$ MeV $\cong 2.0 \times 10^{9}$ joule $\cong$ 2000MJ. Considering an efficiency of 50%, for one gram of ^{56}Fe, 1000 MJ of thermal energy can be generated.

By considering a single big nuclear reactor or 4 to 5 number of small reactors that can convert 1.08×10^{22} number of ^{56}Fe into ^{57}Fe per second, there is a possibility for getting 1000 MW or 1 GW of equivalent electric power. Considering the case of 5000 kW cold nuclear locomotive with all thermal, electric and mechanical losses, roughly 15 milligrams of Iron-56 seem to be sufficient with one or two nuclear reactors.

5.2. Isotopic Conversion of Magnesium-24 to Magnesium-25

Nuclear binding energies of Magnesium-24 and Magnesium-25 are 198.26 MeV and 205.59 MeV respectively. Hence, expected or liberated thermal energy can be given as, 8.8 – (205.59 – 198.26) = 1.47 MeV.

Considering the isotopic conversion of ^{24}Mg to ^{25}Mg, as the abundance of ^{24}Mg is very high, selecting one gram of ^{24}Mg and considering a suitable catalyst, there is a scope for generating thermal energy. Expected number of atoms in one gram of ^{24}Mg seems to be around 2.48×10^{22}. Corresponding thermal energy liberation seems to be around $2.48 \times 10^{22} \times 1.47$ MeV $\cong 5.84 \times 10^{9}$ joule $\cong$ 5841 MJ.

Considering an efficiency of 50%, for one gram of ^{24}Mg, 2920 MJ of thermal energy can be generated. By considering a single big nuclear reactor or 4 to 5 number of small reactors that can convert 2.48×10^{22} number of ^{24}Mg into ^{25}Mg per second, there is a possibility for getting 2920 MW or 2.9 GW of equivalent electric power. Considering the case of 5000 kW cold nuclear locomotive with all thermal and electric losses, roughly 5 milligrams of Magnesium-24 seem to be sufficient with one or two nuclear reactors.

5.3. Cold Nuclear Reactor Design Requirement

Reactor metal should have high mechanical strength and high corrosion strength at around (1000 to 1500) deg. C. In a long run, reactor metal must support the continuous generation of heat without any self-damage and destruction.

Reactor metal should have high thermal conductivity to transfer its internal heat from the reactor to the surrounding water stream. Reactor metal wall thickness should withstand the pressure given to or pressure developed by the hydrogen atoms.

Reactor internal shape should be in such way that, hydrogen atoms should continuously make oscillations in order to attack or bombard the semi liquid and powder form of the Iron-56 or Magnesium-24 resting on the bottom of the reactor. It helps in increasing the number of absorptions per second.

Reactor should have provisions for evacuating the reactor volume, entering and leaving of hydrogen atoms, adding Iron-56 and Magnesium-24 powder, removal of reaction waste, cleaning of the reactor volume on requirement.

Preheating arrangement is required for heating the reactor after loading it with Iron-56 or Magnesium-24. Thermal radiation detectors are to be arranged inside and outside of the reactor for ensuring and assessing the occurrence of cold nuclear fusion.

Provision is required for excess neutron absorption mechanism. It may help in controlling the reaction rate whenever required without stopping the whole process. Even though it is costly, reactor surroundings can be covered with all possible hazardous radiation detectors for long run safety and smooth operations.

Quality of all materials used for constructing the reactor should satisfy international standards. Construction of the reactor should satisfy international safety standards. Reactor volume can be decided as per the required number of hydrogen atom absorptions per second. Surrounding water flow of the reactor can be decided with estimated thermal energy liberation/second.

6. Design Layout of 5000 kW Cold Nuclear Locomotive

Following the above energy liberation mechanism, 5000 kW cold nuclear locomotive design layout can be prepared. It needs one extra bogie to accommodate the following equipment.

(1) Nuclear reactor, nuclear fuel and hydrogen gas unit
(2) Water flow circulating round the reactor unit.
(3) Conversion of water to super-heated steam.
(4) Steam turbine and alternator unit.
(5) Water electrolyser (for onboard hydrogen).
(6) Locomotive power supply unit.

7. Advantages of Cold Nuclear Locomotive

One can expect many advantages of cold nuclear locomotives.

(1) There is no need to maintain overhead power lines.
(2) As the source of power is associated with nuclear reactions, power density is very high.
(3) Handling of Iron-56 and Magnesium-24 is very simple and easy.
(4) Operation point of view, by increasing the rate of isotopic conversions, required power can be generated.
(5) Iron-56, Iron-57, Magnesium-24 and Magnesium-25 are stables elements [19].
(6) Other possible elements can be explored easily.

8. Disadvantages of Cold Nuclear Locomotives

(1) Cold nuclear locomotives need a separate power generating bogie to accommodate the nuclear reactor, steam turbine, alternator and other necessary power generating equipment.
(2) Feeding of nuclear fuels and removal of burnt nuclear fuels needs attention.
(3) Water and Hydrogen need to be stored in sufficient quantities.
(4) Storing and handling of hydrogen needs critical care.
(5) Even though it is well confirmed for low energies, there is a potential threat for beta and gamma radiation at very high energies.

9. NASA's Lattice Confinement Mechanism

With reference to Hot Nuclear Fusion, it is a very promising technique developed by NASA scientists and engineers [3,11]. It can be called 'Lattice Confinement Fusion' (LCF) initiated at ambient temperatures. Main point to be noted is that, at room temperature, Erbium atoms are having a property of absorbing deuterons at 10^{23} per cubic centimeter. This number density is far higher than the currently believed hot plasma number density 10 power 14 per cubic centimeter. In this method, deuterium is loaded to Erbium metal lattice. It may be noted that this is a general practice of storing and confining cold nuclear fuels. The new point of interest is that metal lattice helps in maintaining the positively charged deuterons closer and closer without repelling each other with the counter support of large negative charge density of the metal lattice. Clearly speaking, electron cloud arranges a screen like separator in keeping deuterons side by side without repelling each other. During operation, a gamma ray of energy around 2.2 MeV strikes the deuterons. Thus, deuterons may gain sufficient energy to fuse with other deuterons forming Helium-3 or Hydrogen-3 nuclei liberating considerable energy. This mechanism can be called 'Screening fusion'. Alternatively, deuterons may split into protons and neutrons encouraging Erbium nuclei to transform to Thulium nuclei liberating energy. This mechanism can be called 'Stripping fusion'.

In this context, even though LCF is not a perfect example of cold nuclear fusion, we would like to emphasize the following points. (A) Nuclear reactions will certainly liberate energy at controllable low temperatures compared to million-degree Kelvin. (B) Isotopic and isobaric changes will certainly occur in nuclear reactions associated with metals at controllable temperatures. (C) Metals having significant mass numbers will certainly help in developing cold nuclear fusion techniques in a sustainable approach.

10. Discussion

As fossil fuels are expected to be exhausted by 2060–2090, it needs a vigorous search for alternative fuels [20]. It is very unfortunate to note that, advanced countries are planning to shutdown fission based nuclear reactors due to increasing nuclear radiation, risky technology, uncontrollable evil effects of nuclear radiation caused by damage to nuclear reactors by various natural calamities [21].

At present Indian Railway authorities are having 10238 electric locomotives and 16 billion units of electricity is being consumed every year. To replace all 4543 diesel locomotives, it needs around 30 billion units of electricity [22]. This much of enormous power demand needs a serious green power source.

By visualizing a colliding hydrogen atom with a heavy atom as a case of absorbing one neutron by a heavy atom via weak interaction, there is a possibility of liberation of thermal energy. It needs theoretical calculations for understanding the probability of successful colliding events and liberation of thermal energy.

By bombarding heavy atoms directly with neutrons generated by available nuclear equipment, our proposal can be tested and verified. Compared to hot nuclear fusion, cold nuclear fusion is mostly involved with colliding one neutral hydrogen atom with many neutral heavy atoms under controllable pressure and temperature limits rather than the interaction of two different hydrogen ions at very high pressure and temperature limits.

Design and construction point of view, it is easy to develop cold nuclear reactors that can operate at 500 to 1500 deg C. Compared to hot nuclear fusion equipment, cold nuclear equipment seems to be compact and economical.

With further research, required hydrogen can be generated within the locomotive via fuel cells and electrolysis powered by part of cold nuclear power [23,24]. If it is successful, our proposed concepts can be applied to heavy vehicles, electric generators, ships, aircrafts and metal melting furnaces.

11. General Questions and Answers

Q1: Cold fusion, unlike conventional hot fusion, is assumed to occur at or near room temperature. The study would need to delve into the theoretical frameworks or potential mechanisms that could enable the fusion of iron-56 or magnesium-24 under such conditions.

Answer: In a theoretical approach, we would like to emphasize the point that, process of bombarding medium and heavy stable atomic nuclides with hydrogen atoms may help in getting thermal energy by virtue of isotopic binding energy difference. It needs some selection rules. To confirm our proposal, we appeal nuclear scientists to bombard medium and heavy stable atomic nuclides with direct neutrons.

Q2: The study would need to assess the amount of energy that could realistically be produced from these fuels and the overall efficiency of such a process in a locomotive environment.

Answer: Each isotopic conversion can liberate 1 MeV thermal energy. Increasing number of isotopic conversions can liberate energy in the corresponding proportion. Whole process depends on the reactor design and it needs experimental study.

Q3: The study would need to consider the types of technologies and materials that would be necessary to initiate, sustain, and control cold fusion reactions using iron-56 or magnesium-24. This could include reactor design, containment strategies, and energy extraction methods.

Answer: Needs experimental study.

Q4: Nuclear reactions, by their very nature, involve safety concerns. The study should address the potential risks associated with using these fuels in a mobile platform such as a locomotive, including radiation protection and waste management.

Answer: Energy released in case of nuclear fission is 200 MeV per fission and energy released in cold nuclear fusion is 1 MeV per each conversion. Thus, compared to nuclear fission, risk associated with reactor operations and safety in cold nuclear fusion is only marginal.

Q5: Finally, the study should address the practical challenges of implementing such technology in an actual locomotive, including fuel availability, the size and weight of the systems required, and the overall economic viability compared to existing energy sources.

Answer: Needs experimental study.

Q6: Essentially, the study should determine whether this seemingly unconventional approach to powering electric locomotives has any scientific or engineering value.

Answer: One can refer the current funding scenario in Europe countries and NASA experimental studies. It may be noted that, fossil fuels are getting exhausted and causing lot of environmental pollution, nuclear fission oriented power is associated with high risk of operations and burnt fuel disposal. Hence, proposed cold nuclear fusion concepts can be given a chance.

Q7: How practical its implementation would be, particularly with Iron-56 and Magnesium-24, should be explained better.

Answer: Whether it is Iron-56 or Magnesium-24, semi liquid form of the fuel is being bombarded with hydrogen atoms. Point of concern is that, during the collision, it is expected that,

1. Hydrogen atoms are fused with the base isotopes.
2. Having absorbed one hydrogen atom, each base isotope transforms to its next level isotope.
3. The new isotope, based on the binding energy difference, releases leftover nuclear energy in the form of thermal energy.

Q8: Experimental evidence should be presented or cited by the authors that support the theoretical model of cold nuclear fusion applied to specific fuels like Iron-56 and Magnesium-24.

Answer: There is no direct experimental support or citation for Iron or Magnesium reactors. Russian and Japan experiments on Cold nuclear fusion, Andrea Rosi's E-cat test runs can be considered as possible supporting experiments. NASA's experiments on Lattice confinement can also be considered.

Q9: Proper risk assessment of using nuclear materials, including safety measures and emergency protocols, should be provided to neutralize the potential dangers of radiation.

Answer: On theoretical grounds, there is no chance for emission of alpha, beta and gamma radiation. As expected power is of the order of 5MW, it needs attention for a smooth run of the reactor for a long time. Compared to nuclear power plants, there is no chain reaction concept and there is no such risk.

Q10: Economic viability analysis with a cost-benefit comparison of the costs of cold nuclear fusion technology versus available sources of energy would present a strong case for adopting the technology.

Answer: As Iron is a very cheap element compared to available fossil fuels and nuclear fuels, and the expected reactions are linked with nuclear origin, power density compared to available fossil fuels is on higher side and certainly there exists a great cost reduction.

Q11: The article is right to point out the issues of hydrogen handling and storage. It would be helpful to elaborate on safety technologies and procedures that would neutralize such risks.

Answer: Safety measures are available in current science and technology literature.

Q12: Perception of nuclear technologies is invariably publicly skeptical. Strategies to improve public perception toward cold nuclear fusion must be addressed.

Answer: Japan and Russia experiments and NASA's Lattice confinement experiments and other experimental procedures can be reviewed in international conferences on priority base for the benefit of sharing and spreading the views among public and private institutions and news agencies. Thus, awareness can be created among the public with a positive talk and encouragement.

Q13: How are the estimates of energy output made? What assumptions were made about the efficiency of the interactions?

Answer: With 50% efficiency, 0.5 MeV thermal energy can be expected in each isotopic conversion of Iron-56 to 57 and Magnesium 24 to 25. Thermal power depends on the number of isotopic conversions per second. It depends on the reactor volume, catalyst and number of reactors.

Q14: What environmental consequences, if any, might be seen from the operation of such nuclear systems, especially in relation to waste disposal?

Answer: On theoretical grounds, there is no chance for emission of alpha, beta and gamma radiation. Waste materials like burnt fuel needs identification and analysis, and disposal methodology can be standardized with further studies. It depends on the input fuel mass, isotopic conversion process, rate of fuel consumption, increasing burnt fuel mass etc.

Q15: What long-term experiments have been carried out to guarantee the feasibility and long-term sustainability of the proposed reactor materials for use in cold nuclear locomotives?
Answer: As expected mechanism is very simple and operating temperatures are on lower side around (500 to 1500) C, one can expect long run of the reactor in safe mode.

Q16: Have the authors compared or even thought about their cold fusion technique to other renewable energy technologies, like solar or wind power, in terms of scalability and practicability?
Answer: Scalability depends on the reactor volume, number of reactors, reactor catalyst, number of isotopic conversions/sec. Compared to solar or wind power, operation is quite different and power density is very high. But it needs hydrogen to run the reactor. From a practicability point of view, compared to solar and wind power, a reactor unit has unique features such as compactness, self-consistency, and mobility, while producing energy. It may also be noted that, developing locomotives equipped with a solar plant or a wind turbine plant seems to be not so practical.

12. Conclusions

In this paper, we have proposed a very simple and workable mechanism for developing electric power and running a 5000-kW electric locomotive via cold nuclear low energy nuclear reactions assumed to be realizable with Iron-56 and Magnesuin-24 like stable elements. We have clearly explained the point that, cold nuclear fusion is associated with heavy neutral atoms and neutral hydrogen atoms and there is no scope for coulombic repulsion.

The key point to be noted is that hydrogen atom is being absorbed by the heavy atom in the form of a neutron. This point can be recommended for theoretical and experimental investigations. Even if our approach is wrong, by any chance or any mechanism, if it is possible to insert hydrogen atom or neutron directly into the core of any heavy atom, by means of weak interaction, there is a scope for the occurrence of cold nuclear low energy reactions. As per the nuclear binding energy scheme, to take out a nucleon, 8.8 MeV is required. In reverse order, the ingoing nucleon can release 8.8 MeV. Our basic idea is that, as maximum binding energy per nucleon is around 8.8 MeV, ingoing neutron gives off 8.8 MeV to the surrounding nucleons of the target atom. During the process of neutron absorption, as the target atoms are highly stable and not so heavy compared to fissionable atoms, after a kind of energy saturation and isotopic transformation, (by absorbing 8.8 MeV released by the ingoing neutron), there is a scope for liberation of excess energy in the form of thermal energy. This can be considered as one of the secrets of mystery of cold nuclear fusion. With further study and experiments, required experimental set values can be extracted and finalized.

We would like to emphasize the point that cold nuclear low energy reactions will certainly help in generating green thermal energy as per the need and demand. It needs serious research and experimental trials. As the whole world is in a serious energy crisis and facing severe environmental issues like global warming, breathing air pollution, accumulation of high-level nuclear waste—our proposal can be given some consideration and can be recommended for further research with possible funding.

Author Contributions

Conceptualization, methodology and first draft, S.S.U.V.; Analysis and technical support, S.L. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement

Regarding nuclear binding energy, for data comparison, readers are encouraged to refer [16]. Programming file written in Python can be produced on emailing correspondence.

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Conflicts of Interest

The authors declare no conflict of interest.

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