

1.5.5* DOE report 2004

Since 1989 when a part of the CFP was discovered but its reality had been denied, we had lost communication from scientists in the outside world for a long period except several cases where they forced to respond the works obtained in the field of the CFP. Two of these fortunate cases was the investigation of the CFP by the Department of Energy, US Government who published their results as we refer to them as DOE Report 1989 [DOE 1989] and DOE Report 2004 [DOE 2004].

About the DOE Report 1989, we have given our critique on it in Sec. 1.5.2. We give our estimation on the DOE Report 2004 in this subsection.

DOE Report 2004 [DOE 2004]

The DOE Report 2004 [DOE 2004] has a different character from that of 1989. The new *Report* was issued according to the request presented by several CF researchers as a document [Hagelstein 2004].

“The Department of Energy’s (DOE) Office of Science (SC) was approached in late 2003 by a group of scientists who requested that the Department revisit the question of scientific evidence for low energy nuclear reactions. In 1989 Pons and Fleischman first reported the production of “excess” heat in a Pd electrochemical cell, and postulated that this was due to D-D fusion (D=deuterium), sometimes referred to as ‘cold fusion.’ The work was reviewed in 1989 by the Energy Research Advisory Board (ERAB) of the DOE. ERAB did not recommend the establishment of special programs within DOE devoted to the science of low energy fusion, but supported funding of peer-reviewed experiments for further investigations. Since 1989, research programs in cold fusion have been supported by various universities, private industry, and government agencies in several countries.” [DOE 2004]

“Mail Review Charge Letter of DOE” says;

“Enclosed is the summary document and appendix material related to the review of recent scientific reports of low energy nuclear reactions (LENR) in metal matrices, currently being conducted for the Office of Science by the Offices of Basic Energy Sciences and Nuclear Physics in the Department of Energy on the recent scientific reports of Low Energy Nuclear Reactions (LENR). The goal of the review will be to generate a report on the status of the research field for the Director and the Principal Deputy Director of the Office of Science. The report will be written by DOE federal staff based on the individual inputs from members of a DOE empaneled review team.”* [DOE 2004]

*The scientific reports are the one, the title, authors and abstract and conclusions of which are cited as follows;

“New Physical Effects in Metal Deuterides

P.L. Hagelstein, M.C.H. McKubre, D.J. Nagel, T.A. Chubb, and R.J. Hekman,

Abstract

The experimental evidence for anomalies in metal deuterides, including excess heat and nuclear emissions, suggests the existence of new physical effects.” [Hagelstein 2004]

“6. Conclusions

The research discussed in this paper provides evidence for effects in three categories:

(1) The existence of a physical effect that produces heat in metal deuterides. The heat is measured in quantities greatly exceeding all known chemical processes and the results are many times in excess of determined error using several kinds of apparatus. In addition, the observations have been reproduced, can be reproduced at will when the proper conditions are reproduced, and show the same patterns of behavior. Furthermore, many of the reasons for failure to reproduce the heat effect have been discovered.

(2) The production of ^4He as an ash associated with this excess heat, in amounts commensurate with a reaction mechanism consistent with $D + D \rightarrow ^4\text{He} + 23.8 \text{ MeV}$ (heat).

(3) A physical effect that results in the emission of: (a) energetic particles consistent with $d(d,n)^3\text{He}$ and $d(d,p)t$ fusion reactions, and (b) energetic alphas and protons with energies in excess of 10 MeV, and other emissions not consistent with deuteron-deuteron reactions.

Experimental results for tritium production were noted, and anomalous results from deuteron beam experiments on TiDx were discussed briefly. In each case, the effects cannot be accounted for by known nuclear or solid state physics. The underlying processes that produce these results are not manifestly evident from experiment. The scientific questions posed by these experiments are, in the opinion of the authors, both worthy and capable of resolution by a dedicated program of scientific research.”

According to the limited evidences given to the DOE by the proposers (P.L. Hagelstein et al.) as clearly written in the above short *Abstract*, the material is confined to the “*The experimental evidence for anomalies in metal deuterides*” and does not include the data obtained in the protium systems at all. Therefore, the material given to the DOE is necessarily an incomplete one to show the cold fusion phenomenon as a whole. However, the Report [DOE 2004] had merit in evaluation of positive phases of the CF

researches after the DOE Report 1989 [DOE 1989].

The result of the peer review by DOE is summarized in the Conclusion of DOE's "Report of the Review of Low Energy Nuclear Reactions" cited below:

http://www.science.doe.gov/Sub/Newsroom/News_Releases/DOE-SC/2004/low_energy/CF_Final_120104.pdf

Conclusion of DOE is cited as follows;

"While significant progress has been made in the sophistication of calorimeters since the review of this subject in 1989, the conclusions reached by the reviewers today are similar to those found in the 1989 review.

The current reviewers identified a number of basic science research areas that could be helpful in resolving some of the controversies in the field, two of which were: 1) material science aspects of deuterated metals using modern characterization techniques, and 2) the study of particles reportedly emitted from deuterated foils using state-of-the-art apparatus and methods. The reviewers believed that this field would benefit from the peer-review processes associated with proposal submission to agencies and paper submission to archival journals." [DOE 2004]

It should be cited one of the positive comments in the Report as follows;

"It is now clear that loading level and current density thresholds are required in order to observe excess heat in these experiments. The values are consistent regardless of the approach used and the laboratory where the experiment was conducted. Early failures to reproduce the heat effect were, in part, due to not meeting these requirements. It has also been found that thermal and current density transients, which are thought to effect the chemical environment such as deuterium flux, can trigger heat "events". SRI has published an expression for the correlation between excess power and current density, loading, and deuterium flux. These discoveries have led to a better understanding of the phenomena and more reproducibility." (Reviewer #9)

One of the important results of the CFP not taken up in the DOE Report 2004 (a natural result due to its absence in the proposed material) is the nuclear transmutations both in protium and deuterium systems. The nuclear transmutation (NT) is an astonishing event suggesting a new state of matter in the CF materials (materials responsible to the CFP) entirely different from the states of matter we have had known in physics and chemistry developed in the 20th century.

The data of nuclear transmutations in the CFP are summarized in following books and papers [Kozima 1998a (Chapter 9), 2006 (Section 2.5), 2014a, Storms 2007 (Section

4.5), Section 2.5 of this book] and the stability effect found in the data of nuclear transmutation is explained in following papers and books [Kozima 2005, 2006 (Section 2.11), 2012a, Section 2.14 of this book].

Finally, it is useful to cite a sentence on the controversial *d-d* fusion reactions from the DOE Report 2004. About the theoretical verification of the d-d reaction producing ^4He and lattice energy, the “Report” discussed as follows:

“Charge Element 2: Determine whether the evidence is sufficiently conclusive to demonstrate that such nuclear reactions occur.

Reviewers expert in nuclear physics noted that the cold fusion mechanism put forward by proponents is not in accord with presently accepted knowledge of $D + D$ fusion. Specifically, $D + D$ fusion is accompanied by the production of protons, neutrons, tritons, ^3He , ^4He and high energy gamma rays, all in well-known proportions. The fusion channel resulting in ^4He and high energy gamma rays occurs approximately only once for every 10^7 $D + D$ fusion reactions. These characteristic proportions for the production of the fusion products are found for every energies of the incident deuteron measured so far, down to the lowest that has been measured.

The review document and oral presentations made the argument that the branching ratios are different at low energies and that in cold fusion, ^4He fusion channel is predominant. According to the review document, no high energy gamma rays appear to accompany the ^4He , as is observed in $D-D$ fusion reactions. Instead, the approximately 24 MeV in energy resulting from $D-D$ fusion was purported to appear as heat in the material lattice. To explain these unusual characteristics, the reviewers were presented with a theoretical framework that purported to describe how collective energy from the material lattice couples to a deuteron pair to induce fusion, how the only fusion reaction channel that occurs would be the production of ^4He , and how all the energy is coupled back into the material in the form of heat instead of high energy gamma-rays. The reviewers raised serious concerns regarding the assumptions postulated in the proposed theoretical model for the explanation for ^4He production.

The preponderance of the reviewers’ evaluations indicated that Charge Element 2, the occurrence of low energy nuclear reactions, is not conclusively demonstrated by the evidence presented. One reviewer believed that the occurrence was demonstrated, and several reviewers did not address the question.”[DOE 2004]

Author’s comment on this issue

As we have already seen in this Chapter and will see in following Chapters more

extensively, CFP is not so simple phenomenon as explained by *d-d* fusion reactions, if any. About the ${}^4_2\text{He}$ production, we will give our discussion in Sec. 2.8.

The most important factor we have to notice in CFP is complexity. From its nature of complexity, we could not expect the quantitative reproducibility of events in CFP. It is necessary to use a concept of qualitative reproducibility to specify CFP. This point of view is missing in the proposers' document and therefore in DOE's Report.

The second point we have to recognize in the CFP is variety and diversity of events occurring not only in transition-metal deuterides but also in hydrides. Furthermore, we know it occurs in cross-linked polyethylene with appropriate ions diffused. If we want to treat the CFP as a whole from a unified point of view, we have to seek a common cause for various events both in deuterides and hydrides. The proposers' point of view is on the extension of the line proposed by Fleischmann et al. (the Fleischmann's hypothesis) confined to deuterides using subtle experimental evidences of ${}^4\text{He}$ detection.

These problems are related with essential factors of the CFP and will be discussed in later Chapters phenomenologically inherent in natural science as a positivistic science.