Revisiting Anomalous Explosion of Hydrogen and Oxygen Mixture from a View Point of Cold Fusion

Hiroshi Yamamoto, Free Journalist
3110-17, Tsuzuki, Mikkabi-Cho, Inasa-Gun, Shizuoka-Pref. Zip:431-1402, Japan
e-Mail: hughy@aqua.ocn.ne.jp

ABSTRACT: It has been reported that extraordinary powerful explosions occurred during experiments of cold fusion(1) and in nuclear power plants(2). The magnitude of explosion is far beyond the one which the current combustion theory predicts. As there was no clue to explain these anomalous explosions, it has been neglected to study the real cause of these explosions but just has been categorized as hydrogen explosion. In order to establish safer hydrogen economy in which hydrogen is the main energy carrier for fuel cells, and to avoid unnecessary hydrogen explosion during experiments of cold fusion, it is imperative to clarify the mechanism of the anomalous explosion of hydrogen. It has been demonstrated that hydrogen atoms can achieve lower states than ground state by a resonant collision with a near by atom or combination of atoms having the capability to absorb the energy to effect the transition, namely, an integer multiple of the potential energy of atomic hydrogen, $m \times 27.2eV$ (m=integer) (3) . This reaction was named as the Black-Light Process. The Black-Light Process can generate energy somewhat between nuclear and chemical reaction. This paper revisits the anomalous hydrogen explosions at nuclear power plants from a view point of the Black-Light Process and proposes its explosion mechanism.

Key words: hydrogen explosion, high concentration of hydrogen and oxygen, Hydrino

1. INTRODUCTION

The explosion of a cold fusion cell at SRI International in Menlo Park, California in 1992 is the most memorable one in the history of cold fusion research. The detonating cell (only 2 inches in diameter and 8 inches long), not only killed one researcher but peppered three other researchers in the lab with debris.

It was so powerful that people wondered it might be the first cold fusion bomb. Even though intensive investigation on this accident had been carried out but no radio active substances had been detected and the final conclusion was that it was just a hydrogen explosion. In Aug 2003, Tokyo Electric Power Company disclosed that it experienced 8 unusual pressure rises believed to be hydrogen explosion in its nuclear power plants during the time period of 1993-1997.

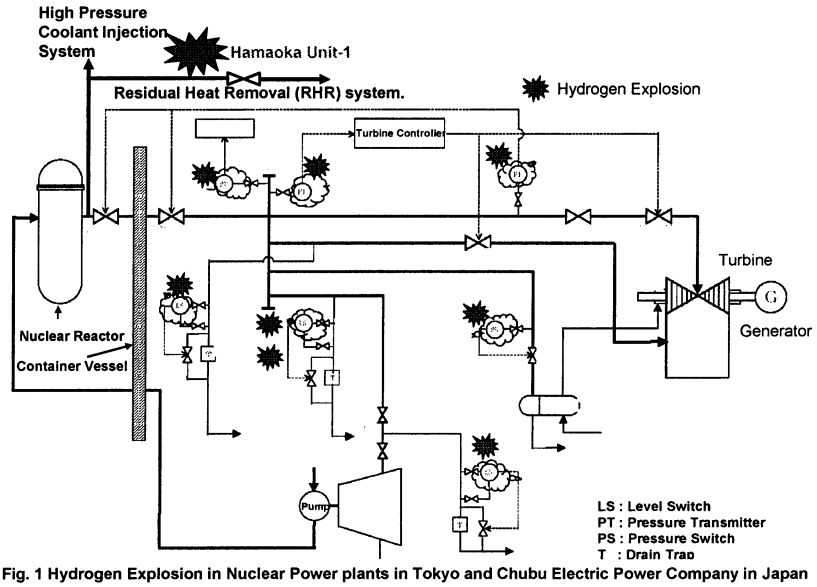

Fig. 1 Hydrogen Explosion in Nuclear Power plants in Tokyo and Chubu Electric Power Company in Japan
Source:http://www.tepco.co.jp/cc/press/03082103-j.html

The mechanism of these explosions was not identified and it was rather natural to have more severe one which took place in 2001 at the Hamaoka nuclear power plant of Chubu Electric Power Company in Japan. Fig 1 shows the places of hydrogen explosion in nuclear power plants in Tokyo and Chubu Electric Power Company.

After the Hamaoka's incident, an intensive investigation on the mechanism of ignition and explosion of hydrogen was done. Fig 2 shows the result of such an investigation. This paper revisits the hydrogen explosions at nuclear plants in Japan.

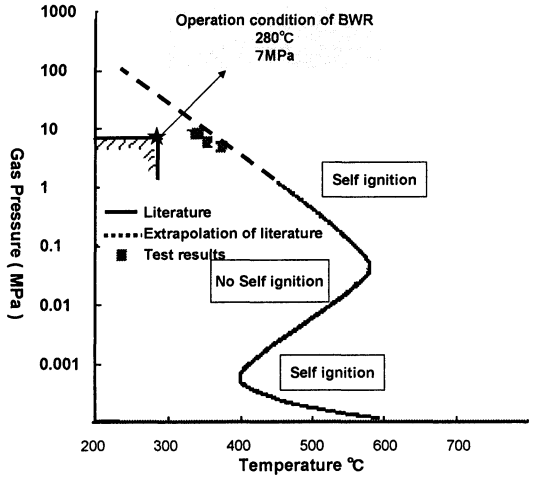

Fig. 2 Self Ignition Area of Stoichiometric Mixture of Hydrogen and Oxygen

Source:Chubu Electric Power Company:
Reactor Manual Shutdown Caused by Pipe Rupture in Residual Heat Removal System at the Hamaoka Nuclear Power Station Unit-1 (Final Report), April 2002 (in Japanese).

2. CHARACTERISTICS OF HYDROGEN EXPLOSION AT NUCLEAR POWER PLANTS

1) Not only stoichiometric mixture of hydrogen and oxygen

Most of explosions took place with stoichiometric mixture of hydrogen and oxygen produced due to radiolysis of water by nuclear reaction in power plants, but in the case of the Hamaoka unit-1, the story is totally different because of the injection of hydrogen and noble metal catalysts into cooling water for prevention of stress corrosion of internal parts made of stainless steel alloy. The purpose of these injections is to enhance the recombination of oxygen that causes corrosion with hydrogen.

Chubu Electric power Company had been operating 4 nuclear power plants at Hamaoka. The unit-1 (in which the incident took place) and unit-2 are boiled water reactor and have a very similar operating history including injection of hydrogen and noble metal catalysts into cooling water. After the incident of unit-1, non-condensable gasses of the unit-2 that were accumulated at the upward dead end of the pipe were taken and its contents were measured as is shown in Fig 3.

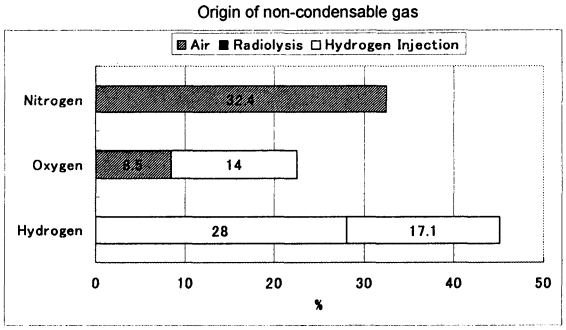

Fig. 3 Concentration of non-condensable gases and its origin in RHR of Hamaoka Unit-2

Source:
Chubu Electric Power Company:
Reactor Manual Shutdown Caused by Pipe Rupture in Residual Heat Removal System at the Hamaoka Nuclear Power Station Unit-1 (Final Report), April 2002 (in Japanese).

Nitrogen came in because the valves had been opened at the previous periodic inspection. This means that the origin of 8.5 % oxygen in Fig 3 is from air, not generated in the nuclear reactor. So, it is obvious that the mixture ratio of hydrogen and oxygen generated in the unit-2 is not 2:1 but over 3.2:1 as is shown in Fig. 3. In the case of unit-1 (in which the incident took place), the valves had not been opened at the previous inspection and most of non-condensable gasses were replaced with hydrogen and oxygen generated in the power plant. That is to say, there were very little air (nitrogen and oxygen) in the pipe at the beginning of the restart of operation. Chubu Electric Power Company claims that the mixture ratio of hydrogen and oxygen in the non-condensable gas in the unit-1 was 2:1, based on the above mentioned measurement and also computer simulation but a rather simple and crude calculation which can be done by deducting the portion of oxygen (8.5%) reveals that the mixture ratio of hydrogen and oxygen in the unit-1 was more than 3.2. Another problem to accept the Chubu's assertion is that hydrogen which was injected into the cooling water must disappear but this is totally out of the principle of physics. In order to explain the anomalous explosion of the Unit-1, it is needed to have another way different than stoichiometric mixture of hydrogen and oxygen.

2) Extraordinary powerful explosion

According to the Tokyo Electric Power's report[4], the pressure rise was estimated to be around 50MPa, resulting in a disengagement of the connector to the pressure gage for measuring the pressure of the main steam line, but it seems no damage to the pressure gage near by. In this configuration, one end is closed but the other is open or in other words, it is like an engine without a piston. In order to have this kind of

rapid pressure rise, one must establish a new combustion or energy release mechanism.

3) Ignition starts at lower temperature

The temperature and pressure in the pipe line of boiled water reactor is around 280 centigrade and 7 MPa which is far lower temperature than the self ignition line shown in Fig 2 which was obtained for the stoichiometric mixture of molecular hydrogen and oxygen. This discrepancy is another point to be studied for identification of the cause of hydrogen explosion.

3.A CANDIDATE HYPOTHESIS: BLACK-LIGHT PROCESS BY DR. R. MILLS

Dr. Randlle Mills demonstrated that hydrogen atoms can achieve lower states than ground state by a resonant collision with a near by atom or combination of atoms having the capability to absorb the energy to effect the transition, namely, an integer multiple of the potential energy of atomic hydrogen, m×27.2eV (m=integer) (3) . He named this shrunken hydrogen atom "Hydrino" and claims that this Hydrino can be a catalyst to shrink other hydrinos to further lower states. He named this reaction the Black-Light Process. Fig 4 illustrates the Black-Light Process.

Based on his hypothesis, he succeeded in generating energy somewhat between chemical and nuclear reaction using water vapor plasma. It is conceived that hydrogen and oxygen in the steam in nuclear power plants are molecular, not atomic, but since these hydrogen and oxygen are generated due to dissociation of water by nuclear radiation, it is quite conceivable that atomic hydrogen and oxygen can co-exist with molecular ones in the nuclear power plants.

4. PROPOSED MECHANISM OF ANOMALOUS HYDROGEN EXPLOSION

The author postulated that 3 body reaction of atomic hydrogen and oxygen can make the Black-Light Process because ionization energy of hydrogen and oxygen is very close as is shown below(5,6).

Hydrogen =13.598 eV, Oxygen =13.618 eV

It can be expected that the following reactions can take place:

$O + O + H \rightarrow H[n=1/2] + 2\,O^{+} + 2\,e^{-}$ ----(a)

$H + H + O \rightarrow H\,[n=1/2] + H^{+} + O^{+} + 2e^{-}$ ----(b)

$H + H + H \rightarrow H[n=1/2] + 2\,H^{+} + 2\,e^{-}$ ----(c)

H[n=1/2] designates a hydrogen whose electron orbit is shrunken to 1/2 the radius of a normal one and these will be shrunken further to lower orbits as reaction continues.

Ions and electrons thus produced will recombine, resulting in generation of energy.

Hydrogen itself is a good candidate for catalyst, but oxygen atom is about 2 times bigger than hydrogen atom. This will give the equation (a) more chances of simultaneous multi-body collision of 3 atoms than equation (c).

It is reported that the Black-Light Process can produce up to 200W/cm3 at 700mTorr(7), but in the case of nuclear power plant, the pressure is almost 5 order bigger than the case of the Black-Light Process and it can be expect that a hydrogen explosion can produce energy about 70MW/cm3 which is powerful enough to destroy the pipeline instantaneously.

Hydrogen and oxygen are atomic only in such cases as very low pressure, very high temperature, or on the noble metal catalysts. But once atomic hydrogen and oxygen are produced and if there is not heat sink at the collision point, collision of atomic hydrogen for a instance, H + H → H2 wouldn't take place but just repulse each other. This suggests that atomic hydrogen and oxygen produced in nuclear plants can exist much longer than normally expected.

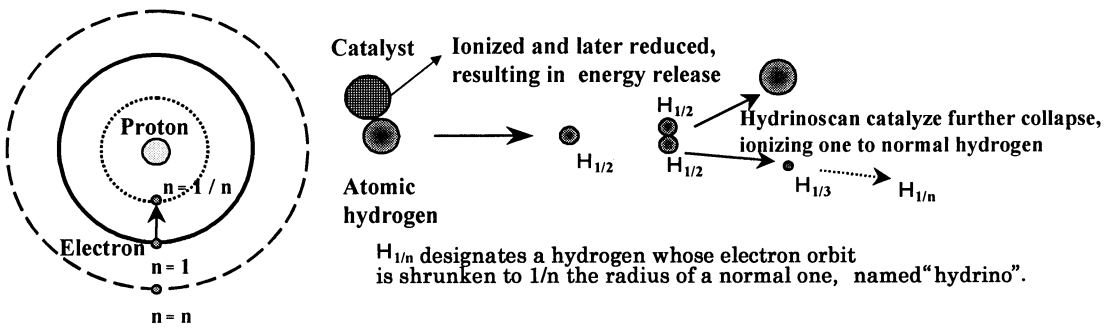

Fig. 4 Mechanism of "hydrino " generation and energy release

SUMMARY

1) Considering the magnitude and nature of damage caused by nuclear power plant's accidents, it is imperative to determine the real cause of hydrogen explosion.
2) In the case of hydrogen explosion in nuclear power plants, it is presumed that hydrogen and oxygen accumulated in the pipe are molecular and the mixture ratio is stoichiometric. But this assumption can't explain the reason why ignition starts at much lower temperature than the reconstruction test result and why the explosion is so powerful.
3) Even though there have been anomalous explosion of hydrogen and oxygen mixture in the past, the lack of plausible hypothesis hindered the research on the real cause of the explosion. But the advent of the new hypothesis namely the Black-Light Process gave us a clue to find out the real cause of hydrogen explosion.
4) It is conceived that hydrogen and oxygen in nuclear power plants are molecular, not atomic, but considering the nature of radiolysis of water, it can be assumed that atomic hydrogen and oxygen can also co-exist with molecular one and this would trigger the Black-Light Process that can produce energy somewhat between chemical and nuclear reaction.
5) It is recommended to pay much attention to the closed electrolysis of water in which noble catalysts are added for recombination of hydrogen and oxygen. In this case, pressure relief valves would not work because of a rapid pressure rise as was seen in the hydrogen explosion in Tokyo Electric Power's nuclear power plants.

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