FINAL

Report on the 2nd Meeting of the Joint Working Group on Safety for the U.S.-PRC Coordinating Committee of Fusion Energy

(U.S.-PRC Safety Monitoring Program)

Meeting in USA, November 4-17, 2010

A. PURPOSE

The purpose of the 2nd meeting of the U.S.-China Joint Working Group on Safety was to informally evaluate the programmatic aspects of environmental, health and safety (ESH) programs in US fusion research facilities by touring laboratory areas and meeting with researchers and safety professionals. Based on these interactions, the U.S.-China delegation was able to share information and provide suggestions in an effort to reduce the likelihood of bodily injury and/or property damage. In addition, good approaches and practices developed at different institutions should be utilized to improve environmental, health and safety programs at other institutions.

B. EXECUTIVE SUMMARY

Two US fusion research laboratories were visited; the Princeton Plasma Physics Laboratory (PPPL) in Princeton and the General Atomics (GA) in San Diego. The China participants in the 2nd meeting of the U.S.-China Joint Working Group conducted during November 4-17, 2010 were:

Prof. Qunying Huang, Head of Reactor Technology division, Institute of Plasma Physics, Chinese Academy of Sciences (ASIPP), Hefei, China
Dr. Yunqing Bai, Fusion Safety Analyst, ASIPP, Hefei, China
Prof. Qiang Li, Deputy Director Center of Fusion Science - Southwest Institutes of Physics (SWIP), Chengdu, China
Prof. Kaiming Feng - Deputy Director Fusion Reactor & Materials Division, SWIP, Chengdu, China

The main US participants were:

Stewart Prager	Director of PPPL
Jerry Levine	Head of Environment Safety and Health, PPPL
Rich Hawryluk	Head of ITER & Tokamaks division, PPPL
A. von Halle	Head of Engineering Operation in NSTX, PPPL
W. Slavin	Safety Engineer, PPPL
Keith R. Rule	Senior Engineer- Environmental Services
Tony Taylor	DIII-D Program Director
Peter Petersen	Assistant Program Director, Energy Group, DIII-D
Mark Foster	Field Program Representative, Office of Science, US Department of Energy
Rick Savercool	Safety Engineer, Power Dispatcher, Energy Group, DIII-D

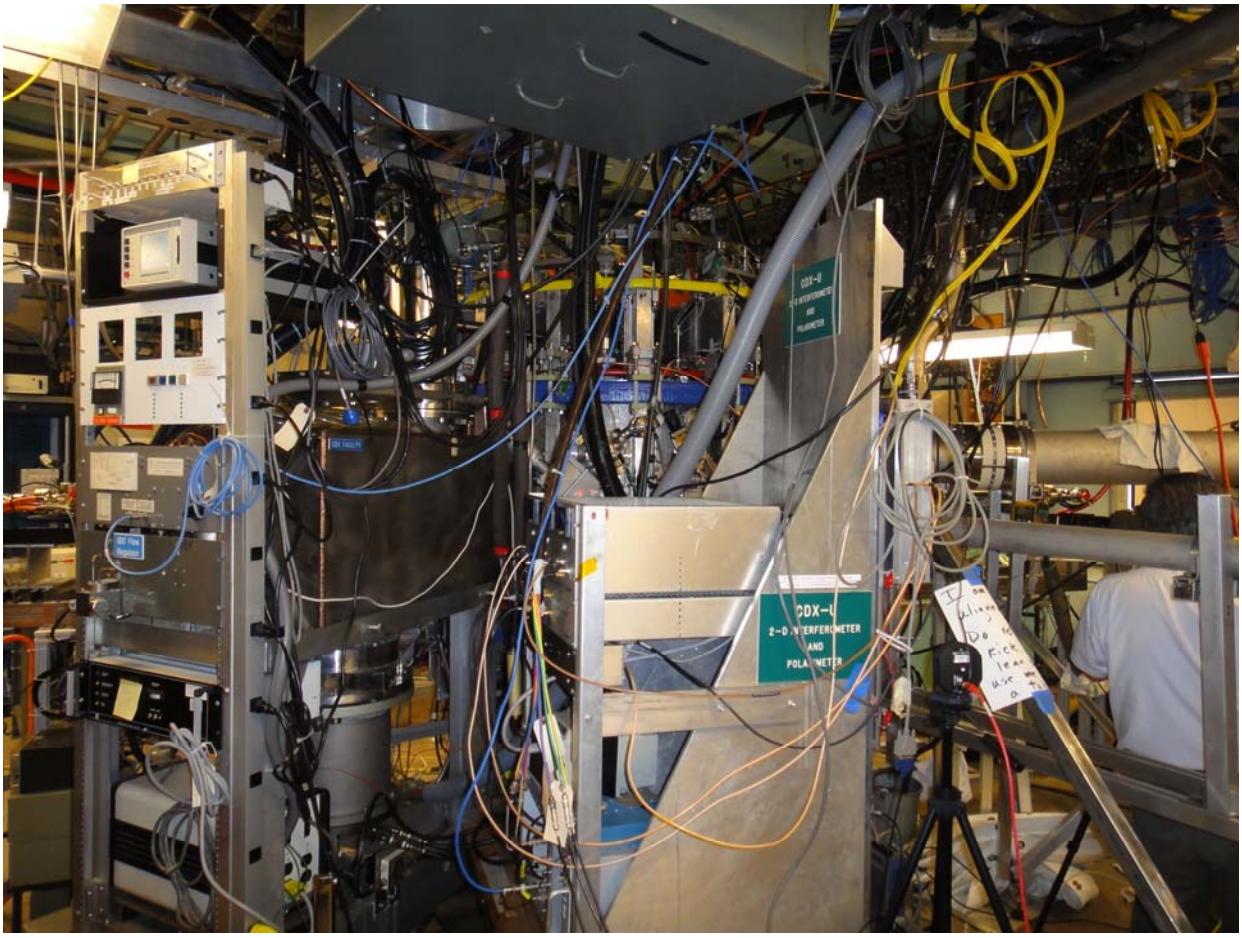
With the fast development of fusion research facilities, such as Experimental Advanced Superconducting Tokamak (EAST), HL-2A, DIII-D, NSTX etc., the cooperation between China and US has become increasingly important for fusion energy research. However, the new hazard factor may be introduced with the cooperation increasing. With regard occupational safety there are varied rules, regulation, and practices in the different institutes of U.S. and China, which can be further affected by the cultural and language difference, therefore communication and training are very important. The objective of the 2nd China-US Joint Working Group meeting and the

China participants visiting the US fusion facilities was to exchange new information from the 1st meeting in China 2009 and to witness the safety practices in US.

The two laboratories being visited have very strict safety practices. There are dedicated divisions to organize, supervise and train the safety related requirements and practices, and the leadership of the laboratories are very focused on the personal safety. The Job Hazard Analysis or Hazardous Work Authorization is used as the effective method to prevent the personal injury. Overall impressions of the research areas were very good. Most areas were clearly marked with international signs and symbols and general fusion safety practices were similar to those of China. We received some safety training files and information from our US colleagues which can also be used and provide for effect safety practices at the China laboratories.

C. Sites Visited

November 4 and 5, 2010 - PPPL



National Spherical Torus Experiment (NSTX)

The U.S. Department of Energy's Princeton Plasma Physics Laboratory (PPPL) is a collaborative national center for plasma and fusion science. Its primary mission is to develop the scientific understanding and the key innovations which will lead to an attractive fusion energy source. Associated missions include conducting world-class research along the broad frontier of plasma science and technology, and providing the highest quality of scientific education. Princeton

University manages PPPL under contract with the United States Department of Energy. The Laboratory is sited on Princeton University's James Forrestal Campus. Through its efforts to build and operate magnetic fusion devices, PPPL has gained extensive capabilities in a host of disciplines including advanced computational simulations, vacuum technology, mechanics, materials sciences, electronics, computer technology, and high-voltage power system. The number of employees at PPPL is 433 with an additional 35 graduate students. The funding for FY 2010 is about 85 million USD.

Magnetic fusion research at PPPL began in 1951 with many notable achievements and experimental devices since that time. The Tokamak Fusion Test Reactor (TFTR) operated at the Princeton Plasma Physics Laboratory (PPPL) from 1982 to 1997. TFTR set a number of world records, including a plasma temperature of 510 million degrees centigrade -- the highest ever produced in a laboratory, and well beyond the 100 million degrees required for commercial fusion. In addition to meeting its physics objectives, TFTR achieved all of its hardware design goals, thus making substantial contributions in many areas of fusion technology development. The National Spherical Torus Experiment (NSTX) began operation in 1999. It is a major element in the U.S. Fusion Energy Sciences Program. It is designed to test the physics principles of spherical torus (ST) plasmas. In 2004, record values of toroidal beta (40%) were achieved in NSTX. The Lithium Tokamak Experiment (LTX) is another notable device at PPPL, which produced the first plasma in September, 2008. The new device will continue the promising, innovative work started on CDX-U in 2000, involving the use of pure lithium metal on surfaces facing or contacting the plasma.

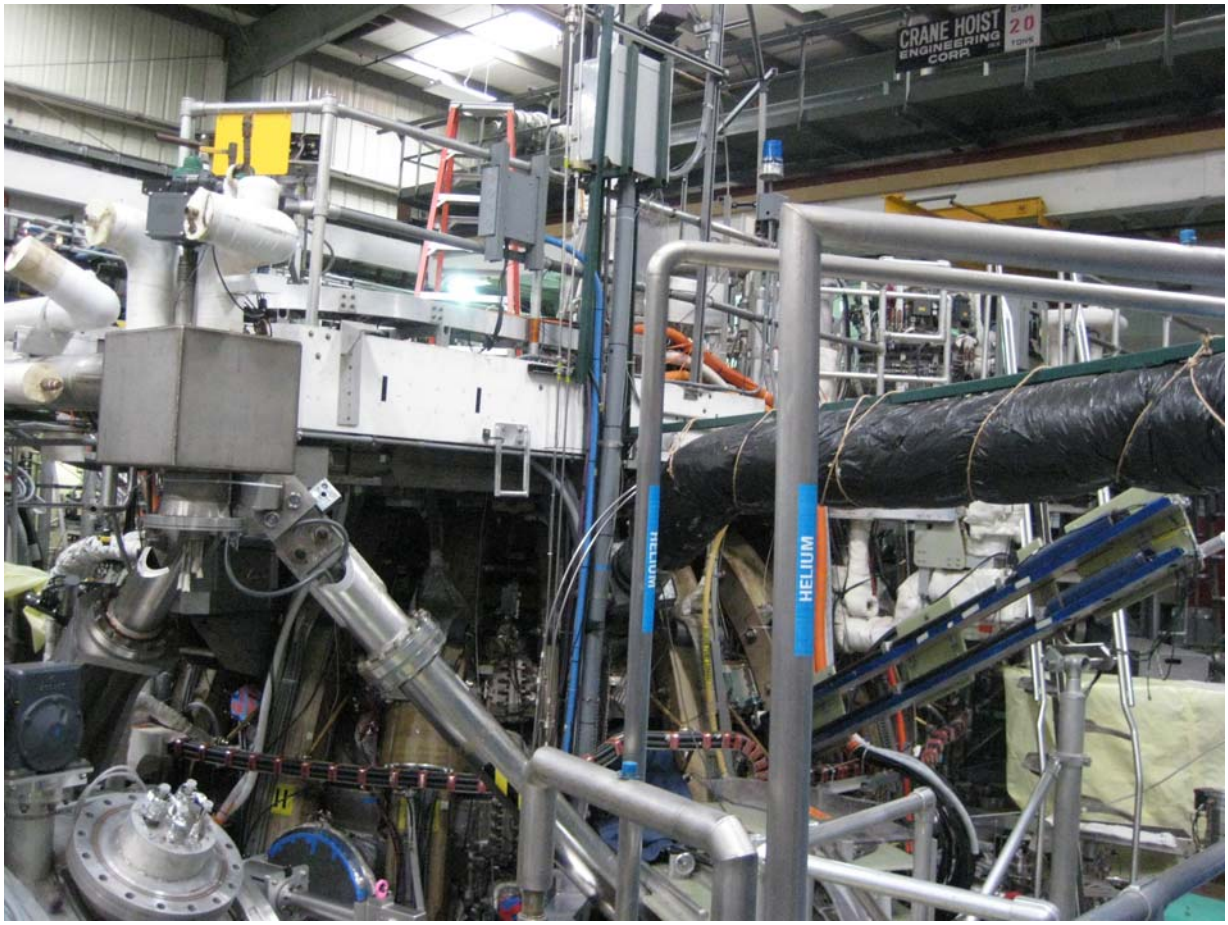
On the morning of November 4, the director of PPPL Dr Prager gave a brief talk about the overview of current & future research at PPPL. The head of ITER and Tokamaks Division Dr Hawryluk introduced the ASIPP & PPPL collaborations. Head of Engineering Operations for NSTX, Al von Halle briefed us on NSTX overview-plans for the upgrade. Prof. Huang and Prof. Li introduced the overview of ASIPP and SWIP, respectively. In the afternoon, Al von Halle conducted a tour of the experimental areas. Keith Rule accompanied us to visit the main fusion experimental devices including NSTX, TFTR test cell, neutron beam device, National Compact Stellarator Experiment (NCSX) and LTX. In the morning of November 5, safety engineer W. Slavin and Keith Rule introduced the abridged Hazard awareness program & tour of practices at PPPL and showed us the "Job Hazard Analysis" procedure and personal protection products.

PPPL has conducted technology collaborations with ASIPP. A lithium injection device was transferred from PPPL to ASIPP, and is now installed in EAST tokamak. The scientist exchange and collaboration will be frequent from China and the US. PPPL has a staff organization dedicated to safety management named Environment, Safety Health and Security to provide safety guidance for all staff. There are four sections of this department; environmental services division, health physics and nuclear MC&A, safety, and site protection. There is a very rigid set of management programs, procedures and rules. This information and PPPL's extensive experience can be used as reference at the China experiments. The Job Hazard Analysis is a very good tool for the protection of workers.

Recommendations

The safety protection program and practices are very good. There are several examples of pictogram international signs throughout many areas. It will be good if these practices can be included or expanded in all areas where collaborators are likely to be present.

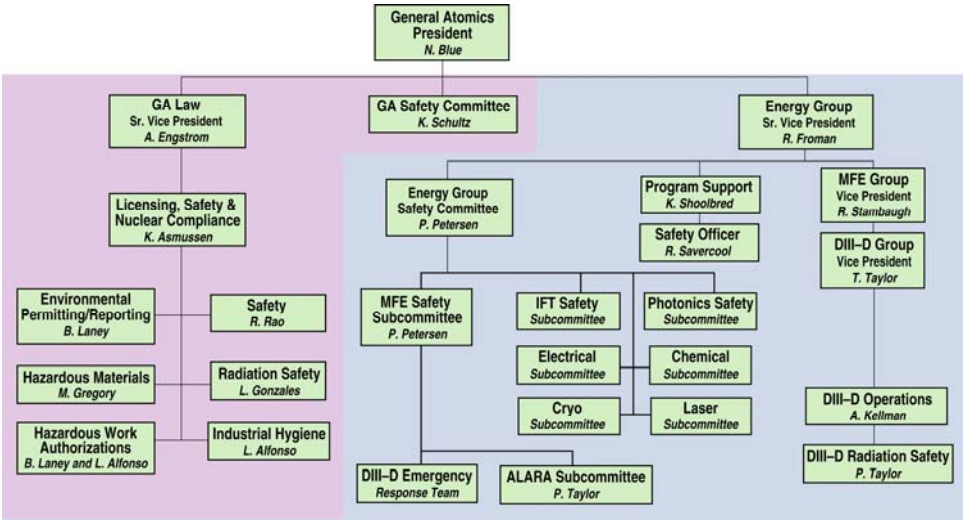
.**November 15-16, 2010 – General Atomics - GA**



General Atomics has been conducting magnetic fusion research since the 1960s and has been a pioneer in the toroidal magnetic confinement device called a tokamak. More specifically, this work has been with non-circular cross-section tokamaks including Doublet II and Doublet III and today with DIII-D. This early work led to the creation of similar machines worldwide, such as JET (UK), TCV (Switzerland), Asdex (Germany) and JT-60 (Japan).

The DIII-D Program is a large international program, with 90 participating institutions and a research team of 515 users. General Atomics operates DIII-D for the Department of Energy through the Office of Fusion Energy Sciences as a true user facility. DIII-D research has been recognized a record four times with the American Physical Society Excellence in Plasma Physics Prize.

GA has a special organization for safety management, the president takes responsibility and directs safety management. The detailed structure is listed below. Every section has special safety management, for example, the MFE safety, IFT safety and photonics safety, etc.. They considered all of the hazards such as radiation safety, nuclear safety, chemical, electricity, cryogenics, laser, and industrial hygiene. All of the staff has responsibility for safety.



The structure for safety management in GA

Neutrons and ionizing radiation are produced in the DIII-D experiment, which requires attention toward radiological safety, which includes an analysis of all radioactive source term, development of radiation limits, individual dose tablets and regular tabulation of dose every three months for all of the staff at GA. Moreover, the area around the experimental device set the neutron and γ dose detectors to detect the intensity of the radiation field, movable dose detector also have been set as well in the critical area.

A movable boron-containing water shield have been set on the upper part of DIII-D device, during the experiment period. This shield will be moved to the top of the device, if not, this shield will be moved to the other laboratories position in order not to affect the crane. This is mainly because the thickness of formal shielding wall is not enough, but the dose from the monitoring results show the current effect of shielding does meet the U.S. standards and requirements.

The removable shielding on the roof for DIII-D device

For the special security areas, such as high pressure or radiation circumstance, the safety interlock system is set and the locks are unique so that only authorized personnel have the right to open the door into the special security area. Moreover, the inflammable, explosive cylinders are placed in a special room and fixed. For the special operations, it requires at least two persons work together on the same site.

GA has developed personnel radiation dose standard which is much more strict than the national standard and the actual radiation dose to working staff is assessed every year. In the specific implementation process ensuring safety, the Integrated Safety Management is used as the first principle of security. As a guide to protect the worker, Hazardous Work Authorization (HWA) table is used to control access. Moreover, a security management organization is established for unity management, environmental impact assessment and safety training for staff. The main contents including in HWA: the definition of the scope of work, to determine all of the hazards, to define the technology to reduce consequences and preventive actions, the definition of necessary job training etc.. HWA is supervised and reviewed by the management, and periodically reviewed for the results of execution. An evaluation of HWA is executed every year and updated in special situation. Every operation department considers their own situation and writes their HWA accordingly. HWA is available and followed in every department. When

performing an operation, each department should be in accordance with the HWA and make the necessary protective preparations. Any accidents and injuries that occur in any department must be reported to supervisors. All the accidents are recorded and statistically evaluated.

D. ACKNOWLEDGEMENTS

The China JWG members would like to thank all the individuals who participated in the second meeting of the U.S.-China JWG and the informative presentations and facility tours. The China JWG members especially thank the hosting institutions for their very gracious hospitality and assistance with this. In addition, the Chinese members were very appreciative of their efforts in organizing the trip and providing guides as needed. Their attention to detail, prior to and during the trip, made the entire event both profitable and enjoyable to all.

E. AGENDAS

Future U.S.-PRC JWG exchange is planned for 2011. The teams discussed a tentative plan for the U.S. delegation to visit China in July of 2011. The US delegation is planned to include visits to ASIPP, SWIP in calendar year 2011.

Travel Schedule:

November 3, 2010- All four JWG members depart Beijing.
November 3, 2010- All four JWG members arrive Princeton US.
November 4-5, 2010-Visit PPPL.
November 6, 2010-Li Qiang and Feng Kaiming travel to San Diego.
November 6, 2010-Huang Qunying and Bai Yunqing travel to Las Vegas.
November 7-8, Li Qiang and Feng Kaiming visit GA.
November 7-11, Huang Qunying and Bai Yunqing attend TOFE-19 meeting.
November 9, Li Qiang and Feng Kaiming return to China.
November 13, Huang Qunying and Bai Yunqing travel to San Diego.
November 15-16, Huang Qunying and Bai Yunqing visit GA.
November 16, Huang Qunying and Bai Yunqing depart San Diego to Oakland.
November 20, Huang Qunying and Bai Yunqing return to China.