

**Report on the 1ST 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 China, December 9-14, 2009

Respectfully submitted on April 12, 2010 to:

**Barry Sullivan
U.S. DOE – Office of Fusion Energy Sciences**

**Professor Yican Wu, Deputy Director
Academy of Science Institute for Plasma Physics**

**Professor Yong Liu, Director
Southwestern Institute of Physics – Center for Fusion Science**

**Prepared by:
Lee Cadwallader, Rick Savercool and Keith Rule – U.S. JWG to China**

**Reviewed by:
Prof. Huang and Dr. Bai – ASIPP
Prof Feng and Dr. Luo - SWIP**

A. PURPOSE

The purpose of the 1st 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 Chinese 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 Chinese fusion research facilities were visited; the Chinese Academy of Sciences Institute of Plasma Physics (ASIPP) in Hefei and the Center for Fusion Science at the Southwestern Institute for Physics (SWIP) in Chengdu. The U.S. participants in the 1st meeting of the U.S.-China Joint Working Group conducted from December 9-14, 2009 were:

Richard Savercool, Fusion Safety Manager, General Atomics
Keith Rule, Senior Project Engineer, Princeton Plasma Physics Lab
Lee Cadwallader, Fusion Safety Analyst/Advisor, Idaho National Lab

The main Chinese participants were:

Dr. Yican Wu, Professor, Deputy Director - ASIPP
Dr. Qunying Huang, Professor, Division Leader Reactor Technology - ASIPP
Dr. Songlin Liu, Professor - ASIPP
Dr. Yunqing Bai, Associate Professor, ASIPP
Dr. Qiang Li, Professor, Deputy Director Center of Fusion Science - SWIP
Dr. Kaiming Feng, Professor, Deputy Director Fusion Reactor & Materials Division - SWIP
Dr. Tianyong Luo – Center for Fusion Science - SWIP

The Safety Monitor Program is an exchange of information between U.S. and Chinese fusion researchers to review personnel safety at fusion experiments operated in each country. This work is part of 2008 – 2010 US-PRC Fusion Cooperation Program. In order to help meet this responsibility we have initiated an exchange program involving a Joint Working Group (JWG) on Safety with our Chinese colleagues that will conduct alternating annual visits to major fusion research laboratories in China and the U.S.

Safety practices are implemented by the engineers and researchers in their areas of responsibility. There are very few full or part time dedicated safety personnel. The responsibility for safety is expressed at all levels of the staff but is ultimately the responsibility of everyone. The Deputy Director provides leadership in this area and passes this onto to the research program leaders and ultimately to the staff. This type of safety approach and culture is also prevalent at the Japanese fusion research facilities; the US JWG has observed this to be a successful approach. We should

note that in Japan formal government programs are in place along with written procedures and training programs.

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 U.S. facilities. We have identified areas for future cooperation and improvement which follow.

The U.S. safety personnel making this trip were Lee Cadwallader, a senior staff engineer from the INL Fusion Safety Program, Rick Savercool, the Fusion Safety Manager of the DIII-D fusion experiment operated by General Atomics in San Diego, California, and Keith Rule, a Senior Project Engineer from the Princeton Plasma Physics Laboratory in New Jersey. The trip itinerary and site agendas are listed in section E.

C. Sites Visited

December 10 and 11, 2009 – ASIPP



Experimental Advanced Superconducting Tokamak – EAST

ASIPP is one of five national research institutions located on Science Island in Hefei, China. The plasma physics research is funded by three separate and distinct organizations; the Ministry of Science and Technology, the Chinese Academy of Sciences and the Chinese National Nuclear Corporation. In addition to fusion energy research on EAST, the institute is deeply involved with ITER research specifically the Test Blanket Module and superconducting magnet fabrication. There is also a significant effort toward neutronics modeling and fusion-fission hybrid reactor designs. Professor Wu briefed us on overall activities of the institute's activities which were followed by several presentations on reactor design and operation, neutronics modeling, test blanket module design, liquid LiPb experimental loop design, and fusion reactor safety analysis'. The two day visit involved many detailed presentations and a walkthrough review of the EAST reactor facilities, cryogenics, power distribution, superconducting magnet fabrication, and a liquid metal flow loop test blanket module facility. A detailed agenda is in section E. of this report.

The institute employees approximately 450 staff with a compliment of an additional 500 graduate students. Graduate students receive a three day course in safety and general protocols for their familiarization prior to beginning their research. There are approximately 100 collaborators on an annual basis with less than 10 who are on site for greater than a one week period. The current safety protocol for visiting collaborators is to be assigned to a host person when working in non-office areas similar to a "buddy" system. No other formal training is available. There is one safety office on Science Island dedicated to the safety of the five research institutions with one technician who is available for safety evaluation and consultation as needed. This safety technician performs a facility safety review of EAST prior to and at the conclusion of each operational campaign. We did not meet with anyone in this office. There was no evidence of a written safety program or governing safety requirements presented during our visit although there was ample evidence of safe practices such as confined space entry controls, high voltage protection, and access controls/interlocks. In addition, there were written procedures in the form of wall postings in the power distribution areas in the Chinese language.

Recommendations

There were several examples of pictogram international signs throughout many areas and other warning signs were in Chinese and English language. We encouraged the research staff to expand the use of these practices in all areas where collaborators are likely to be present. Our hosts agreed and were willing to make this improvement.

There was ample discussion about general site training (e.g., General Employee Training), use of written procedures and instructions, and specific safety training materials for staff and collaborators. There is a particular need for development of some basic information in the English language for collaborators. All of the ASIPP people we met do speak English and this is the common language used with collaborators from any visiting country. We made an offer to send examples of the training material, used at GA and PPPL, to our JWG colleagues at ASIPP. They were willing and happy to receive the assistance. Rick Savercool and Keith Rule will provide these to Professor Wu by the end of February 2010.

There were many port covers and flanged openings at all of the facilities we visited however, few were designated or labeled as confined spaces. Confined spaces may be encountered in virtually any occupation; therefore, their recognition is the first step in preventing fatalities. Confined spaces that contain or have the potential to contain a serious atmospheric hazard should be tested prior to entry and continually monitored. We would like to suggest that the facilities consider using some form of formal, written procedure) regulations with regard to confined spaces. Representative guidance from the U.S. Occupational Safety and Health Administration (OSHA) can be provided as an example of what U.S. laboratories use.

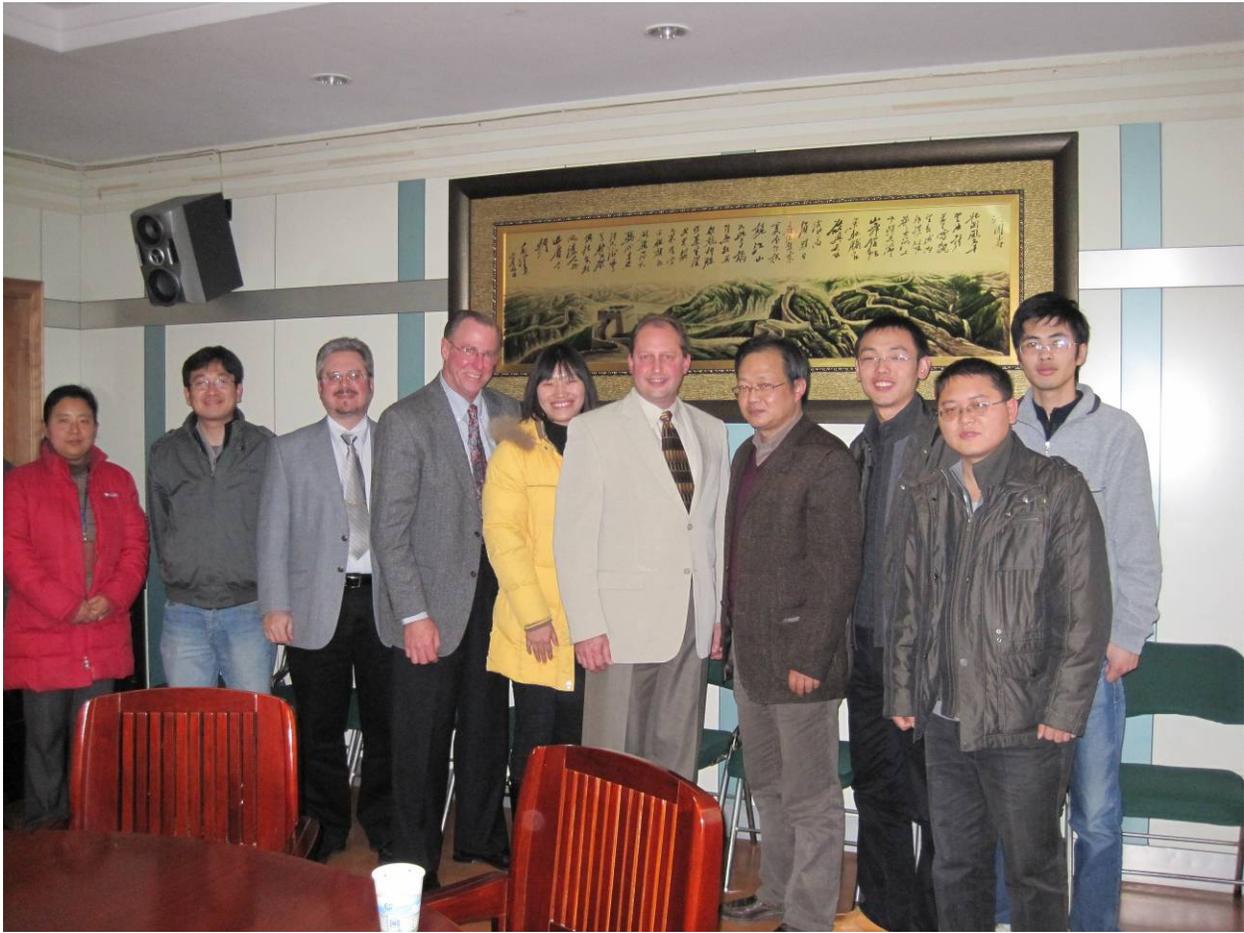
- ◆ **Specific physical safety issues called to the attention of the lab staff:**
- ◆ There was a row of capacitors in storage on the second floor of the electrical distribution building that are no longer in use. A person could easily come in contact with these capacitors and become shocked. The capacitors should be discharged and shorted. The lab staff agreed and indicated they would correct the issue.
- ◆ Gas cylinder safety is important and in need of some improvement. There were several examples of cylinders in use which were not secured. Cylinders in storage or not in use were also not secured and in some cases not capped. In both cases, catastrophic damage and/or serious injury could occur if cylinders were to be knocked over.

◆

Observations

Posted procedures were present in the electrical distribution area at EAST. The EAST team did not see any difficulty in translating their posted procedures to English and then posting in similar fashion to the Chinese language postings.

The cryogenics control room is on the second floor adjacent to the high bay area where the liquid helium tanks and compressors are located. There was only one exit door from this control room. In the event of a helium leak it is quite possible for the gas to enter this control room. It may be prudent to evaluate the need for oxygen monitoring and alarm for this control room.



Charter Review and Closeout Meeting Team

L-R – Dr. Ge Gao (Electrical), Feng Long (Magnets), Lee Cadwallader, Rick Savercool, Qin Zeng (Neutronics), Keith Rule, Prof. Songlin Liu (Engineering), Dr. Yunqing Bai (Safety Analysis), Guangfu Xu & Lingbin Hu (Cryogenics)

. December 14, 2009 – Center for Fusion Science - SWIP

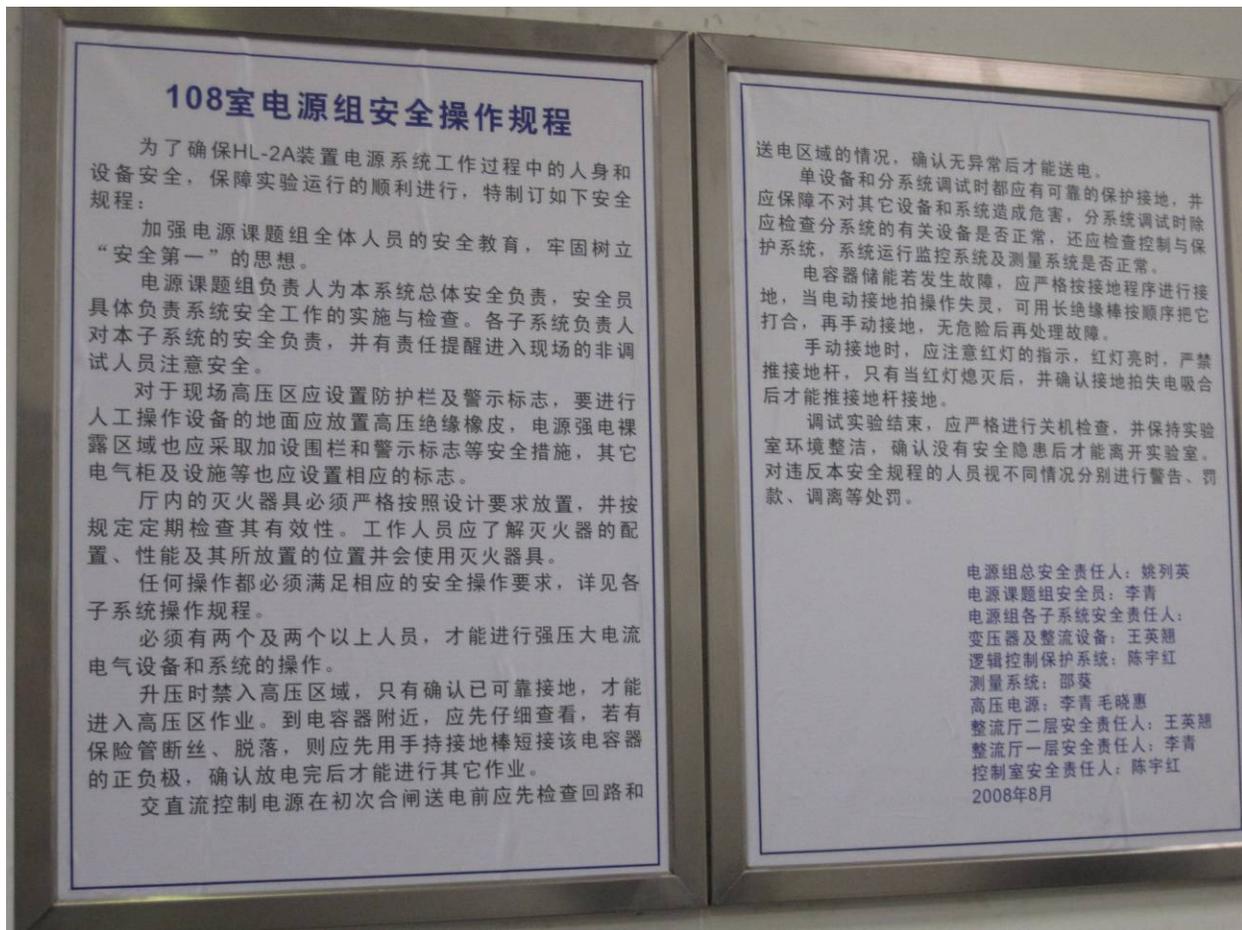


HL-2A Tokamak

The Southwestern Institute for Physics – Center for Fusion Science was established in 1965 by the Chinese National Nuclear Corporation (CNNC) and the Chinese Atomic Energy Authority (CAEA). Currently, the primary funding source is the CNNC, along with the CAEA, State Energy Bureau, Ministry of Science and Technology, and the Chinese Academy of Science. Over their history there have been 22 different fusion research devices. The current research tokamak is the HL-2A divertor tokamak with a machine major radius of 1.65 meters and a maximum field of 2.8 Tesla. They possess 1 MW of neutral beam injection with additional ECRH heating of 3 MW. Current planning is in place to add an additional 1 MW neutral beam. The machine also utilizes approximately 30 diagnostic systems. A significant design modification proposal, HL-2M, has been submitted to the funding authorities for approval with expected decision by January 1, 2010. If approved, this would result in shutdown of HL-2A for four years to provide for major construction of the modified tokamak with an increased total heating power of 20 MW.

Professor Li briefed us on overall activities of the institute's activities which were followed by several presentations on reactor design and operation, ITER design efforts, and safety administration at SWIP. The one day visit involved these presentations and a walkthrough tour of the HL-2A tokamak and support facilities. The machine was in operation and the tour of the experiment was conducted in between shots. A detailed agenda is in section E. of this report.

The institute employees approximately 300 staff which includes graduate students. There are 8 divisions within the Center for Fusion Science Graduate students receive a three day course in safety and general protocols for their familiarization prior to beginning their research. There are fewer than 10 collaborators on an annual basis at the present time. Most of whom are on site for greater than a one week period. The current safety protocol for visiting collaborators is to be assigned to a host person when working in non-office areas similar to a “buddy” system. No other formal training is available. There was no evidence of a written safety program or governing safety requirements presented during our visit although there was ample evidence of safe practices such as confined space entry controls, high voltage protection, and access controls/interlocks. In addition, there were written procedures in the form of wall postings in each of the facility areas in the Chinese language. An example is shown below.



Example of Operations procedure – Responsible persons are listed bottom right

Dr Luo provided insight on the structure of the safety program. The program is identical in philosophy to the ASIPP culture. The Deputy Director is responsible overall for the program and provides leadership and direction toward the Division Heads. The research and support staff then takes personal responsibility for action and implementation. There is an additional component at SWIP where the labour union leaders also supervise workers to include safety elements. A Safety Review is part of the facility design and this review is performed by outside personnel to approve prior to operations. A formal training program is in place for post graduate students and lasts for about one month. The training includes science, writing, safety, and

facility orientation. Luo also explained that there are qualification certificates in place for specific training courses. They also have a policy to investigate near-misses and accidents.

Recommendations

There were several examples of pictogram international signs throughout many areas and other warning signs were in Chinese and English language. We encouraged the research staff to expand the use of these practices in all areas where collaborators are likely to be present.

There was discussion about general site training (e.g., General Employee Training), use of written procedures and instructions, and specific safety training materials for staff and collaborators. There is a particular need for development of some basic information in the English language for collaborators. All of the SWIP people we met do speak English and this is the common language used with collaborators from any visiting country.

There was better attention to gas cylinder storage at this site however there were a few occasions where cylinders were not properly secured for safety when in use and caps were not used to protect the cylinder valves on cylinders in storage.

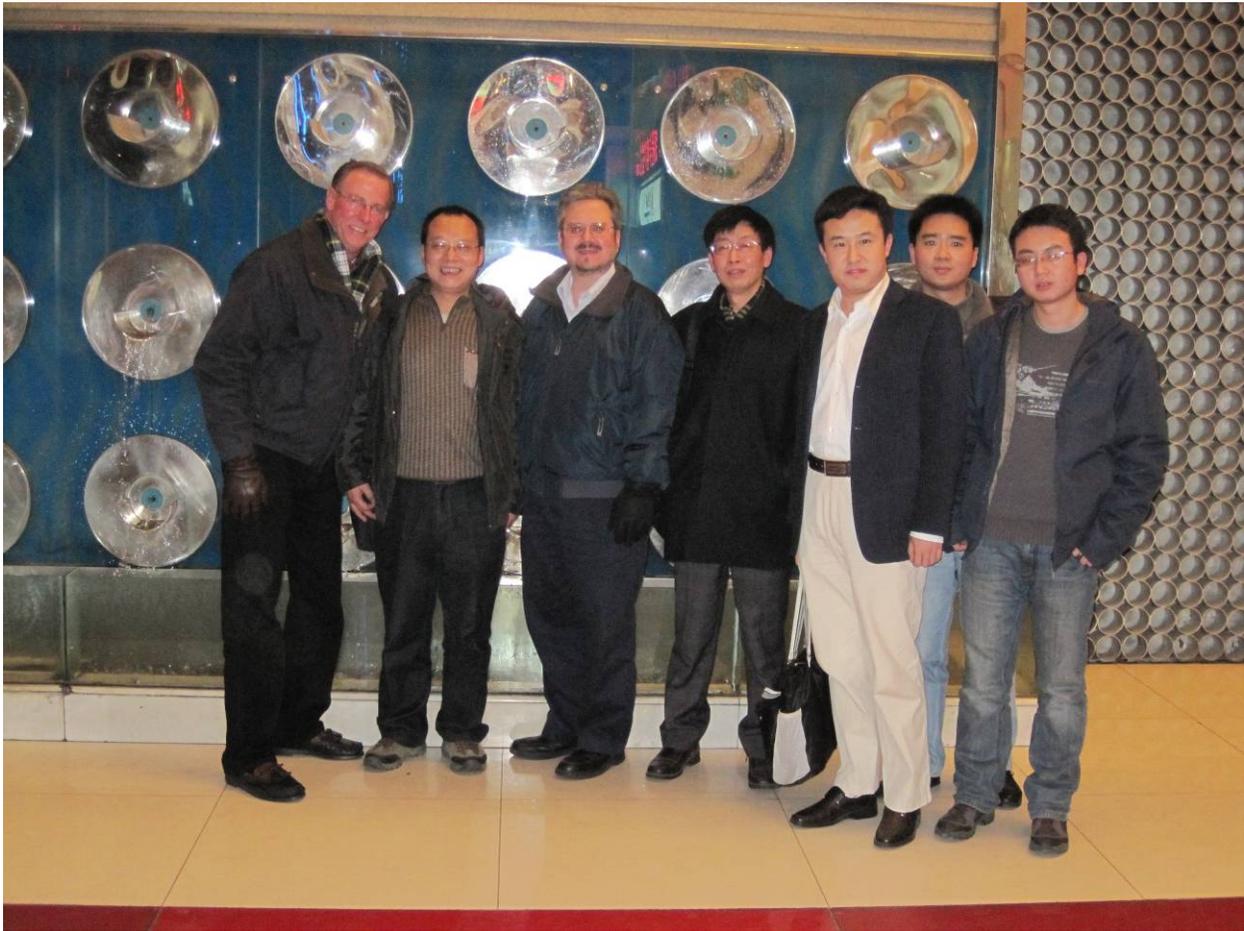
Observations/Comments

The SWIP team did not see any difficulty in translating their posted procedures to English and then posting in similar fashion to the Chinese language postings.

The HL-2A was in operation the day of our visit. There was a large operational staff present which supports the premise of an escort (“buddy”) system, when needed, for visiting collaborators.

The HL-2A machine and support rooms were clean, with little clutter, no storage items were present in aisles or stairwells.

The multiple controls rooms for electrical power, diagnostics, computer data, and the main control room although separate appeared to be quite functional and good communication between the rooms would certainly provide for proper safety.



Charter Review and Closeout Meeting Team

L-R –Rick Savercool, Prof. Qiang Li (Deputy Director), Lee Cadwallader, Prof. Kaiming Feng (Reactor & Materials), Dr. Tianyong Luo (Reactor & Materials), Yanjing Chen (SWIP), Long Zhang (Post grad student)

D. ACKNOWLEDGEMENTS

The U.S JWG members would like to thank all the individuals who participated in this first meeting of the U.S. China JWG and the informative presentations and facility tours. The U.S. JWG members especially thank the hosting institutions for their very gracious hospitality and assistance with travel. In addition, the U.S. 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 2010. The teams discussed a tentative plan for the China delegation to visit the U.S. in November of 2010. The first China delegation is planned to include visits to DII-D at General Atomics in San Diego and PPPL in Princeton, NJ. The Chinese delegates are Professor Huang and Dr. Bai from ASIPP, and Prof. Qiang Li and Professor Kaiming Feng from SWIP.

Travel Schedule:

Tuesday morning, December 8, 2009 - All three JWG members depart the U.S.

Wednesday evening, December 9, 2009 - All members arrive in Hefei, China.

Thursday, December 10, 2009 - Visit ASIPP.

Friday, December 11, 2009 - Visit ASIPP and conclude

Saturday morning, December 12, 2009 Travel on to Chengdu

Monday, December 14, 2008 - Visit Center for Fusion Science at SWIP

Monday evening – Lee Cadwallader travels to Xi An, China for ITER meeting

Tuesday morning – Rick and Keith travel to Beijing, China for return to U.S.

ASIPP – Hefei, China

From 10th December to 11th December

Time	Speaker	Title
10th December		
9:00-9:40		Arrive at ASIPP(the central meeting room of 4th floor)
9:40-10:00	Yican WU	Welcome speech and discussion of Agenda
10:00-10:30	Keith Rule	Introduction of US-CRP JWG
10:30-11:00	Keith Rule	Introduction of PPPL
11:00-11:30	Rick Savercool	Introduction of General Atomics
11:30-12:00	Lee Cadwallader	Introduction of Idaho National Laboratory
12:00-12:20	Yican WU	Introduction of ASIPP and fusion study in China
12:30-13:30		LUNCH (ASIPP Restaurant)
14:00-16:00	Xianzhu	Visit EAST Tokamak
16:00-16:30	Ge	Visit power supply
16:30-17:00	Ming ZHUANG	Visit cryostat system
17:30-20:30		SUPPER(ASIPP Restaurant)
20:30		Back to the hotel
11th December		
8:00-8:30		Arrive at CARET FDS Team
8:40-9:20	Qunying HUANG	Introduction of FDS Team
9:20-9:40	Hongli CHEN	TBM safety analysis
9:40-10:00	Yunqing BAI	Safety analysis for fusion-fission hybrid

10:00-10:15		COFFEE BREAK
10:15-10:45	Qin ZENG	Software for nuclear safety analysis
10:45-11:00	Ruifen CAO	Introduction of Accurate Radiotherapy
11:00-11:15	Pengcheng LONG	Visit Digital Simulation and Visualization
11:15-11:30	Gui LI	Visit Medical Physics Laboratory
11:30-13:30		LUNCH
14:00-17:00	Yican WU	Discuss U.S.-PRC Joint Working Group on Safety Agreement(the central meeting room of 4th floor)
17:30-20:00		SUPPER(Sanhe Holiday Hotel)
20:00		Back to the hotel

Center for Fusion Science – SWIP – Chengdu China

2009 US JWG Delegation to SWIP

Saturday, December 12th, 2009

11:05 am China Eastern Airline flight MU5435, Arrive Chengdu, Check into Kempinski hotel

Sunday, December 13th, 2009

9:00 am Tour in the city

Monday, December 14, 2009

8.30 am Depart hotel to SWIP with Zhang Long. -5:00 pm Arrive back at hotel 8.30pm Lee departs hotel to airport to fly to Xi An - China Eastern Air flight 2344

Tuesday, December 15, 2009

6:00 am Keith and Rick check-out of hotel -to airport, 8:00 am Keith and Rick depart for Beijing - United Airlines flight 5462

Agenda of Monday

Time	Title for presentation	Reporter
9 00-9:10	Welcome and short introduction	Li Qiang
9:10-1030	Presentations by guests	Keith, Rick, Lee
1030-11.00	Introduction of fusion research work in SWIP	Li Qiang
11:00-11:25	Introduction of fusion reactor related research in SWIP -	Feng Kaiming
11:25-11:50	Introduction of safety administration in SWIP	Luo Tianyong
12:00-13:30	Lunch	
13:30-14:30	Tour of facilities- HL-2A.	Li Qiang
1440-1630	Discussions	All

Contact person: Zhang Long, mobile **phone: 13881742994**