

SAFETY TRIP REPORT

ON US-JAPAN EXCHANGE PROGRAM

(FuY 2001)

**Report on the 9th Meeting of the Joint Working Group of
the US-Japan Coordinating Committee of Fusion Energy
on Safety in Inter-Institutional Collaborations
(US-Japan Safety Monitoring Program)
March 18-22, 2002**

PURPOSE

The purpose of the 9th meeting of the US-Japan Safety Monitor Joint Working Group was to informally evaluate the programmatic aspects of environmental, health and safety (EHS) programs in U.S. fusion research facilities by touring laboratory areas and meeting with researchers and safety professionals. Based on these interactions, the US-Japan delegation was 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.

EXECUTIVE SUMMARY

The Japanese delegation to the 9th meeting of the US-Japan Safety Monitor Joint Working Group consisted of the following individuals:

Yuichi Takase	Professor, Graduate School of Frontier Sciences	Univ. of Tokyo
Naoyuki Miya	Head, JT-60 Facilities Div II	JAERI
Kozo Matsushita	General Manager, Safety Div.	JAERI
Tatsuhiko Uda	Director, Safety & Env. Research Center	NIFS
Ken'ichi Takagi	Director, Facilities Div.	NIFS
Isao Ohtake	Director, Dept. of Engineering and Technical Services	NIFS

Rick Savercool, Fusion Safety Manager of General Atomics, traveled with the Japanese delegation to all sites visited. Mark S. Foster, Field Program Manager, U.S. DOE Oakland Office, participated in discussions at UCSD and GA, while Kim Abbott, Field Program Manager, U.S. DOE Berkeley Office, participated in discussions at LBNL and LLNL.

The Japanese delegation was particularly impressed by the commitment to safety by the management. At most institutions, EHS/ESH manager reports directly to the director of the laboratory. Integrated Safety

Management (ISM) is practiced at all institutions visited. DOE provides the basic guidelines of ISM, but its implementation is tailored to suit specific needs of each institution. Each institution has a comprehensive training program, which has been useful in raising awareness of hazards and reducing the number of accidents/incidents. At many institutions EHS/ESH related information is readily available.

SITES VISITED

Kick-off Meeting (Sunday, March 17, 2002, University Park Hotel at MIT)

R. Savercool (GA), Y. Takase (U. Tokyo), N. Miya (JAERI), K. Matsushita (JAERI), T. Uda (NIFS), K. Takagi (NIFS), I. Ohtake (NIFS)

- Lists of US and Japanese JWG (Joint Working Group) members and past meetings were distributed.
- History of JWG was explained by R. Savercool. Distributed documents included a copy of the LLNL memo of the asphyxia accident on MTX which prompted the establishment of the JWG, and the initial and final reports of the 1st JWG Meeting and the Charter of JWG.
- An overview of the Integrated Safety Management (ISM) was given by R. Savercool.

Comments:

- The JCO accident in Tokai has prompted reexamination of the safety program in Japan, and many changes have been made.
- There is a need to update English versions of the Safety Manuals.
- Japanese delegates are interested in learning how smaller university scale labs implement their safety programs.
- It would be useful to hear about recent accidents or near-misses and what kinds of counter measures were implemented.

MIT Plasma Science and Fusion Center (Monday, March 18, 2002)

Personnel contacted:

Miklos Porkolab	PSFC Director
Catherine Fiore	Head, PSFC Office of ES&H
Jim Irby	Alcator Experimental Group Leader
Lou DiBerardinis	Director, MIT EH&S Services
Mitch Galanek	MIT Radiation Protection Officer

- ES&H regulations are better enforced at PSFC than MIT as a whole
- PSFC has 263 total employees including 60 Visiting Scientists (long term and short term)
- PSFC has 1 Full Time Equivalent (FTE) ES&H staff
- ES&H information is available on the web

DiBerardinis/Galanek

- MIT EHS has 40 safety professionals (MIT has approximately 10,000 staff and 10,000 students)
- Reorganization of EHS is in progress
- The Radiation Protection Committee is an MIT presidentially appointed committee which provides oversight of the Institute Radiation Protection Program and is responsible for initiating disciplinary action when required.

Irby

- Alcator C-Mod uses 24MVA peak power at 13.8kV
- 225MVA generator and flywheel (2GJ stored, 300-500MJ extracted)
- 3MW LH (lower hybrid) system to be completed in about 1 year (summer 2003)
- 225kA in TF for 8T operation, twenty 6-turn plates (5MN on each arm)
- OH coaxial feedline (up to 50kA current) in 17T magnetic field
- 13 physics run weeks in FY2002 → run time will increase to 21 weeks in FY 2003

Comments:

- Good presentation, good institute-wide safety program, good relationship with Cambridge Fire Department.
- Wood floors (non-fire-retardant) are used (on mezzanine, etc.) as temporary standing surfaces where parts of the existing mezzanine had been removed during construction. Could be a fire hazard.
- Grating floor is used for mezzanine --- can save on lighting and smoke detector, but could be a hazard for dropping tools, etc.
- Rubber mats could produce toxic gas when catching on fire (being removed)
- Mezzanine should have kickboards (being installed)
- Useful to have signs in SI units (in addition to inch/pound).
- Emergency phone numbers are not posted on some phones.
- No radiation controlled area sign. Difference in Japanese and US regulations is noted. (Posting of radiation controlled area sign on access door during operation will be considered.)

- Some cables are laid on the floor (being stepped on).
- Better housekeeping is recommended.
- Cardboard boxes in front of phones and electrical distribution panels should be removed.
- No sign for fire extinguishers at some locations.
- Diborane system has no filtering before exhausting to the environment (NIFS Diborane system has filtering).
- Electrical cables are laid next to high pressure gas / water lines (15cm required in Japan).

Princeton Plasma Physics Laboratory (PPPL) (Tuesday, March 19, 2002)

Personnel contacted:

Rich Hawryluk	Deputy Director
Jerry Levine	Head, ES&H Division
Mike Williams	Head, PPPL Engineering
Charles Gentile	Head, Tritium Systems
William Slavin	Industrial Hygiene & Safety
Regina Worthy	Training Manager
Robert Sheneman	Manager, Environmental Restoration

Hawryluk

- PPPL is a Collaborative National Center (collaboration both ways, national and international)
- 31% toroidal beta achieved after PF5 error field correction
- NCSX (compact stellarator with quasi-toroidal symmetry) – strongly endorsed by FESAC
- PPPL also has university scale experiments (CDX-U/MRX)
- Large vs. small experiments: Safety standards (thought process) are the same, but implementation is different (level of documentation, reviews, etc.)

Gentile

- ISM - Feedback is important
- Training is useful to raise awareness of hazards and surroundings

Worthy/Slavin

- Training program – has direct support from the management
- Unique training for graduate students (three half-days)

- PPPL has 524 employees, including 20 ES&H professionals

Levine

- Accident/incident history was reported

Comments:

- Very good safety program
- No radiation controlled area sign around the TFTR waste water holding tank. (Not required in accordance with 10CFR835. There is no external dose, and the tritium in the water is almost always low enough to send to the sanitary sewer system.)
- Radiation controlled area boundary in the TFTR test cell was marked by ropes. Difference in the definition of radiation controlled area between the two countries was noted.
- Radiation level and tritium concentration in air are not posted.
- NSTX cell --- better housekeeping is recommended, secure more space (walkways, etc.) if possible.

University of California, San Diego (UCSD) (Wednesday, March 20, 2002)

Personnel contacted:

Stan Luckhardt	Program Leader
Charles Baker	Deputy Director, Center for Engineering Research
Robert Conn	Dean, School of Engineering
Farrokh Najmabadi	Professor
Mark Foster	DOE Field Program Manager (OAK/Berkeley Office)

Overview of the US fusion technology program was given by C. Baker. The fusion technology program is coordinated under the Virtual Laboratory for Technology (VLT) and covers the areas of plasma technology, fusion technology, advanced design, materials, and IFE technology. Program elements include:

- Ferritic steel, SiC composite
- Liquid metal wall, IFE liquid jet
- IFE target fabrication, injection system
- Refurbishment of the STAR National User Facility at INEEL is complete. "Tritium ready" milestone in March 2003.
- FIRE: lower cost option for burning plasma experiment (study started after withdrawal from ITER)
- US burning plasma program will be discussed at Snowmass, and reviewed by FESAC / NAS

- ARIES IFE study is completed. Will start a compact stellarator reactor study.

PISCES

PISCES is a unique experimental facility and is the largest component in the US plasma facing component research program. It has used Be in the past and is planning to resume Be experiments (testing of Be, C, W and thin films) under US-EU collaboration. It also has plans to test liquid Li and Ga. Prevention of exposure to Be dust is a major issue.

- Good Be handling practices and protection system are in place.
- Procedure for changing HEPA filters need to be established.
- Be monitoring device, sensitivity, and standards should be informed clearly to operators.
- Following the OSHA personnel exposure limits for exhaust to the environment.
- Medical check for operators are performed annually.

Laser Lab.

- Handling of Fluorine (poisonous gas should be exhausted through hood and stack).
- There was an unsecured gas cylinder in emergency exit hallway.

General Atomics (GA) (Wednesday, March 20, 2002)

Personnel contacted:

Ron Stambaugh	DIII-D Program Manager
Peter Petersen	Assistant DIII-D Program Manager
Rich Callis	Heating and Current Drive Manager
Randy Kuhn	Assistant Fusion Safety Manager
Mark Foster	DOE Field Program Manager (OAK/Berkeley Office)

DIII-D

- Mezzanine is made well.
- Operation calendar is useful.
- Good safety system and good posting of signs.
- Gyrotron area --- should have posting of leakage magnetic field levels and signs (maximum field of 4T at gyrotron surface)
- Good entry/exit control
- Radiation exposure inside vacuum vessel is reduced to less than 60 μ Sv/hr before access

Lawrence Berkeley National Laboratory (LBNL) (Thursday, March 21, 2002)

Personnel contacted:

Grant Logan	Director, Heavy Ion VNL
Pat Thomas	AFRD ES&H Administrator
Peter Seidl	Scientist & ES&H Coordinator (AFRD)
Frank Bieniosek	Scientist & ES&H Coordinator (Fusion)
Christine Celata	Staff Physicist
Jerry Stoker	Engineer
Kim Abbott	DOE Field Program Manager (Berkeley Office)

Heavy Ion-beam Fusion Virtual National Lab (HIF-VNL) LBNL/LLNL/PPPL

- HCX began operation in January 2002.
- NTX is designed to neutralize space charge for tighter focusing (start experiment in 2002 with PPPL ECR plasma source).
- Good ISM feedback system and LCATS (corrective action tracking system).

HCX

- “Keep Out / Caution / Area Open” sign has many burnt out bulbs (need to be replaced)
- X-ray detector on ceiling for real time monitoring (plus TLD on wall), but the minimum detection level is high (1mR).
- Some cables were hanging from the ceiling or laying on the floor. They need to be cleaned up.
- Lockout/Tagout keybox is controlled by the supervisor
- Better housekeeping is recommended in general
- The control room has been designated to be an earthquake hazard. Presently occupancy time is limited, and will be relocated to a safe area soon.
- Wood should be replaced by noncombustible material if possible.
- Upgrading of the road around the building should be considered.

Lawrence Livermore National Laboratory (LLNL) (Friday, March 22, 2002)

Personnel contacted:

Bick Hooper	Deputy Program Leader, Fusion Energy
Irene Kan	PAT Assurance Manager

Reg Wood RI, SSPX
Lary Ahle RI, Heavy Ion Fusion Source Inj. Lab
Kim Abbott DOE Field Program Manager (Berkeley Office)

- NIF has 192 beams, 1.8 MJ @ 0.35 μm .
- Budget: IFE \$7.6M + MFE \$8.7M (including \$2.6M for DIII-D and \$2.5M for SSPX).

- Good signs
- ISM accountability, feedback and improvement, self-assessment
- Safety awareness, prior planning, feedback and improvement
- Many injuries are related to computer workstations, rather than experimental devices.
- Earthquake (1 g lateral acceleration, bookshelves secured to walls)

SSPX

- Recommendation was made to connect capacitors with fused wires to prevent explosion caused by current flowing into a deteriorated capacitor from neighboring ones.
- Interlocked grounding stick holder is good.
- Black and yellow stripe tape at the edge of raised platform is recommended.
- Recommend measuring electromagnetic fields from pulsed high voltage / high current
- Magnetic field warning should be on the entrance door into the control room.

STS

- HIF ion source design document has a good descriptive cover page.
- High voltage oil tank. Perforated metal and acrylic cover are not sufficient to contain oil in event of explosion, and could result in spreading of fire. (Commercial sealed transformers have steel cover and a glass rupture disk to restrict damage.)
- Safety belt for the scissor stage was located on the wall. Suggestion was made to have the safety belt attached to the stage and make certain that it is used during work.
- STS measuring instruments were placed on high voltage tank. Should not rely on training alone to prevent accidents.

SAFETY PROGRAMS in JAPAN (JAERI and NIFS)

Miya (JAERI)

- 600 workers at Naka Establishment (including 50 foreigners)
- Need to update English version of safety manuals.
- JAERI uses international guideline for magnetic field (different from US standard: American Conference of Governmental Industrial Hygienists)

Uda (NIFS)

- There have been several electrical shock accidents and a Decaborane explosion accident. Diborane is used after this accident.
- US standards for handling FLiBe are more stringent than Japanese standards

GENERAL REMARKS

- Each laboratory has an institute-wide systematic safety program, well supported by the management.
- ISM is the basis for safety programs at DOE-funded labs.
- Feedback and improvement are important components.
- Training is emphasized (covers broad areas, some labs have a training professional and good text for training)

- In the US, it is possible to designate an area as a radiation controlled area “only during operation”.
- Should be considered in Japan too (but caution is necessary for neutron producing experiments).
- May be questionable to apply this to contaminated areas (e.g., TFTR with T contamination). PPPL posts areas with ≥ 1000 dpm/100 cm² of tritium contamination, which is 10% of the requirement in 10CFR835.

- Some facilities have better housekeeping practices than others.

- Use of wood in high voltage experimental areas has been noted. Not all wood used is fire-retardant (difference in regulations between US and Japan).

ACKNOWLEDGMENTS

The US-Japan Safety Monitor Joint Working Group members would like to thank all the individuals who participated in the facility tours. The Japanese delegation is grateful to the hosting institutions for sharing their experience and for their gracious hospitality, Gene Nardella of DOE for organizing this trip, and Rick Savercool of GA for making detailed arrangements and for his generous hospitality throughout the trip.

**Itinerary and Meeting Agenda for the US-Japan Safety Monitoring Program
March 18-22, 2002**

Saturday, March 16, 2002

Japanese delegates arrive in Boston

Sunday, March 17, 2002

18:00 JWG Kick-off Meeting (University Park Hotel @ MIT)

- Distribute and discuss the final agenda
- Distribute and discuss the original JWG Charter
- Distribute and discuss the original Points of Agreement
- Distribute and discuss previously published reports pertaining to the sites to be visited
- Presentation on ISM (Integrated Safety Management)
- Open forum

Monday, March 18, 2002

MIT Plasma Science and Fusion Center

09:00 Welcome (Prof. Miklos Porkolab, PSFC Director)

09:15 PSFC and the PSFC Environmental, Health and Safety Program (Dr. Catherine Fiore, Head, PSFC Office of ES&H)

10:30 MIT Environmental, Health and Safety Program (Lou DiBerardinis, Director of MIT EH&S Services and Mitch Galanek, MIT Radiation Protection Officer)

11:15 Alcator C Mod (Jim Irby, Experimental Group Leader)

12:45 Facility Tour

13:30 Closing Comments and Discussion

Tuesday, March 19, 2002

Princeton Plasma Physics Laboratory

9:00 PPPL Mission & History, Laboratory Population, Current Experiments & Facilities (Richard Hawryluk)

9:45 Fusion Hazards & Controls (Charles Gentile)

10:30 Safety Training: Staff/Visitors/Students (Regina Worthy & William Slavin)

- 11:00 PPPL Accident/Incident History (Jerry Levine)
- 12:15 Tour of the NSTX, TFTR D&D, L-Wing, Hall Thruster (Michael Williams)
- 13:00 Closing Comments and Discussion

Wednesday, March 20, 2002

University of California, San Diego

- 08:30 Overall Lab Activities - UCSD Faculty (Stan Luckhardt, M. Tillack and Colleagues)
- 09:15 US Fusion Technology Program (Charlie Baker)
- 10:00 Visit UCSD PISCES Lab (Stan Luckhardt)
- 10:45 Visit UCSD Laser Matter Interaction Lab (M. Tillack)
- 11:30 Closing Comments and Discussion

General Atomics

- 13:00 Welcome to GA and the Fusion Group (Ron Stambaugh)
- 13:10 DIII-D Program Highlights, Past Accomplishments, Current Activities and Future Goals
(Peter Petersen)
- 13:30 Fusion Safety Program (Rick Savercool & Randy Kuhn)
- 14:25 Tour of the DIII-D Area (Rick Savercool, Peter Petersen & Randy Kuhn)
- 15:15 Highlights of the ICF Program (Hamano)
- 15:30 Tour of the ICF Area (Hamano, Rick Savercool, & Randy Kuhn)
- 16:30 Closing Comments and Discussion

Thursday, March 21, 2002

Lawrence Berkeley National Laboratory

- 09:00 Welcome - Explanation of Current Experiments (Grant Logan)
- 09:30 History of Facility Including ICF Activities (Christine Celata)
- 10:00 Training for Visiting Scientist and Others, Total Compliment of Staff, Students and Others,
Accident and Incident History Including Lost Time Events (Pat Thomas)
- 10:30 Implementation of Operational Procedures (Frank Bieniosek)
- 11:00 Tour of HCX (Peter Seidl & Ralph Hipple)
- 13:00 Closing Comments and Discussion

Friday, March 22, 2002

Lawrence Livermore National Laboratory

- 09:00 Welcome (Bick Hooper, Deputy Program Leader, Fusion Energy)
- 09:15 Implementing Integrated Safety Management in PAT (Irene Kan, ES&H Assurance Manager, Physics and Advanced Technology (PAT) Directorate)
- 10:15 Safety Issues in Japan (presentation by Japanese Delegation)
Miya: Safety Program at JAERI
Uda: Safety Program at NIFS
- 11:00 Operational Safety in the Sustained Spheromak Physics Experiment, SSPX (Reginald Wood, Safety Responsible Individual, SSPX)
- 11:25 Tour of SSPX
- 13:00 Operational Safety in the Heavy Ion Fusion Ion Source Development Lab (Larry Ahle, Safety Responsible Individual, Ion Source Development Systems)
- 13:25 Tour of the Ion Source Development Lab
- 14:00 Closing Comments and Discussion

Saturday, March 23, 2002

Japanese delegates leave San Francisco

List of Acquired Documents

Kick-off Meeting

- Joint Working Group Member List and List of Past Meetings
- Meeting Agenda for the US Japan Safety Monitoring Program
- LLNL Memorandum on Serious Accident: Asphyxia due to oxygen deprivation while working near a nitrogen-purged system
- Initial Report of the Joint Working Group of the US-Japan Coordinating Committee of Fusion Energy on Safety in Inter-Institutional Collaborations
- Report of the Joint Working Group of the US-Japan Coordinating Committee of Fusion Energy on Safety in Inter-Institutional Collaborations
- Integrated Safety Management

MIT PSFC

- The Environmental Safety and Health Program at the MIT PSFC
- Environmental Health and Safety at MIT
- MIT Radiation Protection Program
- The MIT Environmental, Health and Safety Office
- Environment at MIT

PPPL

- Fusion Hazards & Controls
- Safety Training
- PPPL Accident/Incident History

UCSD

- Fusion Energy Science
- Fusion Energy, the 21st Century Challenge (Virtual Laboratory for Technology)

GA

- DIII-D Program Highlights, Past Accomplishments, Current Activities and Future Goals
- Overview of the Fusion Safety Program

- DIII-D Operations
- DIII-D Employee Safety Rules
- Safety within GA
- Information Guide for the DIII-D Facility
- The DIII-D National Fusion Science Facility
- Fusion Science
- Fusion Energy Science
- The Pervasive Plasma State

LBL

- HCX Start-up Procedure
- HCX Operating Procedure
- NTX Project AHD
- NTX Operating Procedure
- Integrated Safety Management at the Heavy Ion Fusion Virtual National Laboratory

LLNL

- Fusion Energy Program
- Implementing Integrated Safety Management in PAT
- Operational Safety in the Sustained Spheromak Physics Experiment
- Safety Issues for the Heavy Ion Fusion Ion Source Injector Development Laboratory at LLNL
- Integrated Safety Management System Description