# International Town Meeting on SiC/SiC Design and Material Issues for Fusion Systems
# January 18-19, 2000

## Oak Ridge National Laboratory

***(Updated January 11, 2000)***

**Objective and Scope**

The major objective of the meeting is to bring together the SiC/SiC design and material communities from Japan, the EU and the US to exchange information, identify the design-related critical issues, discuss them in light of the latest material R&D results, and provide guidelines to help focus future effort. Given that SiC/SiC is being viewed by many as a high risk but high payoff candidate for structural material in a fusion device, it is hoped that the high payoff will clearly emerge out of the design-related presentations and that the material presentations will identify the current knowledge base for SiC/SiC. With both design goals and material development status summarized, the discussion session will focus on developing a material R&D roadmap to address the key challenges giving rise to the high risk.

It is intended to have about 25% of the meeting scheduled for design-related presentations, about 55% scheduled for material-related presentations and about 20% scheduled for discussion topics addressing the above-mentioned meeting objectives. A visit of the SiC/SiC manufacturing and testing facilities at ORNL is also being planned.

In order to help focus the materials presentations, it should be emphasized that proposed designs utilizing SiC/SiC as structural material are based on the use of high temperature He or liquid metal (e.g., Pb-Li) as the coolant with the SiC/SiC operating in the temperature range of about 600-1000°C. Although data on low-temperature compatibility and irradiation performance is of interest from a scientific point of view, such data may not be relevant to this particular meeting unless the lower temperature data (<600°C) can be extrapolated through models to the higher temperatures of interest.

**List of Participants**

**EU**

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Bill Wiffen (DoE), FW.Wiffen@science.doe.gov
Steve Zinkle (ORNL), zinklesj@ornl.gov

## Agenda

*(Each speaker is kindly requested to plan on leaving about 5 minutes of the assigned presentation time for discussion.)*

**Tuesday January 18, 2000 in Room 240, Building 4515 (HTML) at ORNL (X10 site)**

**Administrative**

| | | |
|---|---|---|
| 8:30 | Welcome and introductory remarks | B. Wiffen |
| 8:40 | Administrative items and review of agenda | S. Zinkle/R. Raffray |

**Design Concepts** *(Chairman: R. Raffray)*

| | | |
|---|---|---|
| 8:50 | DREAM blanket concept | S. Nishio |
| 9:20 | Advanced helium cooled pebble bed blanket with SiC/SiC as structural material | L. Boccaccini |
| 9:50 | TAURO blanket system | H. Golfier |
| 10:20 | **Break** | |
| 10:35 | A design studies perspective on advanced materials | M. Tillack |
| 11:05 | ARIES-AT blanket and divertor concepts | R. Raffray |
| 11:35 | Nuclear and activation issues for SiC/SiC | L. El-Guebaly |
| 12:05 | Design guidelines and analysis | M. Billone |
| 12:20 | **Lunch** | |
| 1:20 | Modeling of SiC/SiC composite structures | G. Aiello |
| 1:50 | Life prediction methodology for ceramic matrix composites | S. Case |

**Status of Materials R&D** *(Chairman: R. Jones)*

| | | |
|---|---|---|
| 2:20 | Overview of Japan effort on SiC | A. Kohyama |
| 2:35 | Overview of US effort on SiC | R. Jones |

**Fabrication and Joining** *(Chairman: R. Jones)*

| | | |
|---|---|---|
| 2:50 | SEP SiC/SiC effort | F. Abbé |
| 3:20 | MER SiC/SiC fabrication | M. Kowbel |
| 3:50 | **Break** | |
| 4:05 | SiC/SiC alternate fabrication method | A. Kohyama |
| 4:20 | SiC/SiC joining | C. Lewinsohn |
| 4:50 | Joining of SiC/SiC to SiC/SiC | Y. Katoh |
| 5:20 | Joining of SiC/SiC to other material | A. Hasegawa |
| 5:50 | **Adjourn** | |
| 7:00 | **No-host dinner** | |

**Wed. January 19, 2000 in Room 240, Building 4515 (HTML) at ORNL (X10 site)**

**Baseline Properties** *(Chairmen: M. Billone/L. Snead)*

| | | |
|---|---|---|
| 8:00 | SiC/SiC thermo-physical properties (including thermal conductivity, effective elastic constants and stress-strain behavior beyond elastic range) | Y. Katoh |
| 8:30 | SiC/SiC thermo-physical properties including creep strength | E. Lara-Curzio |
| 9:15 | SiC/SiC creep strength | H. Serizawa |
| 9:30 | SiC/SiC fiber properties | R. Jones/C. Lewinsohn |
| 9:45 | SiC/SiC compatibility with He coolant | R. Jones/ E. Lara-Curzio |
| 10:05 | SiC compatibility with Pb-Li | T. Terai |
| 10:30 | **Break** | |
| 10:45 | FZK activities on compatibility tests of SiC/ Ceramic Breeder, Beryllium and Pb-17Li | L. Boccaccini |
| 11:05 | Irradiation effects on SiC/SiC (including baseline properties, irradiation creep and transmutation products) | R. Jones/L. Snead |
| 11:30 | Irradiation effects on SiC/SiC (including baseline properties, irradiation creep and transmutation products) and lifetime limiting mechanisms | A. Hasegawa |
| 11:55 | "Irradiation Testing of SiCf-SiC Composites at HFR Petten" | P. de Heij |
| 12:10 | Lifetime limiting mechanisms | Y. Katoh |
| 12:25 | Planned activities at FZK on failure mechanism and -rate of SiC composite | L. Boccaccini |
| 12:40 | **Lunch + Tour of ORNL SiC facility** | S. Zinkle |

**Discussion**

| | | |
|---|---|---|
| 2:30 | Summary of design operating conditions to achieve high performance.<br>Summary of potential design limits (e.g., T, pressure, time, dpa, He, etc.) based on current materials knowledge base.<br>Roadmap for material R&D based on design goals, current R&D programs, and R&D resources. | M. Billone/R. Raffray |
| 5:30 | **Adjourn** | |

**Badges**

Please forward the following information as soon as possible to Gabrielle Burn (e-mail: burngl@ornl.gov) so that she can start the necessary paperwork for the issuance of visitors' badges at ORNL:

U.S. visitors, please provide the following information:

Full name:
Employer Name:
Employer Address:
Dates to visit ORNL:

Foreign visitors, please provide the following information:

Full name:
Date of Birth:
City of Birth:
Passport Number:
Passport Expiration Date:
Employer Name:
Present Position:
Address:
Dates to visit ORNL:

**Hotel and Transportation**

A block of rooms has been reserved at the following hotel under the name Silicon Carbide, ORNL:

Garden Plaza Hotel
215 South Illinois Avenue
Oak Ridge, TN 37830.
Tel. (865) 481-2468.

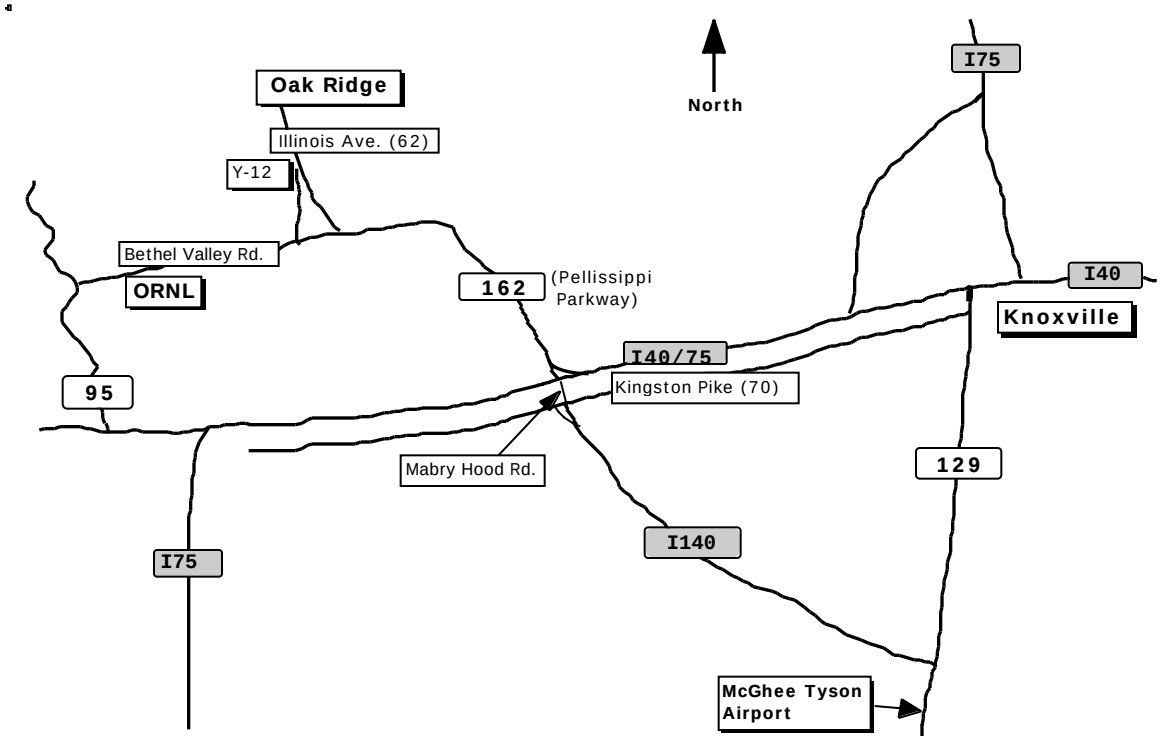
The rate is $55.00 plus tax. Please contact the hotel directly to make your reservation but please note that the cut-off date for making reservations is January 3, 2000.

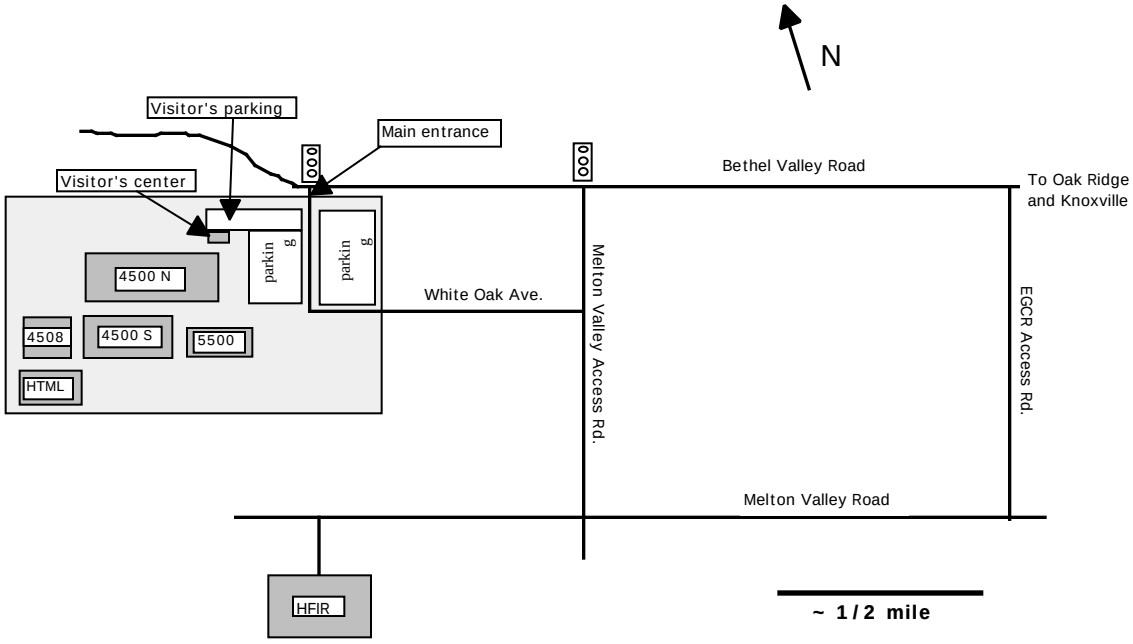
Transportation to and from ORNL or your hotel from the Knoxville airport will be by Executive Sedan and Limo (Tel. (800) 432-7923). The cost is $30.00 each way per person. If there are two or more people, the cost is $20.00 per person.

For those of you renting a car, please find below simple maps of the Oak Ridge area. They show the best route to take from the Knoxville airport to the Garden Plaza hotel in Oak Ridge, and also how to get from the hotel to ORNL (you can ask for more detailed directions from the car rental agency at the airport and from the hotel front desk in Oak Ridge). From the Knoxville airport, the shortest path to Oak Ridge is to go north (towards Knoxville) on Highway 129 about 2 miles, then take the express highway 162 (interstate 140) to Oak Ridge (~18 miles). There is a traffic light when interstate 140 changes into Pellissippi Parkway (highway 162) about halfway along your journey. Turn left onto Pellissippi Parkway and follow the signs to the city of Oak Ridge (~10 miles). The Garden Plaza hotel is located on the right side of Illinois Avenue (highway 62) approximately 1 mile after you enter the city of Oak Ridge.

To reach ORNL from Oak Ridge, take Illinois Avenue south to Scarboro Rd (right turn) and then, after traveling ~2 miles, turn right on Bethel Valley Rd. (see attached map). ORNL is about 6.5 miles after you turn onto Bethel Valley Road. Turn left at the main entrance to ORNL, and follow the (small!) signs to the visitor's parking area. You can pick up your badge in the visitors reception building (see map). Please allow 15 minutes for the trip from the hotel to ORNL and about 15 more minutes for the badge-issuance procedure. On Tuesday January 18, Dr. Steve Zinkle will be at the visitors reception building at 8:15 am to guide visitors to the meeting room (Room 240, Building 4515 (High Temperature Material Laboratory), ORNL (X10 site)).

## Maps


Oak Ridge
North
I75
Illinois Ave. (62)
Y-12
Bethel Valley Rd.
ORNL
162
(Pellissippi Parkway)
I40
Knoxville
I40/75
Kingston Pike (70)
95
Mabry Hood Rd.
129
I140
I75
McGhee Tyson Airport


N
Visitor's parking
Main entrance
Visitor's center
Bethel Valley Road
To Oak Ridge and Knoxville
parking
parking
4500 N
White Oak Ave.
Melton Valley Access Rd.
EGCR Access Rd.
4508
4500 S
5500
HTML
Melton Valley Road
HFIR
~ 1/2 mile

**Contact**

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The meeting is graciously hosted at Oak Ridge National Laboratory under the coordination of Dr. Steve Zinkle. Please address any questions about logistics (transportation, hotel, badges, etc…) to Dr. Zinkle's secretary:

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