

ANNUAL REPORT FOR THE YEAR 2008

OF THE

INTERNATIONAL ENERGY AGENCY IMPLEMENTING AGREEMENT FOR ENERGY CONSERVATION AND EMISSIONS REDUCTION IN COMBUSTION

prepared by the
Executive Committee Secretariat

for

Jay Keller, Agreement Operating Agent
Sandia National Laboratories - California

Program of Research

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Sandia National Laboratories – California

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EXECUTIVE ABSTRACT

YEAR 2008 ACTIVITIES OF THE EXECUTIVE COMMITTEE

A TRIBUTE TO PROFESSOR JUERGEN WARNATZ

A SUMMARY OF RESEARCH ACTIVITIES

EXECUTIVE ABSTRACT

The purpose of the IEA Implementing Agreement on Energy Conservation and Emissions Reduction in Combustion program is to improve fundamental and applied combustion technology which is developed to provide predictive design capabilities for internal combustion engines, furnaces, and gas turbines. This document summarizes the progress made in agreement year 2008.

Since 1978, IEA cooperative research by program participants has focused on developing experimental and computational tools to aid combustion research and on developing advanced laser-optical diagnostic tools that permit in situ, time- and space-resolved measurements of combustion phenomena for achieving this end. The Agreement's Annex 1 has been planned to improve the modeling and simulation processes as well as the instrumentation required for the supporting experimental activities.

Programs of applied research are carried out in one or more of the following areas:

- Advanced piston engine technology;
- Furnaces and boilers;
- Fundamentals
- Advanced turbine technology

New collaborative multi nation initiatives are under way in the areas of hydrogen enriched lean premixed combustion for ultra-low emission gas turbines, fuel sprays, hydrogen-fueled internal combustion engines, nano-particle diagnostics, alternative fuels, and fuels for homogeneous charge compression ignition (HCCI) engines.

YEAR 2008 ACTIVITIES OF THE EXECUTIVE COMMITTEE

The Executive Committee (ExCo) of the International Energy Agency's (IEA) Program of Research, Development and Demonstration on Energy Conservation and Emissions Reduction in Combustion coordinates the cooperative efforts undertaken by participating institutions. The Committee met twice during the business year 2008. The first meeting was held at IEA Headquarters in Paris, France, in May; the second took place following the Agreement's Thirtieth Task Leaders Meeting in September in Capri, Italy.

Actions taken by the Executive Committee this year include:

Tribute to Professor Juergen Warnatz:

In 2008 our friend and colleague, Professor Juergen Warnatz passed away. To honor his memory and recognize his many contributions to the International Combustion Research Community a series of presentations from several of his friends and collaborators was included in the program of the Thirtieth Agreement Task Leaders Meeting held in Capri, Italy in September.

Membership in the Agreement:

The unanimous approval of Korea's application to join the Agreement

30 Year Anniversary Report:

Publishing a report summarizing the highlights from the third decade of the Agreement's Collaborative Combustion Research Activities

Task Leaders Meeting:

The Thirtieth Leaders Meeting, sponsored by the Executive Committee which was held at the Hotel La Palma in Capri, Italy in September. Principal Investigators, Executive Committee members, and invited guests gathered to hear papers presented on the Agreement's research

Executive Committee Meetings:

Minutes of the Executive Committee's meetings of May and September have been published and distributed to IEA Headquarters and to ExCo members. The Proceedings of the Thirtieth Task Leaders Meeting were published and distributed to IEA Headquarters and Executive Committee members for distribution to participants. The Agreement's 2007 Annual Report and 30 Year Anniversary Report are available on the public web site.

Agreement Leadership:

At its September meeting, the Executive Committee unanimously chose as Chairman, Mr. Gurpreet Singh of the United States to direct the Agreement's activities for the forthcoming year, 2008 - 2009. Dr. Bernt Gustafsson of Sweden was elected vice-chair.

Future Meetings:

The Executive Committee scheduled its 2009 meetings for April 2009 at IEA Headquarters, Paris and September 2009 in Lake Louise, Canada. The September meeting will be held immediately following the 31st Task Leaders meeting and at the same location.

Executive Committee members and their alternates as of September 30, 2008 were

BELGIUM	Dr. Philippe Ngendakumana
Alternate:	Dr. Barbara Pesenti
CANADA	Prof. Ömer L. Gülder
Alternates:	Mr. Gregory, J. Smallwood and Dr. Kevin Thomson
FINLAND	Prof. Martti Larmi
Alternate:	Mr. Heikki Kotila
GERMANY	Prof. Frank Behrendt
ITALY	Prof. Felice E. Corcione
Alternate:	Dr. Gerardo Valentino
JAPAN	Prof. Yasuo Moriyoshi
Alternate:	Prof. Tomio Obokata
KOREA	Prof. Choongsik Bae
Alternate:	Prof. Kyoungdong Min
NORWAY	Dr. Marie Bysveen
Alternate:	Prof. Ivar S. Ertesvag
SWEDEN	Dr. Bernt Gustafsson
Alternates:	Prof. Marcus Alden and Dr. Sven-Inge Moller
SWITZERLAND	Dr. Sandra Hermle
Alternates:	Mr. Stephan Renz and Dr. Peter Jansohn
UNITED KINGDOM	Prof. Douglas Greenhalgh
Alternate:	Prof. Phillip Hutchinson
UNITED STATES	Mr. Gurpreet Singh

For the 2008 Agreement Year, the Operating Agents for the Energy Conservation and Emissions Reduction in Combustion Implementing Agreement were Drs. Jay Keller and Dennis Siebers, Sandia National Laboratories, Livermore, California, USA.

Effective December 1, 2007 the Executive Committee accepted with regret the resignation of Dr. Keller due to a shift in his management responsibilities at Sandia. He was replaced by Dr. Dennis Siebers also from Sandia.

Dr. Robert J. Gallagher has been engaged by the Executive Committee to fulfill the administrative responsibilities of the Operating Agent. The Agreement's administrative liaison at IEA Headquarters, Paris is Mr. Thomas Kerr.

A TRIBUTE TO PROFESSOR JUERGEN WARNATZ

[Professor Juergen Wolfrum](#)
[Professor Frank Behrendt](#)
[Professor Masanobu Maeda](#)
[Dr. Corcione](#)
[Professor Hutchinson](#)

SUMMARY OF RESEARCH ACTIVITIES

AREA 1 ADVANCED PISTON ENGINE TECHNOLOGY

SUBAREA 1.1 INDUCTION PROCESSES

No active Subtasks

SUBAREA 1.2 FUEL-AIR MIXING

1.2C Italy
[Air Motion Investigation in Diesel Engines](#)

1.2H Finland
[Fuel Spray Modeling for Diesel Combustion Simulation](#)

1.2K1 Collaborative Task
[Sprays in Combustion](#)

Japan
[Large Eddy Simulation of Diesel Spray Flame using KIVALES with Flamelet Model and CIP Scheme](#)

Japan
[Characteristics of Spray and its Surrounding Flow Initiated from a Swirl Spray](#)

Italy
[Investigation on Diesel Spray Stability from a Heavy Duty Common Rail Injection System](#)

Finland

[Recent Progress in Implicit Large-Eddy Simulation of Fuel Sprays with Focus on Droplet Size Effects](#)

SUBAREA 1.3 IGNITION

No active Subtasks

SUBAREA 1.4 FLAME PROCESSES

1.4G Japan

[Investigate Combustion in Premixed Charge Spark/Compression Ignition Engines](#)

SUBAREA 1.5 EXHAUST PHENOMENA

1.5F Japan

[Spray and Combustion in Diesel Engine](#)

SUBAREA 1.6 COMBUSTION PERFORMANCE AND CHARACTERISTICS OF FUELS

1.6A Collaborative Task

Homogeneous Charge Compression Ignition (HCCI)

Sweden

[HCCI - Fuel](#)

Korea

[The Effect of Mixture Conditions on HCCI Engine Combustion Fueled with Gasoline/LPG/DME](#)

UK

[Combustion and Emissions of Dieseline in a Direct Injection HCCI Engine](#)

Japan

[Development of Gasoline HCCI Using Exhaust Gas Blow-Down Super Charging System](#)

Finland

[New Combustion Technology](#)

Japan

[Two-stage combustion - multipoint autoignition of end gas region of natural gas and air mixture without knock](#)

Italy

[Compression Ratio Reduction effect on LD Diesel Engine Running in PCCI Combustion](#)

Japan

[Investigation of Controlling PCCI Combustion Process in Consideration of Heterogeneity of Mixture](#)

U.S.

[Effects of Jet-Bowl and Jet-Jet Interactions on Late-Injection Low-Temperature Heavy-Duty Diesel Combustion](#)

1.6B1 Collaborative Task

Advanced Hydrogen Fueled Internal Combustion Engines

Japan

[Combustion Method of Diesel Engine Fueled with Hydrogen for High Efficiency](#)

Japan

[Knock Visualization and chemiluminescence analysis in a hydrogen spark-ignition engine](#)

Korea

[Effect of Hydrogen in DME HCCI Combustion](#)

France

[The effect of hydrogen enrichment in strong dilution](#)

U.S.

[Laser-based imaging at Sandia to understand the in-cylinder processes in a DI-H2 ICE](#)

AREA 2

ADVANCED FURNACE TECHNOLOGY

SUBAREA 2.1

BURNER PHENOMENA

2.1H Belgium

[Investigation on Combustion in Oil Burner Flames](#)

2.1I Belgium

[Study of Combustion and Heat Transfer Phenomena in Industrial Furnaces Fired with Gas Burners using Preheated Air](#)

SUBAREA 2.2

GAS FLOWS

No active Subtasks

SUBAREA 2.3

FUEL-AIR MIXING

No active Subtasks

SUBAREA 2.4

FLAME PROCESSES

2.4F Belgium

[Chemical Kinetics Studies of Flames and Soot Formation](#)

SUBAREA 2.5

POSTFLAME PROCESS

No active Subtasks

AREA 3

FUDAMENTALS

SUBAREA 3.1

TURBULENT REACTING FLOWS

3.1C Norway

[Turbulence Modeling, EDC and Finite Rate Detailed Chemical Kinetics for Application to Low Reynolds Number Wall Bounded Reactive Flows](#)

3.1D Japan

[Analysis of Turbulent Combustion Flows](#)

SUBAREA 3.2

PHYSICAL AND CHEMICAL PROCESSES

No active Subtasks

SUBAREA 3.3

NUMERICAL MODELING

No active Subtasks

SUBAREA 3.4

DIAGNOSTICS

3.4A Italy

[Investigation by optical techniques of the effect of hydrogen addition in rich premixed ethylene-air flames](#)

3.4B Japan

[Investigate Dynamic Spray Characteristics by Image Processing](#)

3.4D Sweden

[Thermographic Phosphors for Temperature Measurements](#)

AREA 4

ADVANCED GAS TURBINE TECHNOLOGY

SUBAREA 4.1

COMBUSTION MODELING AND VERIFICATION

4.1A Collaborative Task

Hydrogen Enriched Lean Premixed Combustion for Ultra-Low Emission Gas Turbine Combustors

Sweden

[Activities in the Lund University High Pressure Combustion Rig and Low Swirl Flame Measurements](#)

Switzerland

[Combustion of hydrogen \(en-\) rich \(ed\) fuel gases in gas turbines](#)