IFRF

Annual Report 2012 to members

INTERNATIONAL FLAME RESEARCH FOUNDATION

IFRF Doc N° K63/y/12
Livorno, June 2013

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2012 HIGHLIGHTS

Technical

- Research activity on oxy-coal burner scale-up criteria and thermochemical biomass conversion started in the frame of European Commission FP7 **RELCOM** and **BRISK** projects
- Isothermal Plug Flow Reactor produces characterisation results on different coals and biofuels; development of **IFRF** online Solid Fuel Database continues
- Results of the EU FP7 Project **DEBCO** - Demonstration of Large Scale Biomass Co-Firing and Supply Chain Integration disseminated
- Development of measurement probes and new instrumentation continues
- 4 technical reports issued and 5 papers published
- Young researchers from Europe hosted at **IFRF** during tests

Management and organisation

- Joint Committee ratifies Strategy plan at JC 159
- **RELCOM** and **BRISK** projects kick off
- Alternate **IFRF** Vice President elected
- Monday Night Mail upweighted to include biweekly international news round up
- **IFRF** 17th International Member Conference held in Maffliers, France

Photo: At the IFRF 17th International Member Conference
IFRF Superintendent of Research, Neil Fricker and Lynda Porcheron (EDF)

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Photo: Member Conference entertainment after the gala dinner

Membership

During 2012 Organisational Member numbers remained relatively stable at around 130 industrial and academic realities across Europe, the Americas, and Australia, representing some 1000 individuals.

After the ratification of the Membership Structure proposal at JC 159 in June, activity began around the recruitment of Individual Members. The proposal was elaborated into appropriate communications materials and the relevant database modifications were made.

Exploratory articles were published in MNM and a discussion group on Linked In was established. By year end a small group of individuals had been recruited into the AMG and AFRC groups. Work began on the creation of a clear policy to be tabled at JC 160, after which activity in this area will intensify.

Photo: Member Conference delegates wait to be entertained after the gala dinner

GENERAL SECRETARY'S STATEMENT

2012 saw the continuation of the severe financial crisis in Europe and another challenging year for the combustion community. **IFRF** was able nevertheless to create significant value for Members both from the research perspective and in terms of providing networking opportunities.

As the year began, it was all hands on deck as work started on two important European research programs, **RELCOM** and **BRISK**, EU funded projects in which **IFRF** was granted partner status late in 2011 and which will each provide some 500 k€ over their four year lifetimes.

From a technical point of view, both projects promise to bring significant benefit to our Members. In the context of **RELCOM**, **IFRF** is in a position to further develop previous research into oxy-combustion, whilst **BRISK** enables our involvement in activity around thermochemical biomass conversion. Both of these themes will be explored in open technical meetings over the coming years, and project outcomes will also be shared with Members as information becomes available and also at the end of the period. In the case of **BRISK** specifically, our involvement also permits us to offer Members funded access to joint research and networking activities through a transnational access mechanism.

The key event in the 2012 **IFRF** Calendar was our 17th International Member Conference which took place in Maffliers, France in June. Entitled "Clean and Efficient Fuel Conversion in Industry" the conference attracted an international spread of delegates including many non **IFRF** Members who were particularly welcome. For the first time ever, sponsor participation was invited and enthusiastically taken up. This is an extremely positive signal and I am glad to note the development of a trend in this direction for **IFRF** and National Committee technical events.

On an administrative note, work began during the year on a revision of the **IFRF** Statute. The new document will be ratified during 2013.

I join the **IFRF** President in saluting the efforts of **IFRF** Director Leo Tognotti and his dedicated team. As always, I confirm Enel's commitment to support **IFRF**'s activities and to promote them in the 40 countries in which we have a presence.

Sauro Pasini
General Secretary, IFRF

PRESIDENT'S STATEMENT

The main activities of the IFRF in 2012 have been focused on Research, Networking, and Organizational changes.

The research side involved work primarily on the EU funded BRISK, RELCOM and DEBCO projects and focused on second generation biofuels, oxycoal combustion and coal-biomass cofiring, respectively. These important projects are extensively presented in this annual report.

2012 saw a very successful 17th Members Conference, held for the first time in France. As another first, this conference was sponsored by several industrial companies. Among the most notable networking achievements this year, I would like to mention the completion of actions decided after the strategy workshop held in Turku in 2011.
These were :

- The definition of a new membership structure allowing access to independent professionals, students and retirees,
- The development of a brand-new suite of promotional and communication material providing clarity on our organization, products and services,
- The launch on July 1st 2013 of a new, redesigned IFRF web site.

On the organizational side, the salient point was the recruitment of Tomasz Klajny to ultimately replace Leo Tognotti, who has committed to return to a full time academic career. Tomasz started in March 2013 as Operations Manager, and will take over from Leo later this year as Managing Director.

With a new team in place, IFRF will strive to further develop its networking services, maintaining the required balance with applied research. It will also need to significantly expand the membership by attracting new individual and organizational members from the community of industrial combustion engineers, researchers and young graduates worldwide.

I am pleased to hand over the IFRF's Presidency to Prof. Hartmut Spliethoff at the end of 2013 and wish him the very best in his new role. My involvement with the IFRF will continue as I will take up an advisory role as a B Member in the Joint Committee. I really would like to thank the Livorno team for their dedication and results. My warmest thanks are also extended to the Executive and Joint Committee Members for their collaboration and support during these last years.

Jacques Dugué
President, IFRF

TECHNICAL ACTIVITIES

During 2012, the following technical output was delivered to **IFRF** Members:

Technical Reports and Papers

Four reports were prepared in 2012 and published in early 2013. They are available for download by **IFRF** Members at *www.research.ifrf.net/research/new.html.*

K 65/y/06 - Triennial Report on IFRF Research, *Leo Tognotti*

During the triennial 2009 - 2011, through private funding and collaboration agreements with Enel and University of Pisa, and also by deploying some financial reserves, new experimental work and some desk reviews were made possible in the areas of oxy fuel combustion, solid fuel characterisation and measuring techniques. The report describes the activities carried out and refers to specific associated reports and publications.

F 111/y/01 – Coal-biomass blends combustion characterisation in a 500 kWt furnace, *G. Bonvicini, L. Biasci, G. Coraggio, M. Faleni, M. Landi*

Coal-biomass co-firing is one of the most studied solutions to mitigate the environmental impact of coal combustion concerning formation of pollutants and emissions of greenhouse gases. The experimental campaign described in this report was planned to identify the effects of co-firing coal with a torrefied biomass on heat transfer, combustion efficiency and pollutant emissions. Thus, the campaign comprised temperature measurements within the combustion chamber, fouling and isokinetical sampling, and emissions analyses under different operating conditions and with different biomass fractions in the blend.

G 26/y/01 - Coal characterisation in oxy-firing conditions using the Isothermal Plug Flow Reactor. Part 1 – Methodology, *G. Bonvicini, G. Coraggio, M. Faleni*

The Isothermal Plug Flow Reactor (IPFR) was used to characterise the devolatilization and char combustion rate of three coals under conventional and oxy-fuel conditions. These tests were part of Work Package 1 of the EU co-funded **RELCOM** project, focusing on oxy-coal combustion.

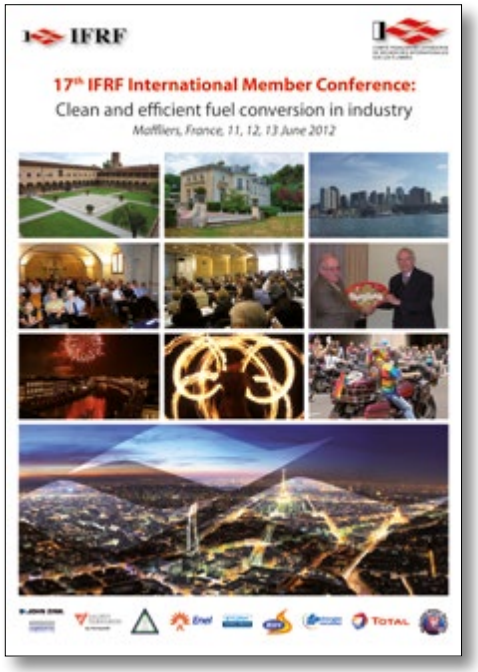
F 112/y/01 - Coal characterisation in oxy-firing conditions using the Isothermal Plug Flow Reactor. Part 2 – Experimental results, *G. Bonvicini, G. Coraggio, M. Faleni*

Three bituminous coals were characterised under conventional and oxy-fuel conditions using the Isothermal Plug Flow Reactor (IPFR). These tests were part of Work Package 1 of the EU co-funded **RELCOM** project, focusing on oxy-coal combustion.

INTERNATIONAL TECHNICAL EVENTS

IFRF 17th International Member Conference

"Clean and Efficient Fuel conversion in Industry" took place in Maffliers outside Paris from 11-13 June 2012.



Organised from Livorno in cooperation with the French National Committee, the conference was a colourful and stimulating event. For the first time ever, sponsor participation was invited and enthusiastically taken up.

The sponsorship contribution enabled the production of an attractive suite of conference materials including a dedicated website *http://ngcom.it/17thMC/* which is still active and which contains a photo gallery of the event. It is hoped that this type of involvement by Member Organisations in **IFRF** events will continue!

Plenary lectures at the conference included "Advanced monitoring techniques for power plants and flames" by **Prof. Yong Yan** of Kent University, Canterbury UK. **Prof. Flemming Frandsen**, DTU, Denmark reviewed the work done in the last twenty years through **IFRF**-related projects on ash problems in solid fuel combustion. Amongst the keynote speakers were **James Seebold** on the topic "Products of Incomplete Combustion from Gaseous Hydrocarbon External Combustion in Jet-Mixed Diffusion Flames". A contribution from the **IPPC Bureau** was also welcomed.

During the review process by the conference Scientific Committee, certain authors were invited to consider submitting their papers to the **IFRF** online journal **Industrial Combustion**. At the time of writing, a number of these invitations have been acted on.

A collection of the reviewed and corrected papers was also compiled after the event and will be marketed to the Membership during 2013 as an ISBN registered electronic publication. In time, the papers from each of the past **IFRF** conferences will be similarly packaged.

IFRF Members may download all the conference presentations from *www.ifrf.net/page/conference-notes/index-conferences*

RESEARCH ACTIVITIES

Background

Despite resource limitations imposed by the volume of internal R&D funds from Membership fees and the small size of permanent core team, **IFRF** plays to its **strengths** which include access to the Enel facilities at Livorno, an established knowledge base and the support of University of Pisa.

Areas of focus during 2012, identified in IFRF Doc. No. D 0/y/37 **IFRF Members Research Programme, an Agenda for 2010-2014** continued to be:

- Solid fuel characterisation/ focus on biofuels
- Probe development for oxy-combustion/novel combustion technologies
- CFD validation: tests and sub-models

with emphasis on experimental tests at semi industrial and pilot scale.

Financial resources, as always, were augmented by some new experimental work and desk reviews in the areas of oxy fuel combustion, solid fuel characterisation and measuring techniques. Support was also provided by the initiation of the DEBCO and BRISK projects.

Semi Industrial Tests

IFRF's aim is to couple experimental and modelling activities at different levels of phenomena and systems. The concept of Design of Experiment (DOE) is applied for planning and execution with the purpose of validating «reduced» sub-models and coupling methodologies. In 2012 the focus of the experimental work continued to be the development of criteria for validating industrial combustion CFD models and codes. Work also continued on developing and testing measurement probes/

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diagnostics with the focus on **in-flame and in furnace measurement techniques for industrial applications**, to quantify uncertainties (UQ) and update/upgrade instrumentation (HW/SW), such as suction probes for in-flame FTIR (for minor species) and optical probes for collecting the fluctuations coming from flames (ODC).

Research Topics and Projects

At the time of writing **IFRF** is involved in the following research topics:

- Oxy-coal combustion (RELCOM, National funding)
- Characterisation of 2nd generation biofuels (BRISK)
- Gasification of 2nd generation biofuels (BRISK, National funding)
- Coal-biomass co-firing, biomass combustion (DEBCO - Enel)
- H2 combustion in gas turbines (National funding)
- Flameless combustion of H2- CH4 mixtures (National fundings, Enel, UniPI)
- Optical diagnostics development and testing (ENEA, National funding)

The main features of the principal projects are briefly reviewed here.

	LAB/PILOT SCALE	SEMI-INDUSTRIAL SCALE	FULL SCALE
WHAT	MOLECULAR PROCESS UNIT PROBLEMS	COUPLED PROBLEMS	COMPLETE SYSTEM
PHENOMENA INVESTIGATED	CHEM.KINETICS DEVOLATILISATION HETEROG. REACTIONS MIN.MATTER TRANSF.	FLOW FIELD FLAME STABILITY TURBULENCE-KINETICS INTERACTIONS, POLLUTANT GENERATION	SYSTEM FLOW FIELD AND TEMPERATURE DISTRIBUTION, HEAT TRANSFER, BURNER INTERACTIONS, FATE OF POLLUTANTS
COMPUTATIONAL METHODS AND SCOPES	VALIDATION OF SUB MODELS AND UNCERTAINTIES QUANTIFICATION (UQ) Kinetics parameters/ Particles properties variation	«REDUCED» SUB-MODELS AND COUPLING METHOD. (COMBUSTION MODELS) VALIDATION/UQ Design, optimisation of component performances (i.e. burners) –	COMPREHENSIVE MODELLING VALIDATION/UQ boiler/furnace overall performances design/optimisation/ Control
EXPERIMENTAL APPROACH AND SCOPES	«AD HOC» EXPERIMENTS CFD-AIDED EXPERIMENTS: QUALIFICATION OF PROCEDURES AT LAB/PILOT SCALE: UQ	Design Of Experiment (DOE) DEVELOPMENT/TESTING OF MEASUREMENT PROBES/DIAGNOSTICS (UQ) for industrial application	DESIGN OF FULL-SCALE CAMPAIGNS FULL SCALE DIGNOSTICS OPTIMISATION

RESEARCH ACTIVITIES

RELCOM project

RELCOM – **"Reliable and Efficient Combustion of Oxygen/Coal/Recycled Flue Gas Mixtures"** is designed to undertake a series of applied research, development and demonstration activities involving both experimental studies and modelling work to enable full-scale early demonstration oxyfuel plant to be designed and specified with greater confidence and to provide improved assessment of the commercial risks and opportunities.

The project is funded by the European Commission Seventh Framework Programme and is being undertaken by a consortium of higher education institutions, research centres and industrial partners.

IFRF has both research and dissemination roles in RELCOM and early in the year, developed and launched a sophisticated website *www.relcomeu.com*.

In terms of research activities assigned, the first of these is to provide a baseline for oxy-coal burner scale-up criteria, collecting all the information about the burners available in the project, starting with the **IFRF AASB** burner.

In 2012 **IFRF** started the characterisation of three coals in oxy-combustion environment with the **IPFR** (Isothermal Plug Flow Reactor) and was also involved in oxy-combustion sub-model development and validation through different scale experimental campaigns. During the tests, **IFRF** hosted visiting scientists and investigators from partners, including **IFRF** Member organisations **Silesian University of Technology, Technische Universität Munchen, Glamorgan University** and **IFK Stuttgart**.

G 26/y/01 - Coal characterisation in oxy-firing conditions using the Isothermal Plug Flow Reactor.

Part 1 – Methodology is the first part of a comprehensive set of reports on coal characterization under oxyfuel combustion, and describes the applied procedures and the main issues concerning the IPFR operations, including the determination of the experimental error affecting the results.

Part 2 includes all the results of the analyses performed on the samples collected from the IPFR and the conversion trends versus residence time for three different coals in all the tested conditions.

Part 3 will be dedicated to the analysis of the data produced by the IPFR for the determination of kinetic parameters for devolatilisation and char reactions under both conventional and oxyfuel combustion, according to different models.

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BRISK Project

BRISK (Biomass Research Infrastructure for Sharing Knowledge) has a four year life span, is an initiative from the European Commission's 7th Framework Programme, and is coordinated by **KTH Royal Institute of Technology** in Sweden.

BRISK aims to develop a European research infrastructure for **thermochemical biomass conversion** - a family of processes whereby second generation biomasses such as wood, energy crops, agricultural wastes and other biogenic materials can be thermally converted into liquids, gases and solids for the production of electricity, heat, transport fuels and a wide variety of chemicals.

The three principle activities incorporated in BRISK are **Transnational Access, Joint Research Activities** and **Networking**.

Transnational Access enables European organisations, including those outside the project partnership, to send their researchers to undertake experiments on any of the laboratories offering access or test facilities. The cost of running the rigs for these activities will be met by the EC's BRISK cofunding.

For BRISK **IFRF** offers access to its **Isothermal Plug Flow Reactor** (IPFR), and also to a **tar cracking unit** and **200kW downdraft fixed bed gasifier** which are the property of the University of Pisa.

Photo: Guests at RELCOM trials

RESEARCH ACTIVITIES

The paper **Pilot scale biomass gasification at CRIBE: survey of the experimental activities** presented at the **IFRF 17th Member Conference**, describes the facilities and provides a novel set of pilot scale experimental data.

In late 2012, Oskar Karlström, a post graduate researcher from **Åbo Akademi University** in Finland completed a two week collaboration with **IFRF** investigators running experiments on the IPFR. Oskar was the first researcher to visit **IFRF** as a beneficiary of **BRISK** and was followed shortly afterwards by Jun Li, from **KTH Royal Institute of Technology** in Sweden. Jun worked with the **IFRF** team on a biofuel characterisation campaign to investigate the kinetics of thermal conversion of 2nd generation biomasses and chars in the **IPFR** and develop procedures to determine the kinetic parameters needed for single particle models to be used as sub-models in CFD codes.

BRISK funding has allowed **IFRF** to complete the development of an online searchable database of European test rigs initiated as part of the European Flame Research Initiative (EFRI). The scope has been extended to include all aspects of fuels processing adding for example gasification, pyrolisis, cleaning, and upgrading. *www.briskeu.com*

Photo: Pictured at the IPFR, Jun Li with IFRF's Giorgio Bonvicini and Marco Faleni

RESEARCH ACTIVITIES

DEBCO Project

In December 2012 **DEBCO** - **Demonstration of Large Scale Biomass Co-Firing and Supply Chain Integration** in which **IFRF** had the responsibility for dissemination, reached completion. At the final conference in Brussels in December, the results of four years' work were shared with the public.

The project was concerned with increasing the share of biomass in co-firing in fossil fuel-fired power plants. Over the length of the project, this was investigated for different types of biomass and combustion techniques, and all process steps, from fuel processing to flue gas treatment and ash utilisation, were analysed.

The final conference proceedings, project report and a guidebook are all available on the project website which was developed and managed by **IFRF** during the project and will continue to be maintained as an **IFRF** resource. *www.debco.eu*

Other Biomass Cofiring Projects

In 2012 the **500 KW furnace** was employed for co-combustion studies, with a sub bituminous coal and a torrefied biomass for assessing the effect of biomass share on fouling tendency and emission levels. Report **F 111/y/01 – Coal-biomass blends combustion characterisation in a 500 kWt furnace** resulted and the system is now set up for further co-firing campaigns in 2013.

Hydrogen combustion tests in GT burners

In 2012, **IFRF** was involved in the project "Development of an ultra low NOx hydrogen fuelled burner". The objective of the project, which is funded by Regione Veneto and the Ministry of the Environment, is to develop an innovative hydrogen burner limiting NOx emission below 100 mg/Nm3 with reduced inert injection in flame. The **Optical Test Rig for Gas Turbines** (TAO) was used for the necessary tests.

"In flame" temperature measurements tests were executed on burners designed by co-partner Nuovo Pignone of the GE group, and involved the use of a micropyrometer expressly designed and manufactured for the purpose.

In further tests, **IFRF** performed velocity field characterization of the prototype burners in the Enel aerodynamic laboratory.

The project will continue in 2013.

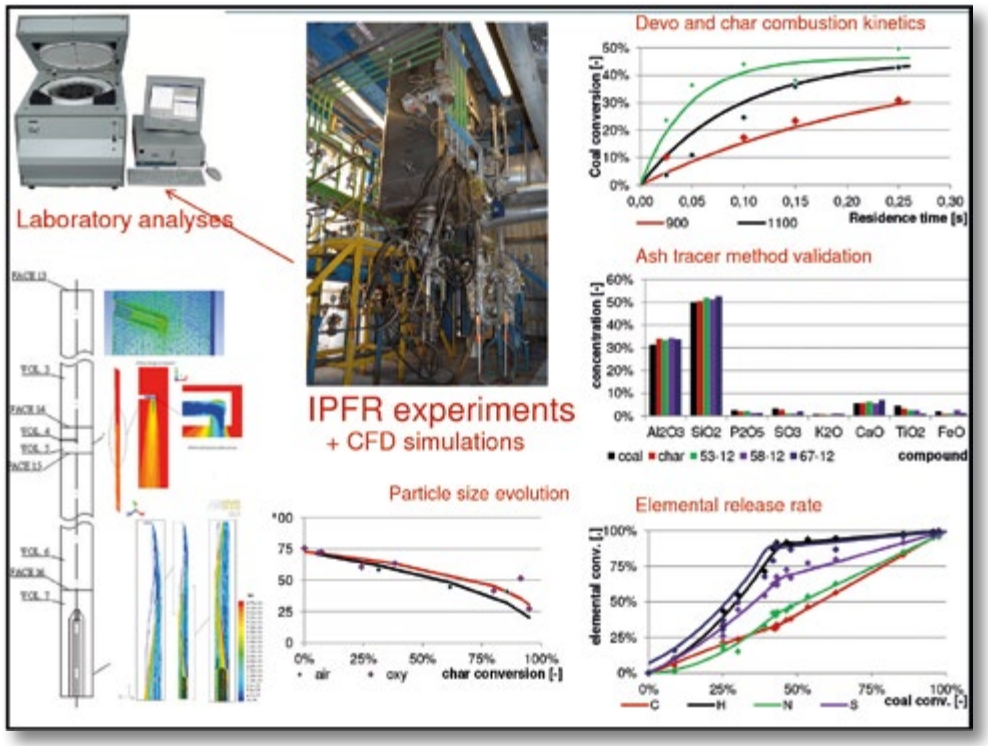
RESEARCH ACTIVITIES

Solid fuel characterisation and development of a solid fuel database

One of the main areas of **IFRF** research is solid fuel characterisation. Over the years, the objectives of the activities have developed as follows:

- to establish **protocols** for solid fuels combustion characterisation;
- to characterise solid fuels, and to fill data gaps for numerical model validation & application;
- to include economically and environmentally significant fuels - biomass, wastes, and their blends with coals - and conditions that reflect the current interests of **IFRF** Members and other sponsors.

The **IFRF Solid Fuel Database** has been available to **IFRF** Members as an online resource since 2010 for use in the design and operation of industrial solid fuel fired combustors and gasifiers. Originally populated with devolatilisation, char combustion and nitrogen release data from the IPFR (Isothermal Plug Flow Reactor), the key facility for solid fuel characterisation, the database is being steadily extended with information generated at the same source.



In 2012, experimental tests were performed on different coals and biomasses in the context of **RELCOM** and **BRISK** and updates made to the SFDB.

In June 2013 at the time of writing, the database contains a complete dataset on the characterisation of three coals in an oxy fuel environment. Users may compare conventional and oxy fuel devolatilization and char combustion, and also quantify the role of char gasification with carbon dioxide and water in an oxy fuel atmosphere.

Finally, devolatilization and char combustion of various biomasses including straw, black pellet, wood pellet, palm kernel shell and lignin can be compared and analyzed to determine reliable kinetic parameters.
http://sfdb.ifrf.net//

Related papers presented at the **IFRF 17th Member Conference, Paris, June 2012** include:

- **Solid fuel databases: state of the art and evolution plan at IFRF**, *E. Biagini, L. Tognotti*
- **Ignition delay of coal particle jets in oxy fuel conditions,** *C. Galletti, S. Tarquini, R. Bruschi, S. Giammartini, G. Coraggio, L. Tognotti*

(See Appendix pag. 30)

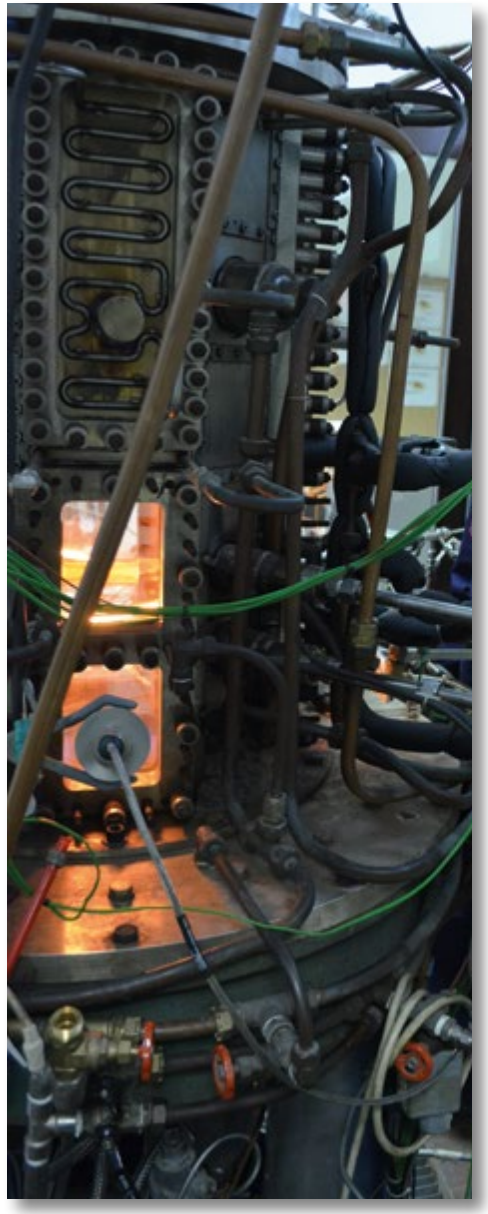


Photo: Optical Test Rig for Gas Turbines

MANAGEMENT AND ORGANISATION

Staffing

During 2012, the staff complement of the **IFRF** was again sustained by contracted investigators and a technician. An additional full time resource was engaged to take over secretarial and accounting responsibilities from the Communications Manager. The individuals contracted to **IFRF** during the year:

- **Leo Tognotti**
  Director
- **Tracey Biller**
  Communications and Marketing permanent staff
- **Giovanni Coraggio**
  Investigator, Measurement Techniques permanent staff
- **Cristiana Gheorghe**
  Admin accounts and secretarial permanent staff
- **Leonardo Biasci**
  IPFR tests - contractor
- **Marco Faleni**
  IPFR Technician - contractor
- **Beatrice Cioni**
  BRISK – part time contract
- **Enrico Biagini**
  BRISK – part time contract
- **Luigi Petarca**
  BRISK and RELCOM – part time contract
- **Neil Fricker**
  Consultant, also retained to assist with the BRISK project

Enel and UNIPI support for Research

- **Enel Experimental Area:** Davide Cecchini and a team of 10 engineers and technicians
- **University of Pisa:** Researchers Chiara Galletti and Marco Simone

External suppliers

- **Studio Bonaccorsi** for bookkeeping and accounts
- **Studio Guerrini Vitti** for auditing
- **Nextworks, InterVisors, Tesene** and **Antonio Raimondo** for IT
- **Net Group Communication** for visual design
- **Patrick Lavery** for Combustion Industry News

In-kind support was also made available by **IFRF** Member **Canmet** to edit the **IFRF** Journal

- **Pat Hughes** and later **Peter Gogolek** Editor-in-Chief
- **Peter Gogolek** and later **Cecilia Lam** Editorial Secretary

MANAGEMENT AND ORGANISATION

Strategy Project

In the early part of 2012, and ahead of its ratification at JC 159, the first steps were taken towards the implementation of a renewed business and marketing strategy for **IFRF**.

The tasks for the year were to:

- Revisit the **IFRF** suite of promotional material
- Rethink, redesign and relaunch the Monday Night Mail (MNM)
- Develop and implement a new membership structure
- Institute and complete a revamp of the **IFRF** website with a comprehensive rewrite of the content
- Run a promotional campaign targeted at individuals

Whilst not all the tasks were completed in the twelve months to December 2012, good progress was made in laying a solid foundation for future marketing efforts.

Specific achievements:

- Given that organisation of the Member Conference took precedence over most other activities in the first part of the year, the event itself became a vehicle for strategy – specifically as regards the development of a new visual personality for **IFRF**.

  This process was continued in the 2011 Annual Report which was produced in July, setting a tone which was established definitively in the promotional literature which began to emerge in the later part of the year and which crystalised the **IFRF's** service offering and Membership Scheme so as to make it communicable to members and potential members. By year end, the preparations had been made for the production of a brochure describing **IFRF** experimental facilities. This was printed in March 2013.

Photo: Jarek Hercog (IEN), Giovanni Coraggio (IFRF), Oskar Karlström (Äbo Akademi) at MC 17.

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- From its first issue in 2012, MNM became a bi-weekly publication offering much enriched content and new features:
  - A regular monthly update from the Livorno experimental area
  - A monthly newsbrief from **IFRF** Director Leo Tognotti
  - Intermittent reports from Neil Fricker, Supervisor of Research
  - Periodic updates on the new European Commission co-funded **RELCOM** and **BRISK** projects
  - A wrap up of news and views from the combustion arena provided by Patrick Lavery in Sydney

Readers were also promised regular contributions from the IFRF National Committees and news from Member organisations. This element needs further development.

- The Membership Proposal (**IFRF** Doc No D 124/y/1) was developed into a draft policy document which was presented to the Executive in February 2013 and circulated to Joint Committee Members thereafter. This will be ratified at JC 160, enabling National Committees and Livorno to promote the concept of **IFRF** membership for independent individuals with greater knowledge and confidence.
  In the mean time, also in an attempt to introduce **IFRF** to a wider audience, a Linked In discussion group was set up and had attracted some 200 followers by year end.
- The issue of the **IFRF** website, certainly the critical factor in repositioning **IFRF** in the minds of target audiences, was able to be tackled only in December and only partially, with the acceptance by the Executive of a proposal for a cosmetic facelift which would simplify navigation without disturbing the underlying legacy databases. This project, with the associated rewrite of all web content, is being completed as this report goes to print.

Photo: MC 17 Special guest, Gérard de Soete

IFRF EXECUTIVE COMMITTEE

At December 31st 2012, the members of the **IFRF** Executive were:

President:
Jacques Dugué
Total, France
(January 2011 to December 2013)

Vice President:
Hartmut Spliethoff
TUM, Germany
(January 2011 to December 2013)

Vice President:
Gérard Flament
(June 2012 to December 2013)

General Secretary:
Sauro Pasini
Enel Engineering & Research, Italy
(June 2009 - No fixed term)

Superintendent of Research:
Neil Fricker
University of Glamorgan, UK
(January 2011 to December 2013)

FINANCIAL SUMMARY

During the financial year 2012, having achieved the status of an ONLUS (Organizzazione Non Lucrativa di Utilita` Sociale) in 2008, the **IFRF** continued to operate as a 'not-for-profit' Foundation in Italy.

The Financial Statements are presented in the form of a Balance Sheet and Income Statement showing the financial information for ONLUS. The consolidated Profit and Loss figure is compared with the approved budget (JC158).

The figures used in this annual report are taken from the full audited Financial Statements for ONLUS produced according to Italian bookkeeping and accounting principles.

Copies of the full Financial Statements were made available to Members of the **IFRF** governing body, the Joint Committee following the acceptance of a draft version by the **IFRF** Executive Committee.

The Financial Statements were accepted by the **IFRF** Executive Committee as being a true representation of the financial affairs of the International Flame Research Foundation in 2012.

BALANCE SHEET AT 31st DECEMBER 2012 – ONLUS

ASSETS		At 31-12-2012		At 31-12-2011
		Partial	Total	
B	FIXED ASSETS			
B.I.	*INTANGIBLE ASSETS*			
B.I.2	Research, development and advertising costs		28.198	
B.I.4	Concessions, licenses, trademarks and similar		694	1.388
Total INTANGIBLE ASSETS			28.892	1.388
B.II	*TANGIBLE ASSETS*			
B.II.2	Equipment and machinery		105.288	127.80
B.II.3	Industrial and commercial equipment		960	
B.II.4	Other tangible assets		8.245	5.519
Total TANGIBLE ASSETS			**114.493**	**133.320**
TOTAL FIXED ASSETS			**143.385**	**134.708**
C	CURRENT ASSETS			
C.I	*INVENTORY*			
C.I.3	Contracted work in progress		541.445	177.140
Total INVENTORY			**541.445**	**177.140**
C.II	*RECEIVABLES*			
C.II.1	Trade receivables		221.607	204.004
	within 12 months			
C.II.4-bis	Tax credit/receivables		21.932	8
	within 12 months	21.932		47.606
C.II.5	Other receivables from third parties		50.072	47.061
	within 12 months			
Total RECEIVABLES			**293.611**	**251.073**
C.IV	*CASH AND BANKS*			
C.IV.1	Bank and postal deposits		201.623	327.411
C.IV.3	Cash		31	257
Total CASH AND BANKS			**201.654**	**327.668**
TOTAL CURRENT ASSETS			**1.036.710**	**755.881**
D	ACCRUED INCOME AND PREPAID EXPENSES			
	Prepayments and deferred expenditures		5.384	
Total ACCRUED INCOME AND PREPAID EXPENSED			**5.384**	
TOTAL ASSETS			**1.185.479**	**890.590**

IFRF Doc N° K63/y/12
Livorno, June 2013

Annual Report 2012
Summary Financial Statements 2012

BALANCE SHEET AT 31st DECEMBER 2012 – ONLUS

LIABILITIES		At 31-12-2012		At 31-12-2011
		Partial	Total	
A	EQUITY			
A.I	*CAPITAL*		171.785	171.785
A.VII	*OTHER RESERVES*		188.177	146.853
Reserve for difference from rounding-off to Euro unit		(2)		
Miscellaneous reserves		188.179		146.853
A.IX	*PROFIT (LOSS) FOR THE PERIOD*		47.458	41.326
Total EQUITY			**407.420**	**359.964**
B	PROVISION FOR LIABILITIES AND CHARGES			
B 2	*DEFERRED TAXES*		—	—
Total PROVISION FOR LIABILITIES AND CHARGES			—	—
C	EMPLOYEE RETIREMENT INDEMNITY		36.582	27.558
Total EMPLOYMENT RETIREMENT INDEMNITY			36.582	27.558
D	PAYABLES			
D.6	Advance payments		433.724	27.373
	beyond 12 months	433.724		
D.7	Accounts payable to suppliers		258.831	224.771
	within 12 months	258.831		
D.12	Taxes payable		10.030	8.283
	within 12 months	10.030		
D.13	Social security payables		13.249	7.156
	within 12 months	13.249		
D.14	Other payables		25.643	8.608
	within 12 months	25.643		
Total PAYABLES			**741.477**	**276.191**
E	ACCRUED EXPENSES AND DEFERRED INCOME			
	Accruals and deferred income			226.877
Total ACCRUED EXPENSES AND DEFERRED INCOME				**226.877**
TOTAL LIABILITIES			**1.185.479**	**890.590**

INCOME STATEMENT

INCOME STATEMENT		At 31-12-2012		At 31-12-2011
		Partial	Total	
A	VALUE OF PRODUCTION			
A.1	Net sales from production and services		31.780	211.140
A.3	Changes to contracted work in progress		364.305	13.308
A.3	Additions to assets by internal production		35.248	
A.5	Other revenues and income		344.488	289.089
A.5.a	Other contributions	182.740		258.091
A.5.b	Other operating revenues	161.748		30.998
Total VALUE OF PRODUCTION			775.821	513.537
B	COST OF PRODUCTION			
B.6	Raw, ancillary, consumable materials/goods		12.795	24.291
B.7	For services		486.019	272.927
B.8	For leasing and rentals		6.453	4.755
B.9	For personnel		174.536	135.140
B.9.a	Salaries and wages	126.618		96.530
B.9.b	Social security contributions	37.074		31.411
B.9.c	Employee retirement indemnity	9.124		7.199
B.9.e	Other costs	1.720		—
B.10	Depreciation and write-downs		34.460	29.296
B.10.a	Depreciation of intangible fixed assets	7.744		982
B.10.b	Depreciation of tangible fixed assets	26.716		28.314
B.14	Other operating expenses		14.962	5.766
Total COST OF PRODUCTION			729.225	472.175
	Net income from operating activities		46.596	41.362
C	FINANCIAL INCOME AND EXPENSES			
C.16	Other financial income		71	18
C.16.d	Other financial income	71		18
C.16.d.4	Income from other companies	71		18
C.17	Interest and other financial expenses		(66)	(51)
	Expenses to other companies	(66)		(51)
C.17-bis	Profit and loss on exchange		(1)	(3)
Total FINANCIAL INCOME (EXPENSES)			4	(36)

INCOME STATEMENT

INCOME STATEMENT		At 31-12-2012		At 31-12-2011
		Partial	Total	
E	EXTRAORDINARY INCOME AND EXPENSES		858	
E.20	Extraordinary income	3		—
E.20.b	Other extraordinary income	855		—
E.21	Extraordinary expenses		—	—
E.21.b	Other extraordinary expenses		—	—
Net EXTRAORDINARY INCOME (LOSS)			858	
	Results before taxes (A-B+C+E)		47.458	41.326
23	Net income for the year		47.458	41.326

Notes to the balance sheet and income statement

General Accounting Principles

The accounts have been prepared on the basis of historical cost (except when stated otherwise). If not stated otherwise, assets and liabilities are shown at face value.

Principles for valuation of assets and liabilities

Tangible assets
Tangible assets are valued at cost less accumulated depreciation. The depreciation is calculated on a straight-line basis and based on an expected economic life of 3 - 5 years.

Work in progress
The work in progress comprises material costs and labour costs plus overhead pro rata. Provision is made for projects that cannot be covered by their revenues in the future.

Debtors-trade
Current assets include debtors, which fall due within one year. Provision is made for amounts that probably will not be received.

Principles for determination of results

Revenues and costs
Revenues and costs are allocated to the financial year to which they relate. Losses and risks are also recognised in the period to which they relate.

Total revenue
Total revenue comprises the invoiced fees from the Member Organisations and the invoiced amounts for other services rendered, and the change of work in progress. Revenues on work-in-progress are recognized at the time the projects are completed.

PROFIT AND LOSS COMPARISON WITH BUDGET FIGURES

	2012 Consolidated	2012 Budget	Variation 2011 vs 2011 JC	
REVENUES	**775.821**	**645.000**	**130.821**	**20,3 %**
Member Organisation Fees	182.740	200.000	**(17.260)**	**8,6 %**
Funded Members Research Programme	364.305	300.000	**64.305**	**21,4 %**
Technical Meetings	64.006	20.000	**44.006**	**220,0 %**
Special Projects	153.990	100.000	**53.990**	**54,0 %**
Reports-Consulting-Hardware	10.780	25.000	**(14.220)**	**(56,9 %)**
COSTS	**729.226**	**575.000**	**154.226**	**26,8 %**
Internal + External Staff Costs	333.096	200.000	**133.096**	**66,5 %**
Research services/consumables	199.769	250.000	**(50.231)**	**20,1 %**
Technical Meetings	56.259	10.000	**46.259**	**462,6 %**
IFRF NET/ Members Services	42.384	20.000	**22.384**	**111,9 %**
Reports-Consulting-Hardware	6.453	10.000	**(3.547)**	**(35,5 %)**
Depreciation	34.460	15.000	**19.460**	**129,7 %**
General Operating Costs	56.805	70.000	**(13.195)**	**(18,9 %)**
Operating Result	**46.595**	**70.000**	**(23.405)**	**(33,4 %)**

DIRECTOR'S COMMENTS ON THE IFRF'S FINANCIAL POSITION

The financial position of ONLUS is determined as at December 31st 2012.

A Profit and Loss surplus of € 46,595.00 was achieved in 2012. This was below the budgeted figure (JC 158) of € 70,000.00. There were some differences compared to the budgeted figures, in particular:

- The budgeted Research and Development Income (Funded MRP and Special Projects) of € 400,000 was actually € 518,000 (+20%). This was because the EU FP7 **RELCOM** and **BRISK** started after a delay, and some activities related to public and private funding were acquired in 2012.
- The expenses were larger (+26%) for the reasons mentioned above and for the implementation of the Strategy Project.
- There was a shortfall on the budgeted figure for Members' fees of about € 17,000.

The **cash available** at the **IFRF** bank accounts on December 31st 2012 was € 201,654 compared with € 327,688 on the same day in 2011.

During the year, the **IFRF** took on certain research projects within the scope of its non-profit nature. In addition the technical meeting and members' contributions enhanced the organisation's financial position.

In 2012 the Foundation continued to work to strengthen its global profile through the establishment of relationships with scientific and industrial organisations. Whilst such relationships contributed to supplying financial resources to the Foundation, they also enabled it to further increase the accumulated scientific and technological know-how which is at its heart.
It can be reasonably assumed that during the course of 2013 the Foundation will continue to strengthen its capital position through careful management of its resources and to fulfill its mission both quantitatively and as regards increased efficiency.

APPENDIX

Papers and presentations at IFRF events *www.trends.ifrf.net/trends/project.html?pid=44*

• **Development of novel instrumentation/probes for oxy fuel semi-industrial tests**, *G. Coraggio, L. Biasci, M. Faleni, L. Lupetti, L. Tognotti, IFRF 17th Member Conference, Paris, June 2012*

• **Solid fuel databases: state of the art and evolution plan at IFRF**, *E. Biagini, L. Tognotti, IFRF 17th Member Conference, Paris, June 2012*

• **Modelling oxy-coal combustion in a semi-industrial furnace,** *C. Galletti, L. Giovannini, G. Coraggio, L. Tognotti, IFRF 17th Member Conference, Paris, June 2012*

• **Ignition delay of coal particle jets in oxy fuel conditions,** *C. Galletti, S. Tarquini, R. Bruschi, S. Giammartini, G. Coraggio, L. Tognotti, IFRF 17th Member Conference, Paris, June 2012*

• **Pilot scale biomass gasification at CRIBE: survey of the experimental activities,** *M. Simone F. Barontini, C. Nicolella, E. Biagini, L. Tognotti, IFRF 17th Member Conference, Paris, June 2012*

Papers in International Journals

• *One-Parameter Model for the Oxidation of Pulverized Bituminous Coal Chars,* O. Karlström, A. Brink, J. Hercog , M. Hupa, L. Tognotti, Energy Fuels, 2012

• *Comparing reaction orders of anthracite chars with bituminous coal chars at high temperature oxidation conditions,* O. Karlström, A. Brink, M. Hupa, L. Tognotti, E. Biagini XXXIV Symp. Comb. 2012

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