

# FPC trends

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## e d i t o

Welcome to the latest newsletter from FPC, your partner in fire risk analysis, fire safety engineering and incident management.

With the continuous thirst for making bigger, taller and more complex building structures, traditional (prescriptive) approaches do not always give outright answers to what level of structural fire resistance is required. Our main article 'cost effective structural fire design' gives insight into new techniques to better support architects and building designers into making economical yet safe structural designs.

This issue also looks back to a very successful customer and partner event organised within the light of FPC's 30th anniversary last December here in Antwerp. As a supplement you find a fun 30-year FPC retrospective included. In fact, the conference was so successful that we decided to organise a new event later this year in Dubai.

One of the hot topics at the conference related to the importance of emergency management and other operational aspects in the field of fire safety. To give this further shape, FPC decided to launch Safety Center Europe together with AVD from Holland.

Also in this Trends, a description of a recently completed study performed in Qatar for one of the leading petrochemical concerns in the world and a selection of new, exciting, projects.

Enjoy Reading !!

FPC Team



## Celebrating Fire Consultancy

**Fire protection engineering has been part of industry lexicon for well over 100 years, but sophisticated fire consultancy is a fairly recent and rapidly developing phenomenon. Specialty consulting engineering firms like FPC have learned how to harness advanced research findings to help their clients achieve higher levels of safety at lower cost and with greater reliability.**

On 3 December, 2004 FPC held a special Customer and Partner Conference to celebrate its 30th anniversary of leadership and service in this important field. I was honoured to be one of the speakers at the event, held at the unique floating conference centre known as The Ark in Antwerp Harbour. An impressive and informative day it was!

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# Announcements

## NoKeos® AIG certified product

We are proud to announce that NoKeos and FPC have been selected by American International Group, Inc. (AIG) as a certified software product and qualified service provider for emergency management. American International Group, Inc. (AIG) is the world's leading international insurance and financial services organization, with operations in more than 130 countries and jurisdiction.

FPC and NoKeos will soon be recommended on AIG's website as part of the Planning And Tracking Response Online (PATROLSM) program, enabling AIG Environmental® clients to engage, exchange data with and dispatch, via a collaborative web-based software platform, a linked network or pre-qualified global service providers with expertise in pre-event and post-event crisis planning, management and response disciplines.



### Seminar Dubai – September 2005

## Fire safety design of complex buildings

This seminar will bring together anyone with a certain interest for the topic, to discuss challenges (and solutions) that architects and fire engineers face when designing complex and architecturally unique buildings. The venue shouldn't come as a surprise, since Dubai is a model example where these types of buildings are constructed.

Keynote speakers on the subjects are invited and the seminar will be hosted under the patronage of the Dubai Civil Defence.

The exact date, venue and programme will be communicated later this month.

## Safety Center Europe

**FPC is pleased to announce the launch of Safety Center Europe (SCE), a joint venture with Adviesbureau Van Dijke (AVD).**

Adviesbureau Van Dijke (AVD) is Holland's most important safety firm specialised in servicing government (ministries, fire brigade, police, and medical services) with structuring safety policies and operations.

While FPC mainly provides technical solutions in respect to life & fire safety for private enterprises, SCE will focus on

supporting entities from an operational perspective: think public and private fire brigade structuring, advice in respect to staffing, preparation of disaster plans, technology advice, business continuity planning, training, interim management, corporate juridical advice, etc...

SCE will also provide supporting methods and EM software tools to support organisations before, during and after incidents.

With the launch of SCE we want to bring our clients know how in terms of

structuring and running safety operations more efficiently. Depending upon specific project requests SCE can draw from a pool of resources ranging from communication specialists, jurists, training officers to incident commanders and security specialists.

For more information about Safety Center Europe please mail [infosce@safetycenter.com](mailto:infosce@safetycenter.com).



# Cost effective structural fire design

## Introduction

**Fire safety can have a major impact on the overall concept of buildings, i.e. architectural, building design and function, cost, etc. Therefore it is essential to include the impact that fire safety has on any new building from the onset of the project. One important aspect is the behaviour of the building's load-bearing structure(s) when exposed to fire(s). Structural fire design is the engineering discipline that deals with the analysis and design of the building structures to withstand fire.**

## Prescriptive vs. performance design

Since the beginning of the 20th century, the design of structures exposed to fire has been based upon the ability of structural elements (beams, columns, etc.) to withstand a given load during a given duration when tested against a standard fire in a furnace. Prescriptive rules were then established to design the structural elements without performing test(s) in furnace for each design. Although widely used, this approach is based on a poor representation of the behaviour of real structures submitted to real fires and thus often leads to uneconomical structures.

The strong tendency towards constructing atypical buildings leads to situations where prescriptive fire design, i.e. a design that fulfils some predetermined protective measures, is inappropriate. The solution then requires a full performance based approach that includes; the determination of fire development inside a compartment, the evolution of temperature profiles in structural elements and, finally, the mechanical behaviour of the entire structure.

Thanks to substantial research efforts during the last decades, significant advances have been made that enable a more realistic estimation of both exposure and response of structures submitted to real fires. Such performance-based designs have led to the construction of safer buildings at lower costs.

## Design approach

All structural designs should include the calculation of:

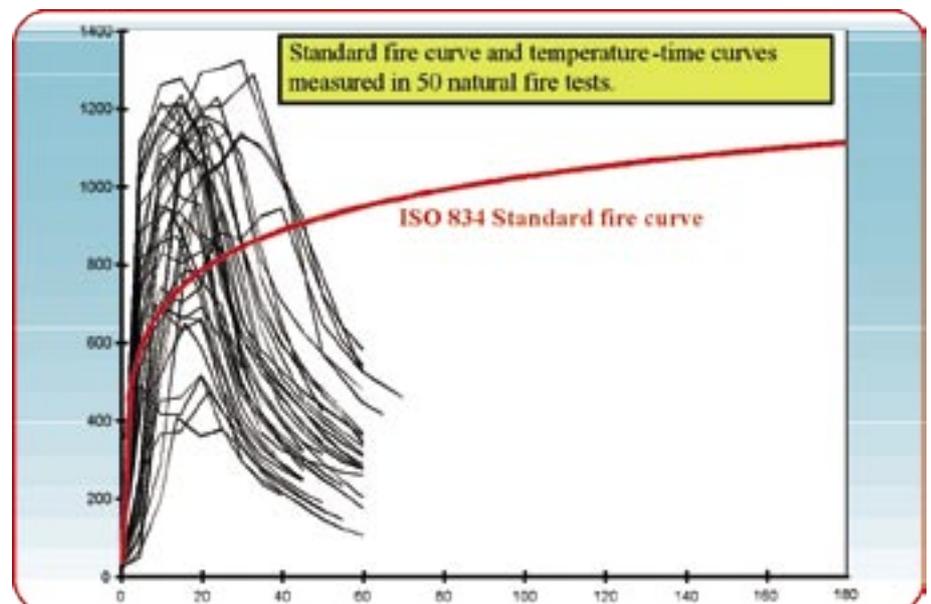
- ✓ The thermal action of the fire on the structure;
- ✓ The temperature profile inside the structure;
- ✓ The mechanical behaviour of the structure when exposed to fire.

These calculations can be done in a very rough manner using prescriptive rules or in a more realistic way, using more advanced concepts based on latest developments in both structural and fire engineering.

## Fire modelling

The common practice in structural fire engineering is to represent a fire by a standard fire curve (temperature-time curve). For buildings, this curve is in most cases a standard fire curve such as ISO 834 or ASTM E119. Once the standard fire curve has been selected, the only difference between two designs is the time during which an element is exposed to the fire curve - for example 30 minutes for a single storey building or 4 hours for a high rise building.

Standard fire curves do not take into account important parameters that are



From Capot L.G., et al., Valorisation project - Natural Fire Safety Concept. Final Report EUR 20349 EN, 2002.

well known to strongly influence the development of a building fire, i.e. the fire load, the ventilation conditions, the size and geometry of the fire compartment, the boundaries etc. Standard fire curves simply do not represent real building fires and in fact are not intended for that purpose. They have been established to compare the fire resistance of structural elements between each other. As a consequence, a structure composed of elements with a 60 minute ISO rating will probably not collapse after 60 minutes in a real fire. For a very severe fire, a structure might collapse after 20 minutes, but in most cases it might never collapse at all.

Modelling fires, instead of using a standard fire curve, is a significant step to achieve more performant fire safety structures. Modelling can be done by hand calculation methods or sophisticated computer programs. These methods enable to take into account real fire conditions and represent better the real fire exposure of structures.

## Structural response to fire

In prescriptive-based design, the designer only requires to apply simple design rules/methods to satisfy code requirements. For example in case of concrete structures, the fire design may be limited to the definition of a sufficient cover of the rebars.

A more advanced study supported by computer modelling takes into account the mechanical properties of materials at elevated temperatures, combined with numerical modelling of the stability of structures (for example by non-linear finite element methods). Such approach enables to estimate the behaviour of large, complex, structures that fall out of the prescriptive design scope.

Moreover the stability of building structures does not only depend on the

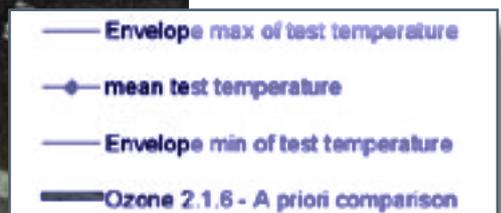
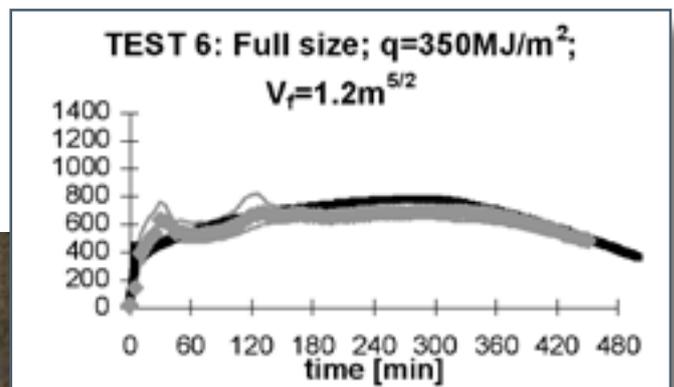
structural elements as such but also on the interaction between these elements. The contribution of the latter can be significant and is not fully considered in a prescriptive approach. The interaction between structural elements can only be properly accounted for when modelling the structure as a whole.

## Code background

Performance-based fire codes are becoming more common all over the world.

In the US, the National Fire Protection Association's (NFPA's) 2000 Life Safety Code contains a performance-based design option.

In Europe, the EUROCODES that are a set of harmonised technical rules for



*Numerical modelling with the zone model OZone of a compartment fire test (8 hours)*

the design of construction works allow performance-based design for structural fire safety.

## Conclusions

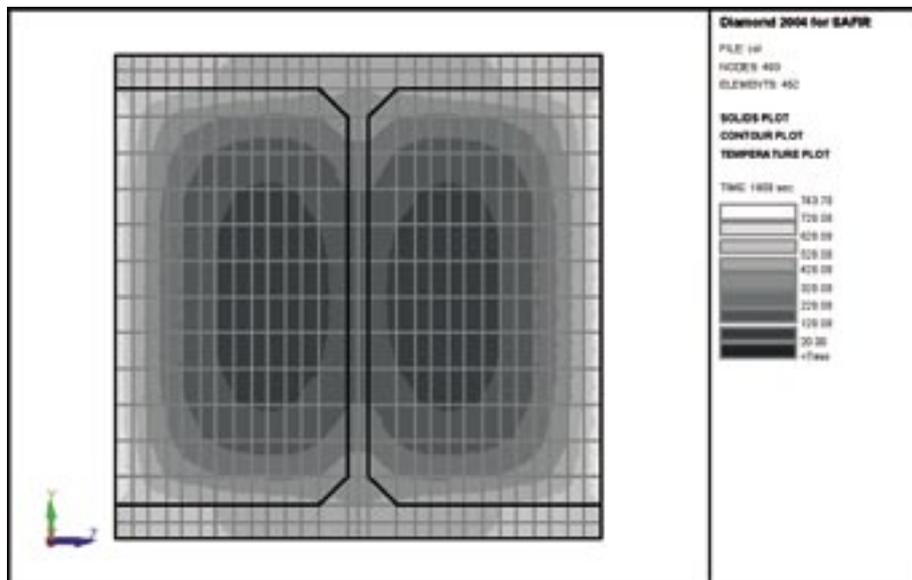
Structural fire safety is only one but nevertheless important aspect that determines the overall life & fire safety of a building.

Other elements that influence the life and fire safety performance of a building are: evacuation of people, smoke management, fire detection & alarm and fire suppression and many more.

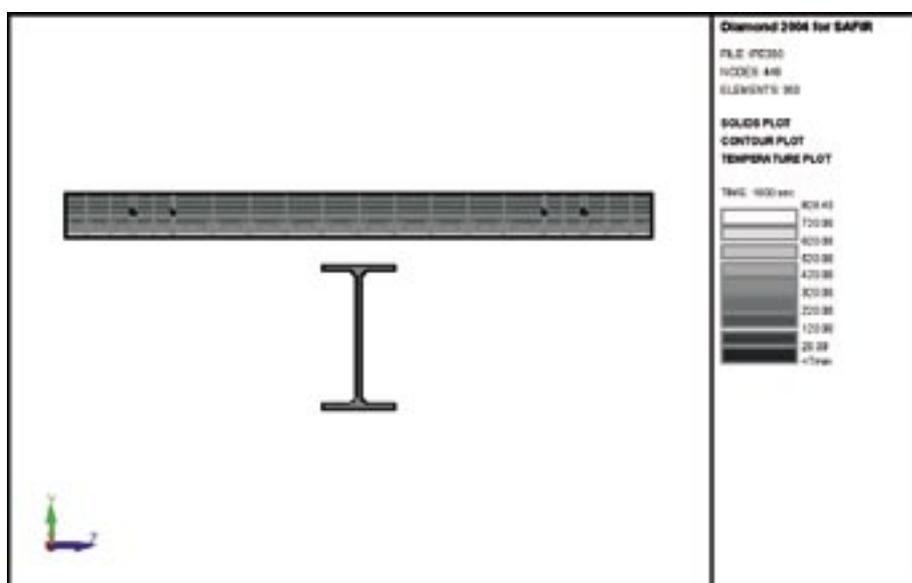
The main benefits of a performance-based approach are:

- ✓ Better assessment of the real behaviour of structures in fires
- ✓ A higher level of safety
- ✓ Better knowledge of the safety of the building
- ✓ More flexibility in the concept and the design
- ✓ In most cases, lower cost for fire protection
- ✓ In any case, better use of the fire protection measures.

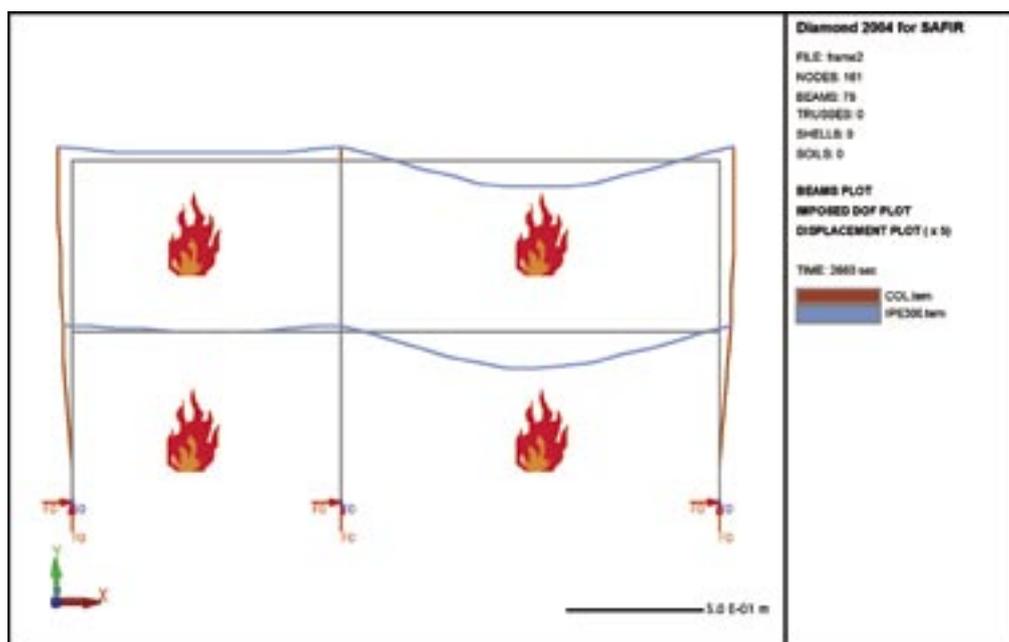
*For more information about structural fire safety analysis and design please contact Jean-François Cadorin at [JFCadorin@fpc.be](mailto:JFCadorin@fpc.be)*



*Temperatures in a column section after 30 min of fire exposure*



*Temperatures in the beam section after 30 min of fire exposure*



*Deformation of the frame just before failure*

Example of the modelling of the structural behaviour of a composite steel and concrete frame submitted to fire (Finite element model SAFIR developed at University of Liege)

# Petrochemical Industry – Qatar

## Evaluation of Firewater Supply and Distribution System

### Project Introduction

This project was conducted for a joint venture company established in Qatar and relates to the construction of a world class Linear Low Density Polyethylene (LLDPE) plant. The plant is expected to produce around 450,000 metric tons of polyethylene every year, which will be mainly exported to Asia and Europe.



### Project request

FPC's client requested a feasibility study to determine if the existing firewater network and supply of an adjacent plant would be capable to deliver the required demand at the new LLDPE plant.

Therefore an evaluation was required in terms of (1) expected firewater demands at the new plant and (2) capabilities of the existing fire water supply and distribution network to deliver the demand.

### Project challenges

The main project challenges related to the selection and definition of performance-based criteria for several design aspects such as:

- ✓ Defining what design fire is most critical in terms of firewater supply
- ✓ Determining the required pressure and quantity of firewater
- ✓ Selecting the most performant fire fighting systems to deliver the required supply

- ✓ Developing design criteria for existing and new firewater system.

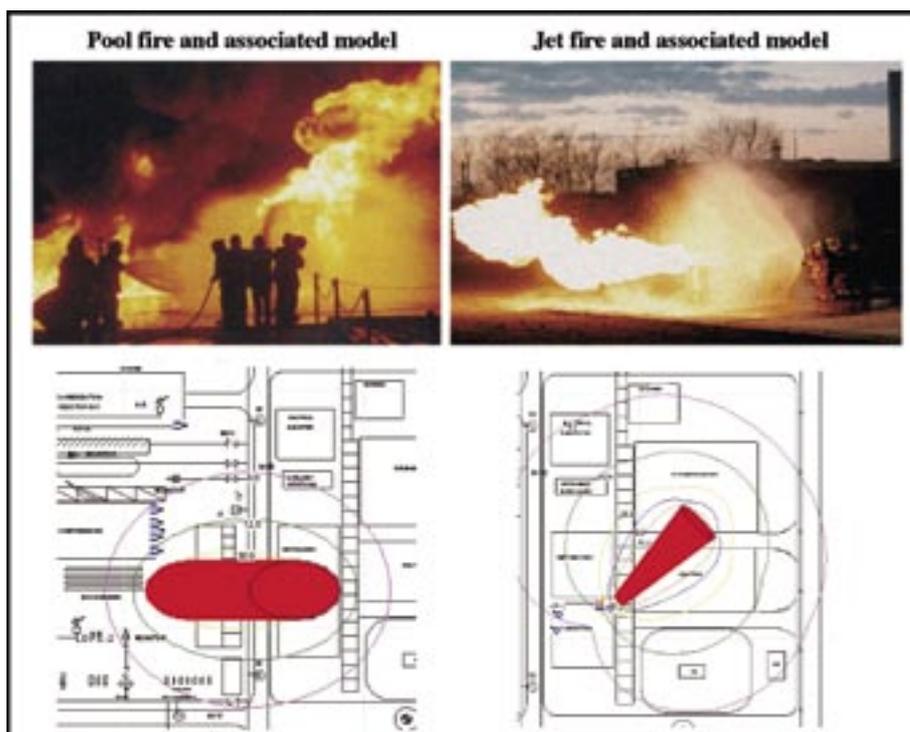
### Project approach

FPC applied following steps to achieve the project goal:

1. Definition of a series of credible fire scenarios;
2. Assessment of heat radiation impact on surrounding installations/equipment;
3. Determination of the theoretical required firewater demand for the most credible/demanding scenarios;
4. Translation of theoretical demands into application rates supplied by fire fighting systems;
5. Conducting hydraulic analysis to verify if the firewater network and the pumps are able to meet this demand;
6. Formulation of recommendations and proposition of improvements.

### Project results

The study resulted into (i) cost effective recommendations with only limited impact on the existing network and (ii) a highly performant design of the new network to cope with the expected fire risks and associated firewater demands on the new LLDPE plant.



# New projects - a selection



## FPC Offshore in Dutch waters

Petro-Canada Netherlands B.V. (PCNL) is presently developing the De Ruyter field, located in Block P11b. De Ruyter is a new production platform that will be built in the Dutch North Sea some 60 km offshore from The Hague. Scheduled to come on stream mid 2006, FPC is pleased to provide its services to Heerema and IV Consult for the supply and hydraulic verification of some critical fire fighting systems on the platform.

## L&FS Consultancy for Sheraton Jumeirah Suites - Dubai

FPC Middle East Ltd has been awarded a contract by the owning company of Sheraton Jumeirah to provide Life & Fire Safety Consultancy services covering preparation of Firesafety Master Plans and Technical support during construction and commissioning stages of the Sheraton Jumeirah Suites.

The 24 storey building is part of the JBR, Jumeirah Beach Residence Project comprising of 36 high rise towers and four hotels. Overlooking the brilliant blue of the Gulf, Jumeirah Beach Residence is a unique beach resort located right at the heart of Dubai's new growth corridor, one that includes luxury hotels, golf clubs and universities.



## Hilton International Sprinkler Roll Out

FPC has been selected to support Hilton International with a major sprinkler-upgrading programme for a dozen hotels located throughout Europe and Africa. FPC's scope relates to the preparation of bid documents for all hotels and to support Hilton with overall project management.

Featured at the all-day event were speakers from continental Europe, the US and UK, the Middle East and Japan. Topics of discussion covered a wide spectrum ranging from insurance issues, legislation, emergency management and quality risk assessment to cost benefit analysis and performance-based design. Having myself been in the fire protection engineering profession for over 40 years I was reminded of the vast breadth the field has evolved to include over the decades... with applications in facilities ranging from high-rise buildings to the petrochemical industries.

The 30-year celebration not only marked the great advancements in the field



but also the individual leadership of its founder, engineer Ed Bruyninckx. Ed had the vision to bring a high quality, leading consultancy to Europe and the Middle

East and oversaw a highly successful business enterprise along the way. And, for me personally, it was a great pleasure to see the torch passed along to Ed's son Ralph Bruyninckx. Ralf completed his fire protection engineering master of science degree as one of my students at Worcester Polytechnic Institute...he was the first Belgian to do so! We professors get great satisfaction from seeing our students succeed.

Congratulations to FPC for its important work in making the world a safer place... and to Ed for his vision and leadership. And best wishes to Ralf and his colleagues for the decades ahead.

**David A. Lucht, P.E., FSFPE**

*Professor and Director Emeritus  
Center for Firesafety Studies*

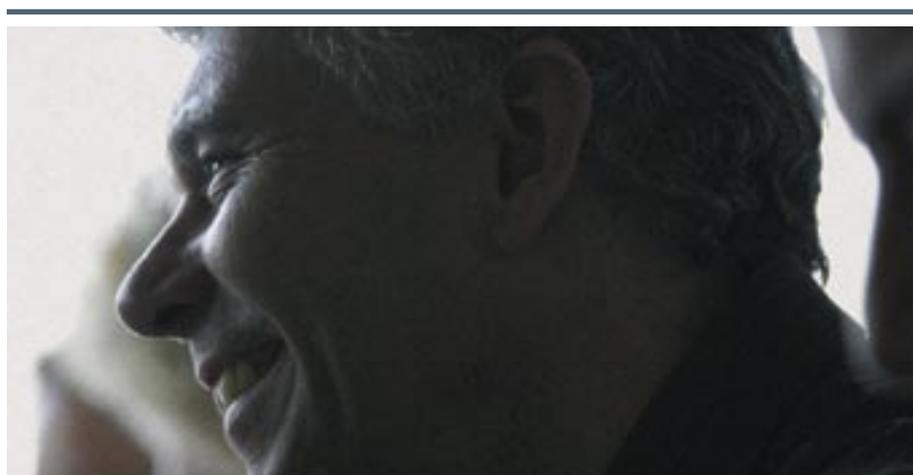
*Worcester Polytechnic Institute (February 2005)*



**The 30 year FPC retrospective caught a lot of attention during the conference. For those who missed it, we have the retrospective included as a supplement.**



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## Luc Feremans XXV years at FPC

We would like to honour our Luc Feremans for his 25 years dedication, loyalty and great work at FPC. Luc was one of FPC's first employees and is without any doubt the hardest working and most travelled man in the entire fire protection industry. Luc has realised numerous complicated projects successfully and is a great motivator to our younger engineers. He is the spirit of the company and a great knowledgeable guy to work with for any customer. Thanks Luc and please keep on going....

**Ralf Bruyninckx**