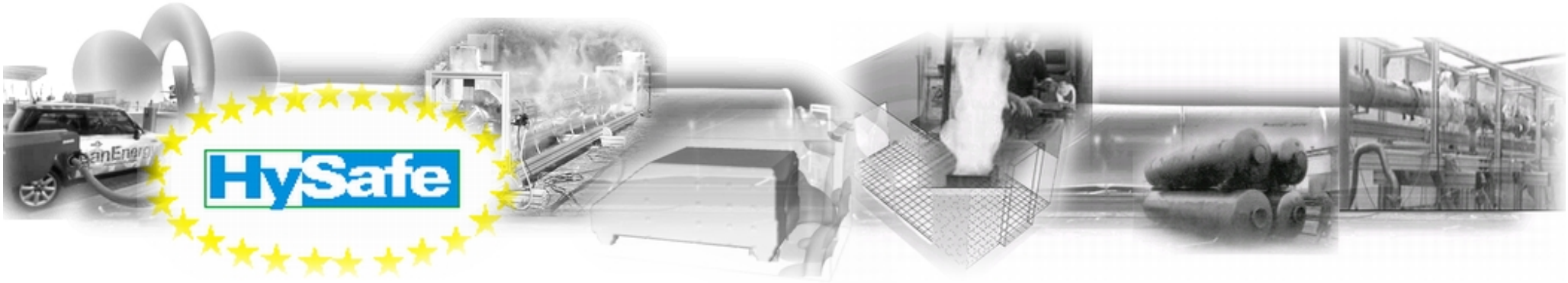
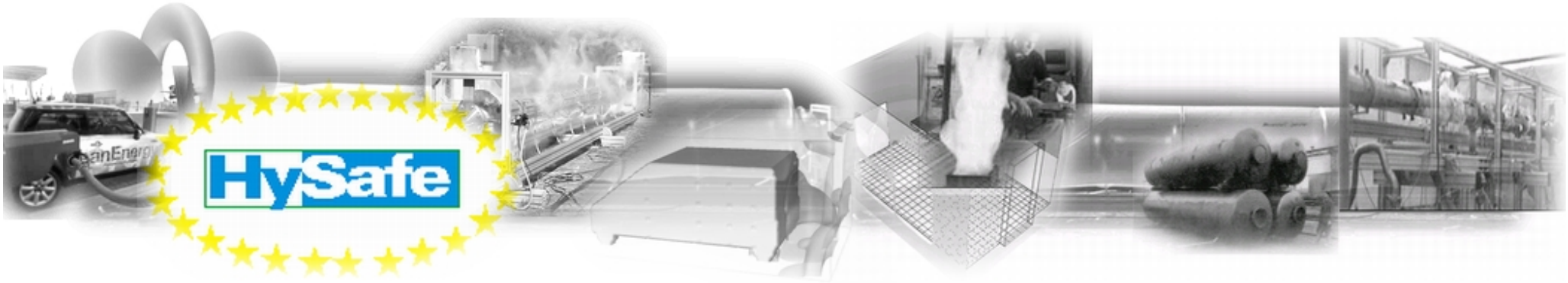
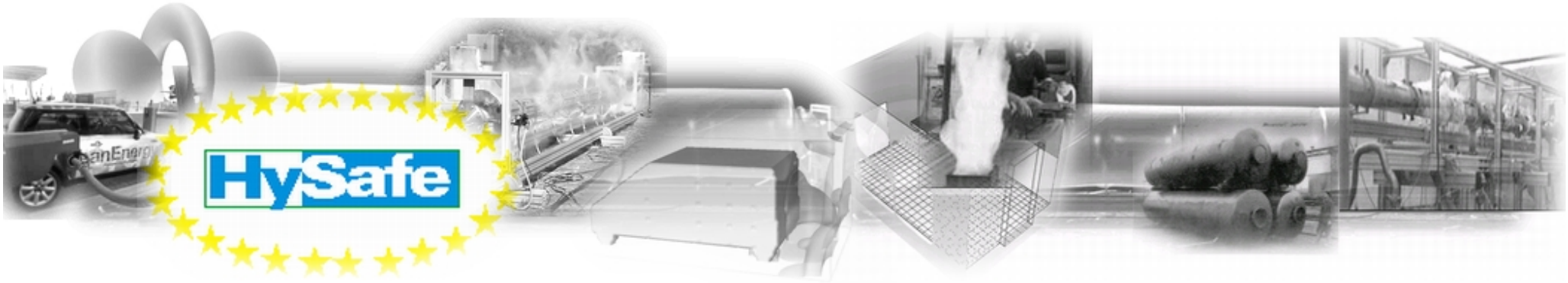


Meeting
e-Academy of Hydrogen Safety
14th of June, 2005
Warsaw, Poland
Institute of Heat Engineering
Warsaw University of Technology



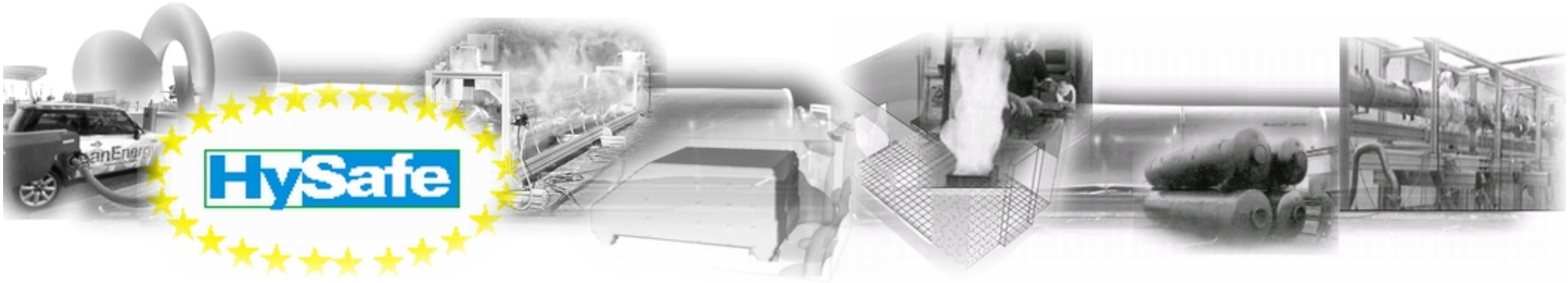
Agenda of the meeting

10.00-10.10	Introduction
10.10-10.50	Module Thermodynamics
	Module Fluid Dynamics
	Module Heat and Mass Transfer
	Module Solid Mechanics
10.50-11.20	Implement improvements/modifications
11.20-11.30	Break
11.30-12.00	Module Introduction to Hydrogen as an Energy Carrier
	Module Combustion Fundamentals of Hydrogen Safety
	Module Release, Mixing and Distribution
12.00-12.30	Implement improvements/modifications
12.30-13.30	Lunch



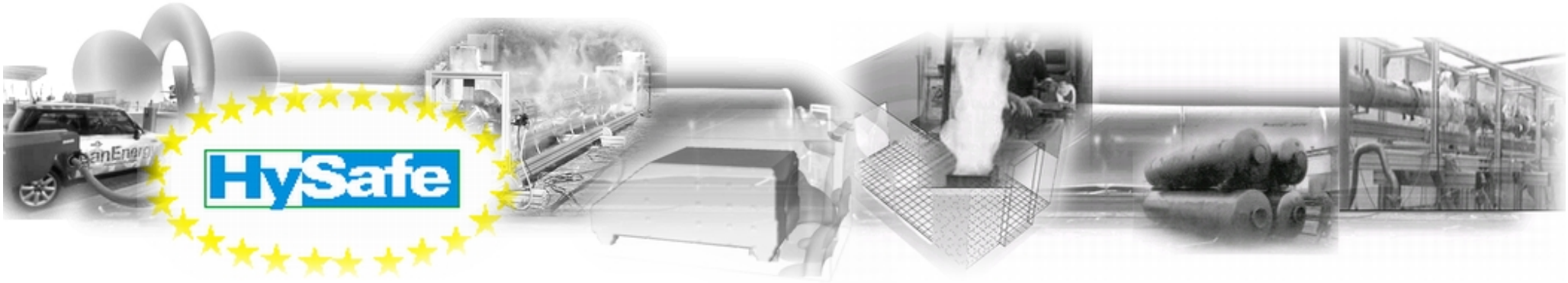
Agenda of the meeting

13.30-14.20	Module Hydrogen Ignition
	Module Hydrogen Fires
	Module Deflagrations and Detonations
	Module Fire and Explosion Effects
14.20-14.50	Implement improvements/modifications
14.50-15.00	Break
15.00-15.50	Module Hydrogen Mitigation
	Module Risk Assessment
	Module Computational Hydrogen Safety Engineering
15.50-16.20	Implement improvements/modifications
16.20-16.30	Conclusion



Objectives of the meeting:

- Modification/improvement curriculum structure
- Modification/improvement detailed topical content
- Agreement on changes already proposed to curriculum structure and topical content
- Prepare deliverable D30 !!!



There are no educational/training programmes in Europe on Hydrogen Safety at the moment

Status of WP15 (12 MM for 18 months)

e-Academy of Hydrogen Safety

Partners: UU, UPM, UNIPI, IST, UC, WUT, GexCon, FZK, FZJ

Objectives (1-18) and (13-30)

Objective (1-18):

- Integration of academic and other institutions through the development of international curriculum on hydrogen safety engineering

Updated objectives for a new period (13-30):

- Integration of academic and other institutions through the development and **implementation** of international curriculum on hydrogen safety engineering
- Support of database of organisations working in hydrogen industry
- **New:** The creation of **new European cadres** of researchers contributing to closing the knowledge gaps in hydrogen safety (MC EST **HySAFEST** “EST in Fundamentals of Hydrogen Safety”)
- **New:** **Spreading the excellence** through the organisation of coherent series of training courses on hydrogen safety (MC SCF **HyCourse** “European Summer School on Hydrogen Safety”)

JPA months 1-18

Efforts:

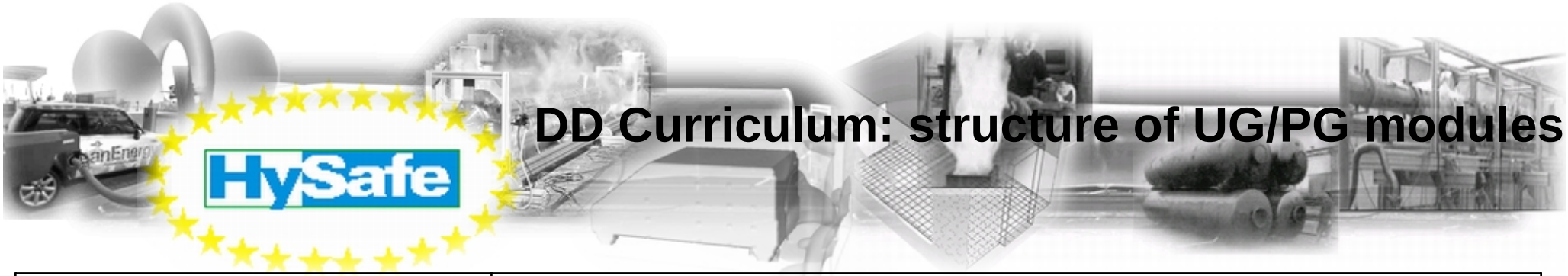
- Lecturer in Hydrogen Safety at the University of Ulster
- Draft for Development of International Curriculum on Hydrogen Safety Engineering, its structure, topical content and references has been developed and placed on HySafe website; D30, month 17
- Database of organisations working in the hydrogen industry has been brought to 1000; D17, month 11
- Consolidated topics for research students; month 17
- Marie Curie actions to gain critical mass: HySAFEST, HyCourse

Sub-task 15.1 Update

15.1. International curriculum on hydrogen safety engineering

- Input from WP15 HySafe partners: UNIPI, UPM, GexCon, FZK, FZJ
- Input from WP12 Risk Assessment Methodologies
- Input from HySafe partners: Air Liquid, NH, DNV, TNO
- Input from HySafe Advisory Board: Sergey Dorofeev, Dag Bjerkedvedt
- Experts from outside: University of Bergen, NRIFD (Japan), Kurchatov Institute (Russia)
- Output to WP13 (Website, Version 1 at month 10…)
- Output to WP1 (BRHS, month 11): contents of BRHS (mutual improvements)

Output to WP4 (PSR, month 9): “zero page” for phenomena and scenario ranking



DD Curriculum: structure of UG/PG modules

Basic modules	Module Thermodynamics Module Fluid Dynamics Module Heat and Mass Transfer Module Solid Mechanics
Fundamental modules	Module Introduction to Hydrogen as an Energy Carrier Module Fundamentals of Hydrogen Safety Module Release, Mixing and Distribution Module Hydrogen Ignition Module Hydrogen Fires Module Deflagrations and Detonations
Applied modules	Module Fire and Explosion Effects Module Hydrogen Mitigation Module Risk Assessment Module Computational Hydrogen Safety Engineering

Detailed topical information is on www.hysafe.org

Sub-task 15.2 Update

15.2. Database of hydrogen industry organisations

Database of organisations working in the hydrogen industry has been brought to 1000 in January 2005 (D30, month11) and is now being led by partner WUT:

- Usefulness of database was tested by sending a questionnaire on the level of interest in Hydrogen Safety Education to about 600 organisations. The catchment population was 28 (20 from respondents outside and 8 inside HySafe), yielding a potential market of average 119 trainees/year. The largest interest is in Short Courses (40%), followed by MSc (30%) and PG Certificate (11%)

8 HySafe partners

20 other institutions

QUESTIONNAIRE
Assessment of the demand for education on Hydrogen Safety Engineering

Title/Name: .....
Company/Institution: .....
Address: .....
City/Area: .....
Post code: .....
Country: .....
Telephone: .....
Fax: .....
E-mail: .....
URL: .....
No. of employees: .....

1. Is your company/institution involved in the hydrogen industry or in hydrogen-related activities?

Yes ☐ No ☐

2. How many people in your company/institution are involved in hydrogen related activities?

1-10 ☐ 11-100 ☐ 101-1000 ☐ 1000-10000 ☐ More than 10000 ☐

3. How would you categorise your company involvement in hydrogen related activities?

☐ % in design ☐ % in manufacture ☐ % in legislation
☐ % in maintenance ☐ % in installation ☐ % in research
☐ % in teaching

4. How many people in your company/institution would be interested in education on Hydrogen Safety Engineering each year?

1-10 ☐ 10-20 ☐ 20-50 ☐ 50-100 ☐ More than 100 ☐

5. What is the most beneficial for your company/institution in terms of continuous professional development of its employees?

☐ % Postgraduate Certificate ☐ % Postgraduate Diploma
☐ % Master of Science ☐ % Short courses
☐ % CPD (continuous professional development) course

Thank you for your cooperation!

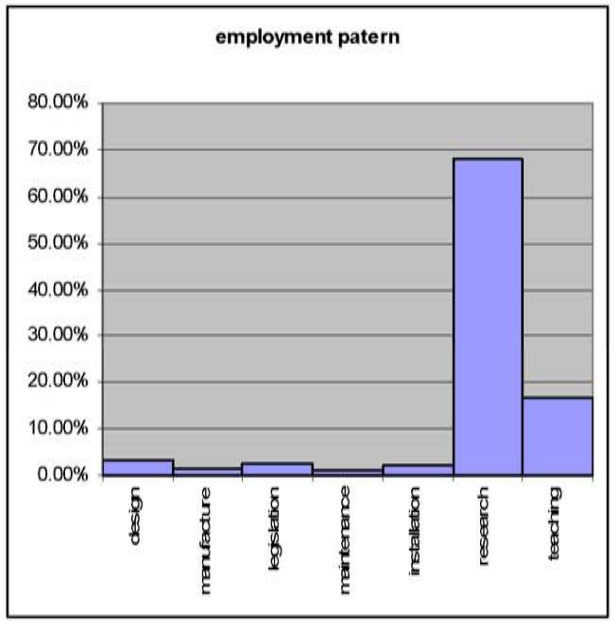
Please return this Questionnaire by post, e-mail or fax to:
Dr Arief Dahoe
FireSERT (Block 27)
University of Ulster
Newtownabbey, BT37 0QB, UK

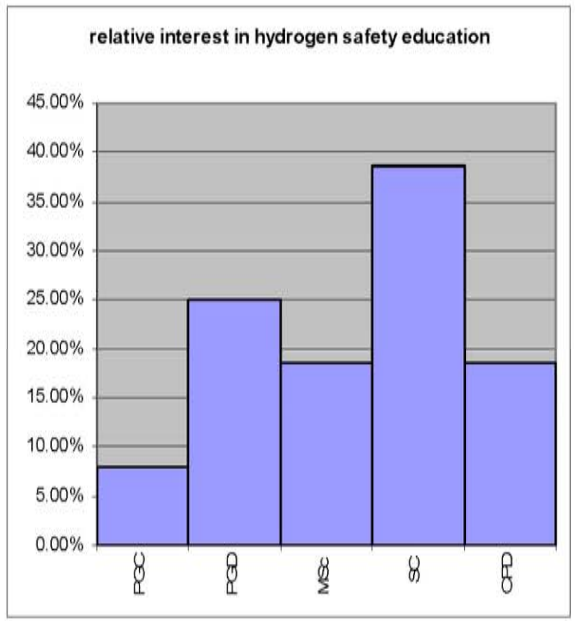
Phone: +44(0)2890 368763
Fax: +44(0)2890 368700
E-mail: ae.dahoe@ulster.ac.uk

Questionnaire results

Employment pattern	
design	3.45%
manufacture	1.61%
legislation	2.71%
maintenance	1.01%
installation	2.38%
research	68.21%
teaching	16.79%

Interest in Hydrogen Safety Education	
Postgraduate Certifcate (PGC)	7.87%
Postgraduate Diploma (PGD)	25.00%
Master of Science (MSc)	18.51%
Short Course (SC)	38.72%
Continuous Professional Development (CPD)	18.51%





Sub-task 15.3 Update

15.3. Consolidated topics for research students

WUT – 6 topics; UU – 5 topics; FZJ – 2 topics; Advisory Board (Dag Bjerkedvedt) – 3 topics; CEA – 1 topic = **17 topics** +

HySafe Website (WP13)

+ Marie Curie **HySAFEST** „EST in Fundamentals of Hydrogen Safety“ tentative topics (15.12.04, Stage 1; 26.04.05, Stage 2):

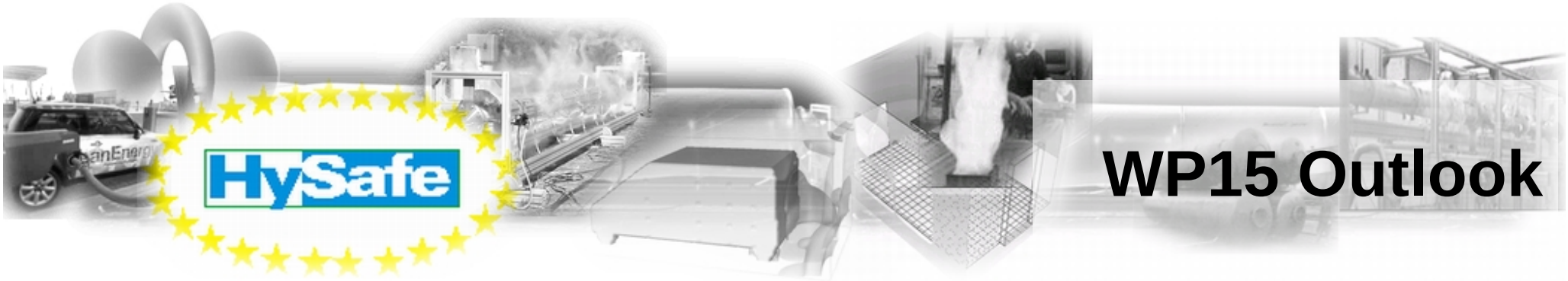
- Formation and combustion of inhomogeneous clouds after unscheduled releases of hydrogen in confined geometries and atmosphere;
- Mechanisms of hydrogen ignition, jet fires and conjugate heat transfer to construction elements;
- Mitigation technologies for hydrogen deflagrations and deflagration-to-detonation transition;
- Comparative risk analysis of hydrogen and hydrocarbon fuels throughout a life cycle of typical applications

Success

- **Contributions to Integration**
  - Collaborative development of the Draft for Development of an **International Curriculum** for Hydrogen Safety Engineering (45 pages); placement on the *HySafe website.*
  - Deployment of the **Database of Organisations** working in the Hydrogen Industry: a tool for teaching/training "marketing"; spread of information on HySafe activities throughout the world.
  - HRM Marie-Curie actions:
    creation of "exchange" opportunities for EST researchers of HySafe partners (**HySAFEST**),
    promotion of knowledge dissemination (**HyCourse**).
  - Unification of topics in **WP15, WP1 (BRHS), WP4 (SPR)**

Status vs Planning

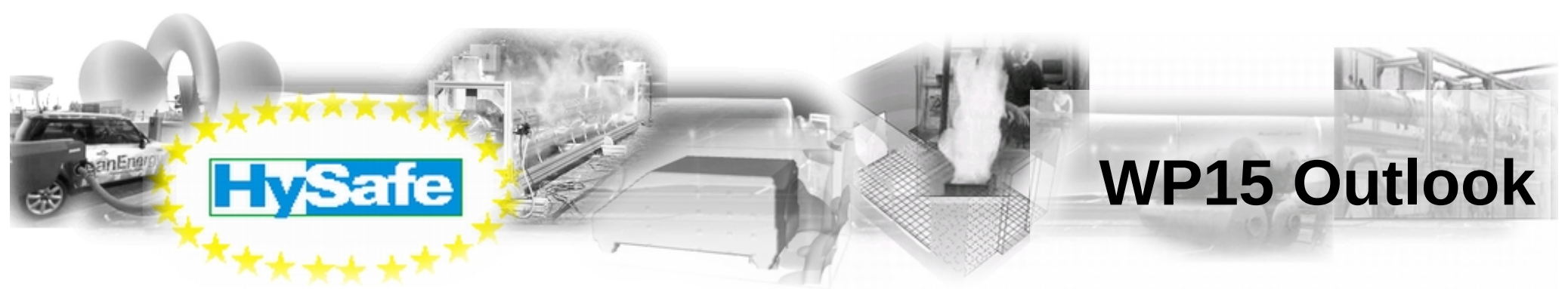
- **No deviations from JPA planning**
- **Foreseen difficulty:** pro-active implementation of educational programmes at Universities (finance). The following scheme aims to tackle this:
  - Development of International Curriculum (HySafe);
  - Development of detailed Teaching Materials (HyCourse: to fill in the Curriculum topics by materials prepared by leading experts throughout the world);
  - Distance learning modules (HyCourse) to “test” the market before Universities investment.



WP15 Outlook

NEXT STEPS:

- **Month 15:** Application “European Summer School on Hydrogen Safety” (**HyCourse**)
- **Month 16:** WP15 meeting (Warsaw): International Curriculum + HyCourse
- **Month 17:** List of consolidated topics for research students (placed on WWW)
- **Month 17: D17 –** DD International Curriculum on Hydrogen Safety Engineering
- **Month 19:** Dissemination of the DD ICHSE within and outside NoE HySafe
- **Month 23:** annual **D30 –** Database of hydrogen industry organisations (2000 - WUT)
- **Month 27:** Recruitment of **HySAFEST** researchers from HySafe partners, etc
- **Month 29:** The First European Summer School on Hydrogen Safety at UU
- **Month 30:** Update of International Curriculum on Hydrogen Safety Engineering
- **Month 30:** Start of the first MC project **“EST in Fundamentals of Hydrogen Safety”** complementary to e-Academy of Hydrogen Safety



WP15 Outlook

1st European Summer School on H2 Safety

12 15 18 21 24 27 30

D30 DBO 1000

MC Summer School application

M

D17 Curriculum

Meeting DD

MS Dissemination of curriculum

MS Consolidated topics

MS Curriculum

D30 DBO 2000

MS Conferences structure

EST recruitment

MS Curriculum update

HySAFEST start

Participants e-Academy Meeting 14th of June 2005, Warsaw

Participants
A. Teodorczyck (WUT)
T. Jordan (FZK)
H. Schneider (Fh-ICT)
O. Hansen (GexCon)
A. Marangon (UNIPI)
V. Molkov (UU)
A. Dahoe (UU)

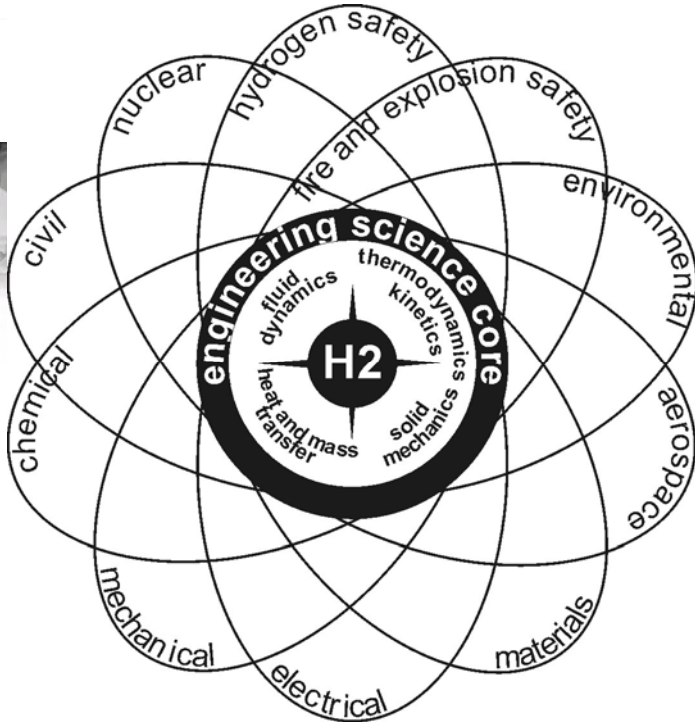
Objectives of the meeting:

- Modification/improvement curriculum structure
- Modification/improvement detailed topical content
- Agreement on changes already proposed
- Prepare deliverable D30 !!!

Agreement on changes already proposed

Proposer	Changes already proposed	agree
Dorofeev (FMR)	Modifications to topical content curriculum	y
	Introduce module on combustion (Module Combustion Fundmentals of Hydrogen Safety)	[y]
Engebo (DNV)	Modification structure and topical content of Module Risk Assessment	y
Pasman (TNO)	Introduce LOPA into Module Risk Assessment	y
Gallego (UPM)	Modifications to topical content curriculum	y
	Include module on Fundamentals of Hydrogen Safety covering fundamentals of hydrogen release and mixing, hydrogen ignition properties and ignition sources, fundamentals of hydrogen fires, deflagrations, detonation, transitional hydrogen explosion phenomena	n
	Include Module Hydrogen Prevention & Mitigation covering prevention, protection and mitigation, basic phenomena underpinning mitigation technologies, handling hydrogen releases, inertisation, containment, explosion venting, prevention of hydrogen ignition, flame and detonation arresters, and standards, regulations and good practices related to hydrogen safety	[y]
Makarov (UU)	Addition of Module Computational Hydrogen Safety	y
Reinecke (FZJ)	Modification to detailed topical content Module Hydrogen Mitigation	y
Kirillov (KIAE)	Modifications to topical content curriculum	y

HyCourse



HySafe WP15: create blueprint (i.e. curriculum) for teaching on Hydrogen Safety based on theengineering science core

HyCourse: generate resources for development of teaching materials on Hydrogen Safety by organising 4 Summer Schools (2006,2007,2008,2009)