



The Fuel Cell Testing and STandardisation NETwork **FCTESTNET**

Workshop on Regulations Codes & Standards

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Georgios TSOTRIDIS

European Commission

DG Joint Research Centre

Institute for Energy

PETTEN, The NETHERLANDS



Overview

1. FCTESTNET

- Network objectives
- Network deliverables
- Network structure

2. Transport Applications

Objectives

Deliverables

3. Gaps and needs for future pre-normative R&D

4. FCTESTNET International cooperation on testing



FCTESTNET

START: 01.01.2003

56 participating organisations

Duration: 36 months

Budget: 2.1M€

An FP5 Thematic Network funded by the European Commission

NETWORK OBJECTIVES

➤ Compile already existing and further develop harmonised testing procedures and methodologies applicable to:

- transport applications;
- stationary power sources;
- portable fuel cells

Focusing on:

- fuel cells
- fuel cell stacks
- fuel cell systems

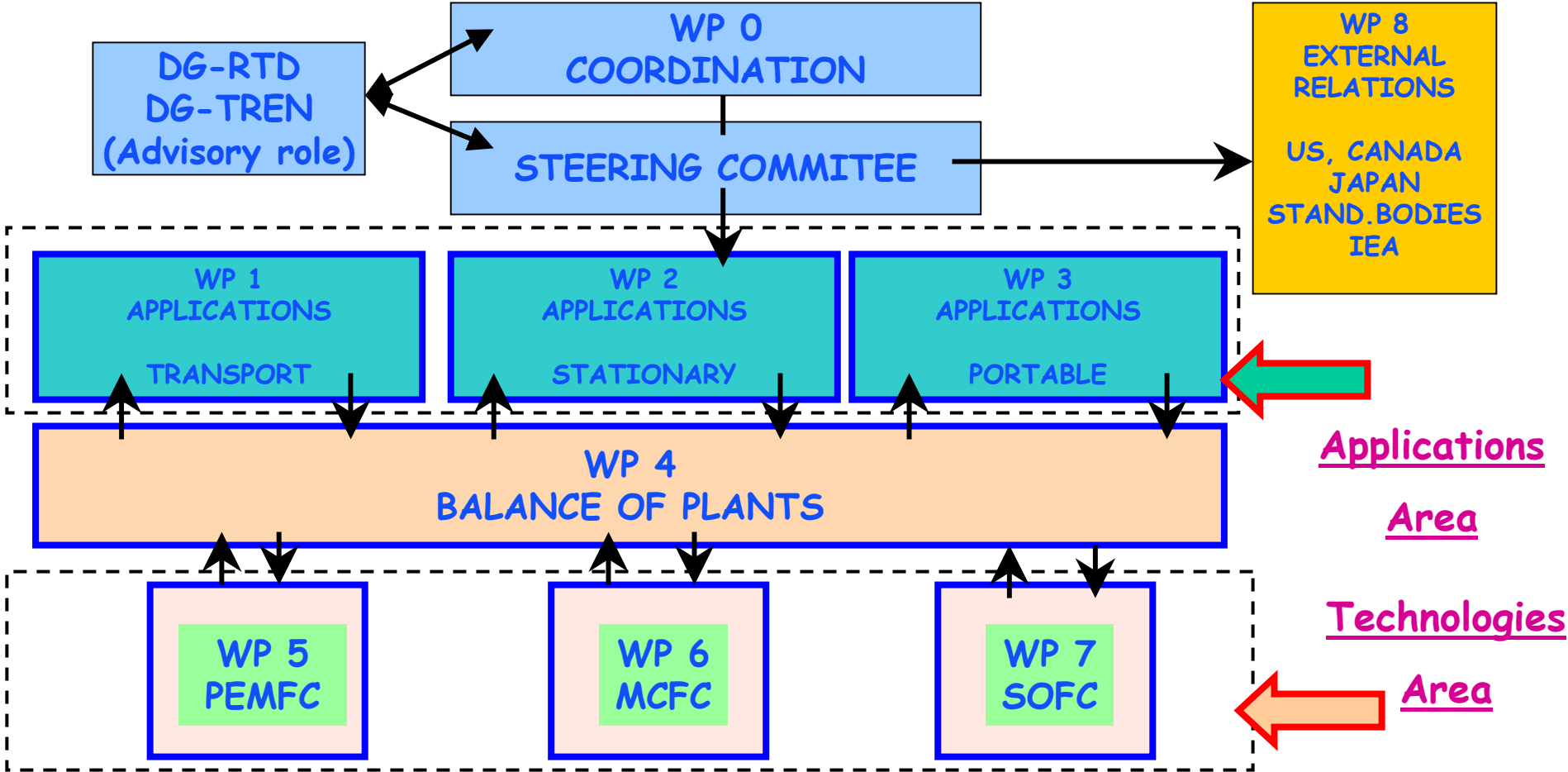


NETWORK DELIVERABLES

- Mapping of testing competencies and inventory of equipment around Europe;
- Compile and further develop methodologies for testing procedures;
- Common measuring criteria;
- Agree and harmonise approaches;
- Establish links between European, US and Japanese standardisation bodies in the frame of harmonising procedures

FCTESTNET STRUCTURE

Joint Research Centre



TRANSPORT APPLICATIONS

Main Objective: To define a general set of tests and the associated test parameters that are necessary to characterize the suitability for different transport applications of various kinds of fuel cell systems, containing different types of fuel cells.

The work package covers the analysis of the following transport applications:

- road transport
- rail transport
- maritime application
- aviation



- TRANSPORT APPLICATIONS (cont.)

Focus on test procedures for the evaluation of **fuel cell systems** in relation to transport applications with respect to:

- performance
- efficiency
- emissions
- response to ambient conditions (temperature, shock & vibrations, etc.)
- safety

TRANSPORT APPLICATIONS DELIVERABLES

- Inventory of operational conditions and requirements that determine the **need for testing**
- Inventory of **existing procedures for conventional systems** which require translation to fuel cells
- Resulting in a 1st **All Relevant Tests (ART) list**
 - It should be updated accordingly
- Development of a **framework for harmonisation**
- Application of harmonisation framework by developing **9 application-oriented test procedures** at FC system level
- Identification of **gaps and need for further work**



TRANSPORT APPLICATIONS DELIVERABLES (cont.)

- Common terminology
 - [FCTESTNET Glossary](#)
- Identification of commonalities and differences in testing requirements for different applications
 - many harmonisation opportunities were found in area of transport applications:
 - basic test requirements appear similar for different applications
 - test conditions and acceptance values vary



- Reports from WP1 TRANSPORT APPLICATIONS
(April 2005)

Report R1: Inventory of existing formal & ad-hoc test procedures for transport applications for conventional engines / systems and vehicles with conventional energy conversion systems (power train & APU),

Report R2: Analysis of operational conditions and requirements for fuel cell systems in transport applications

Report R3: All Relevant Tests list for characterising fuel cell systems in the context of transport applications

Report R4: Test procedures (short versions)

Report R5: Contribution to the research agenda for FC development and application (identification of gaps and needs for future R&D)

Gaps and needs for future pre-normative R&D

Automotive applications

- Generate information in:
 - **exhaust emissions** of various types of FCs (cell type and with/without reformer) in different applications. More information is necessary to be able to identify the needs for adapting measurement and test procedures;
 - In type approval testing only those test conditions are varied which are known to have an effect on the emissions of conventional engines. It should be investigated if these factors are also important for fuel cells;
 - **test conditions** that influence FC system performance
 - **load profiles** for various **APU-applications**

Gaps and needs for future pre-normative R&D

Automotive applications (cont.)

- For road transport applications some procedures are being developed for **type approval testing**:
 - Type approval test procedures should be in place before technology enters the market!
 - For **LD road vehicles** development of vehicle-based procedure using a $v(t)$ driving cycle is rather straightforward
 - For **HD vehicles** type approval occurs at the "engine" level: no meaningful translation to FC and hybrid power trains
 - Need for pre-normative R&D to generate options!

Gaps and needs for future pre-normative R&D

Automotive applications (cont.)

- Study impact of using **real-world test cycles** on comparison between conventional vehicles and HEVs/FCEVs
- **Application-oriented test procedures** at the level of **FC systems** are at present not available:
 - Relevant to vehicle manufacturers and system integrators
 - Enable evaluation and benchmarking of systems developed in EU-funded projects

Gaps and needs for future pre-normative R&D (cont.)

Marine applications

- Test procedures for marine systems focus strongly on **safety and reliability**
 - Current marine regulatory requirements have largely been developed on the basis of incidents and in service experience from existing installations. Fuel cell technology is fundamentally different to that traditionally associated with marine power generation
 - so that any demonstration of the ability to meet existing performance requirements may not always be sufficient or indeed, may perhaps not always be appropriate;

Gaps and needs for future pre-normative R&D (cont.)

Marine applications (cont.)

- New tools for safety evaluation may be necessary
- Dedicated programmes for type testing or approval necessary
- As FC systems are becoming complex, also testing and approval of system components is necessary

Gaps and needs for future pre-normative R&D (cont.)

Aviation applications

- Test modules for FC systems for aviation application are not existing. Can in principle be established by adapting EUROCAE regulations
- Generate more knowledge of **integration** of the FC system **into the aircraft system design**, especially concerning:
 - application area (replacement of battery, ram air turbine or APU)
 - power class (depending on the application)
 - location in the aircraft (interaction with other aircraft components)
 - safety requirements



International co-operation in standardisation and testing

Feb. 2004

1st International FCTESTNET Workshop in Leysin

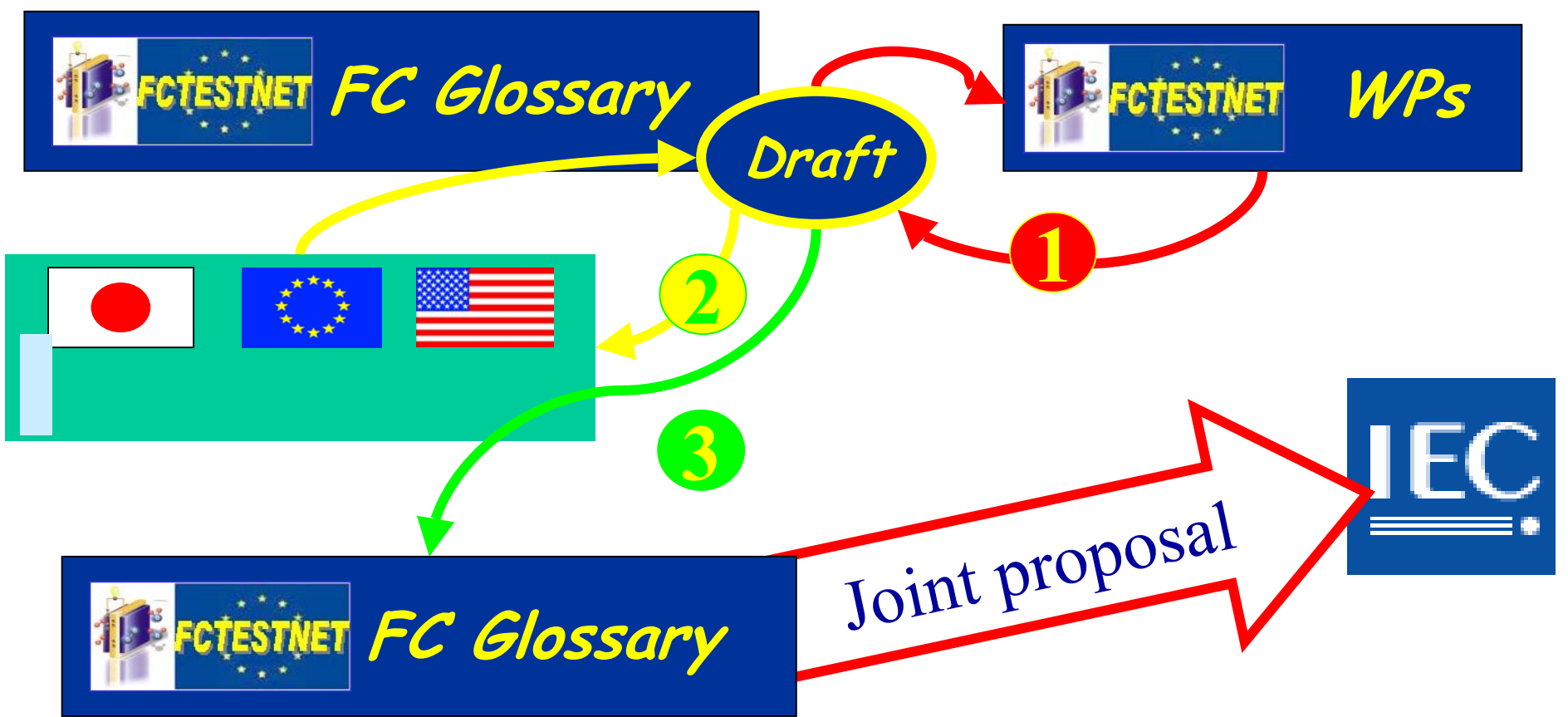
Oct. 2004

2nd International FCTESTNET Workshop in Ulm

**Participation from US DoE, USFCC, NEDO, KIST,
IEA, IEC-TC-105, CEN/CENELEC**

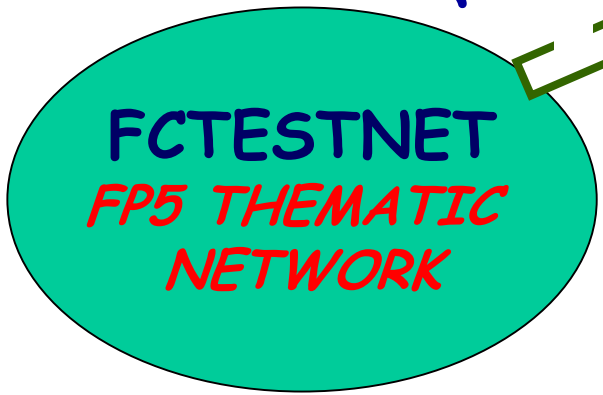
Starting international co-operation in supporting standardisation efforts

Joint Research Centre



Proposed approach in
EU H2+FC
Technology Platform

TP initiative group on C&S



Validation & Benchmarking of
procedures and methodologies
for testing, safety and quality
assurance



Input of Pre-
normative
Research
results to SDOs

Harmonisation of testing
procedures and methodologies