



**Tentative programme**

**Dissemination Conference of HyTunnel-CS project “PNR for safety of hydrogen driven vehicles and transport through tunnels and similar confined spaces”, 14-15 July 2022, Brussels**

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| **Day 1, 14 July 2022** | |
| **Opening and project overview** | |
| 09:00-09:05 | Opening and welcome (D. Makarov, UU) |
| 09:05-09:30 | Hydrogen safety activities within FCH JU (A. Garcia Hombrados, FCH JU) |
| 09:30-09:50 | Overview of HyTunnel-CS project and structure of recommendations for stakeholders (D. Makarov, UU) |
| **Closing knowledge gaps, physical phenomena and engineering tools** | |
| 09:50-10:05 | Concrete spalling by hydrogen jet fires (F. Markert, DTU) |
| 10:05-10:20 | Effect of tunnel slope on hydrogen dispersion (A. Venetsanos, NCSRD) |
| 10:20-10:40 | Effect of counter- and co-flow on hydrogen jets: simulations versus experiment (S. Giannissi, NCSRD) |
| 10:40-10:55 | Correlation for overpressure during ignited spurious hydrogen release (D. Cirrone, UU) |
| *10:55-11:10* | *Coffee break* |
| 11:10-11:30 | Dimensionless correlation for blast wave decay in a tunnel (V. Shentsov, UU) |
| 11:30-11:50 | Deflagration of hydrogen releases and in tunnel: large-scale experiments (W. Rattigan, HSE; E. Tolias, NCSRD) |
| 11:50-12:10 | Scaling experiments at reduced size to real tunnels (HSE) |
| 12:10-12:30 | Blast wave and fireball after hydrogen tank rupture: real tunnel experiments and simulations (D. Bouix, G. Bernard-Michel, CEA) |
| 12:30-12:45 | Drastic difference between fireball dynamics in the open space and in a tunnel (V. Shentsov, UU) |
| 12:45-13:00 | Interaction with water sprays and mist systems with hydrogen fire (J. Grune, PS) |
| 13:00-14:00 | *Lunch* |
| **Recommendations to deal with unignited hydrogen releases and jet fires in confined spaces** | |
| 14:00-14:20 | Principles of inherently safer design of hydrogen vehicles for use in confined spaces (D. Makarov, UU) |
| 14:20-14:35 | ‎Contribution of hydrogen released through TPRD to heat release rate of a vehicle fire (S. Kashkarov, UU)‎ |
| 14:35-14:55 | Garages and maintenance shops: mitigation of pressure peaking phenomenon (A. Gaathaug, USN) |
| 14:55-15:15 | Underground parking: requirements to TPRD size and release direction (V. Shentsov, D. Cirrone, UU) |
| 15:15-15:35 | CFD and FEM study of hydrogen jet fire effect on tunnel structure (D. Cirrone, UU; L. Giuliani, DTU) |
| 15:35-15:50 | *Coffee break* |
| 15:50-16:05 | Erosion of tunnel materials by hydrogen jets (W. Rattigan, HSE) |
| **Recommendations to prevent and mitigate hydrogen deflagrations, DDT and detonations in confined spaces** | |
| 16:05-16:25 | Correlation for flame acceleration and DDT in non-uniform hydrogen-air mixtures in tunnels (M. Kuznetsov, KIT) |
| 16:25-16:45 | ‎CFD and FEM study of hydrogen tank rupture on tunnel structure (V. Shentsov, UU; L. Giuliani, DTU) |
| 16:45-17:05 | Deflagration of non-uniform clouds with concentration gradient (HSE, NCSRD, CEA) |
| 17:05-17:25 | Blast wave attenuation by absorbing materials, water sprays and mist systems (KIT, PS) |
| 17:25-17:40 | Deflagration propagation through fire extinguishing foam (J. Grune, PS) |
| 17:40-18:00 | Q&A session (V. Molkov, UU) |
| **Day 2, 15 July 2022** | |
| **Recommendations to prevent hydrogen tank rupture in a fire** | |
| 09:00-09:20 | Design of tank-TPRD system to exclude rupture in a fire and the pressure peaking phenomenon (S. Kashkarov, UU) |
| 09:20-09:40 | Breakthrough safety technology of explosion free in a fire TPRD-less tank (S. Kashkarov, UU) |
| **Quantitative risk assessment** | |
| 09:40-10:05 | Quantitative risk assessment methodology for hydrogen vehicles in confined space (P. Russo, URS) |
| 10:05-10:25 | QRA of hydrogen vehicles in road tunnels (S. Kashkarov, UU) |
| 10:25-10:45 | QRA of hydrogen trains in rail tunnels (P. Russo, URS) |
| 10:45-11:05 | QRA of hydrogen vehicles in underground parking (F. Markert, DTU) |
| 11:05-11:20 | *Coffee break* |
| **Harmonised recommendations on response to hydrogen accidents** | |
| 11:20-11:40 | Project findings and their effect on intervention strategies and tactics (C. Brauner, IFA) |
| 11:40-12:00 | Interaction of HyTunnel-CS and HyResponder projects (T. Van Esbroeck, SPFI) |
| **Recommendations for RCS** | |
| 12:00-12:25 | Recommendations for Regulations, Codes and Standards (J. van den Berg, NEN) |
| **Q&A session and closing remarks** | |
| 12:25-12:50 | Q&A session (V. Molkov, UU) |
| 12:50-13:00 | Closing remarks (D. Makarov, UU) |

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| **HyTunnel-CS partners** | | | |
|  | UU - University of Ulster, UK (coordinator) |  | IFA - International Fire Academy, Switzerland |
|  | KIT - Karlsruher Institut fuer ‎Technologie, Germany |  | URS - Universita Degli Studi Di Roma La Sapienza, Italy |
|  | NCSRD - National Center for ‎Scientific Research ‎‎"Demokritos", Greece |  | NEN - Stichting Nederlands Normalisatie – Instituut, Netherlands |
|  | USN - Hogskolen I Sorost-Norge, Norway |  | SPFI - Service Public Federal Interieur, Belgium |
|  | HSE - Health and Safety ‎Executive, UK |  | CEA - Commissariat A L Energie Atomique Et Aux Energies Alternatives, France |
|  | DTU - Danmarks Tekniske ‎Universitet, Denmark |  | PS - Pro-Science - Gesellschaft Fur Wissenschaftliche Und Technische Dienstleistungen Mbh, Germany |
|  | FHa - Fundacion Para El ‎Desarrollo De Las Nuevas ‎Tecnologias Del Hidrogeno ‎En Aragon, Spain | **Contact details: Dr Dmitriy Makarov, dv.makarov@ulster.ac.uk** | |