



# Future challenges for tunnel safety and operation from the perspective of the PIARC Tunnels Committee

**Ingo Kaundinya**, Chair PIARC TC 4.4 “Tunnels”

V International Tunneling Forum

6-8 February 2023, Warsaw, Poland and online

# What is PIARC?

- PIARC is the World Road Association
- We were founded in 1909 as a non-profit, non-political Association
- Our goal is to organise exchange of knowledge on all matters related to roads and road transport
- PIARC has a Consultative Status to Economic and Social Council of United Nations since 1970
- Acknowledged for the quality of its outputs
- The activities of the Association are guided by a Strategic Plan of 4 years



# Structure according to Strategic Plan 2020-2023

Strategic Theme 1 Road Administration	Strategic Theme 2 Mobility	Strategic Theme 3 Safety and Sustainability	Strategic Theme 4 Resilient Infrastructure
TECHNICAL COMMITTEES			
TC 1.1 Performance of Transport Administrations	TC 2.1 Mobility in Urban Areas	TC 3.1 Road Safety	TC 4.1 Pavements
TC 1.2 Planning Road Infrastructure and Transport to Economic and Social Development	TC 2.2 Accessibility and Mobility in Rural Areas	TC 3.2 Winter Service	TC 4.2 Bridges
TC 1.3 Finance and Procurement	TC 2.3 Freight	TC 3.3 Asset Management	TC 4.3 Earthworks
TC 1.4 Climate change and resilience of Road Network	TC 2.4 Road Network Operation/ITS	TC 3.4 Environmental Sustainability in Road Infrastructure and Transport	TC 4.4 Tunnels
TC 1.5 Disaster management			
CROSS-CUTTING COMMITTEES			
Terminology Committee			
Road Statistics Committee			
RESPONSE TEAM			
PIARC Covid-19 Response Team			
TASK FORCES			
TF 1.1 Well-Prepared Projects	TF 2.1 New mobility and its impact on road infrastructure and Transport	TF 3.1 Road Infrastructure and Transport Security	TF 4.1 Road Design Standards
TF 1.2 HDM-4	TF 2.2 Electric Road Systems		

# TC 4.4 Tunnels

- 170 members
- 38 Countries around the world represented
- Work is organized in TC meetings and 7 working groups and task





# TC 4.4 Tunnels

- Working groups and task forces

WGs cycle 2020-2023	Leader	Co-leader	Responsible for Topic (Strategic Plan 2020-23)
WG 1 “Sustainable Operations and Maintenance”	Arthur Kabuya	Urs Welte	4.4.2
WG 2 “Safety and Resilience”	Ronald Mante	Bernhard Kohl	4.4.1
WG 3 “ITS in Tunnels”	Henric Modig	Martin Kelly	4.4.4
WG 4 “New Propulsion Technologies & Ventilation”	Peter Sturm	Gary Clark	4.4.3
Task Force “Knowledge Management / Tunnel Manual”	Salvatore Giua	Hing-Wai Wong	4.4.5
Task Force “International Conference”	Rafael Lopez	Ignacio del Rey	4.4.6
Task Force DGQRAM	Christophe Willmann		4.4.7

# Activities in the current work cycle 2020 - 2023

## 1. Measures for increasing resilience of tunnels (4.4.1)

- **Literature Review Report on Tunnel Resilience (2021LR01EN)**
  - More than 100 literature sources were reviewed and the results were synthesized
- **Briefing Note including Collection of Case Studies (2022R04EN)**
  - 18 case studies collected from 12 countries world-wide
- **Full Technical Report (2023)**
  - Containing practical road map to manage and improve resilience;
  - Containing “measure sheets” with assessment of effectiveness and cost-effectiveness of various resilience measures with main focus on recovery



# Activities in the current work cycle 2020 - 2023

## 2. Best practices in management in urban and heavily trafficked tunnels (topic 4.4.2)

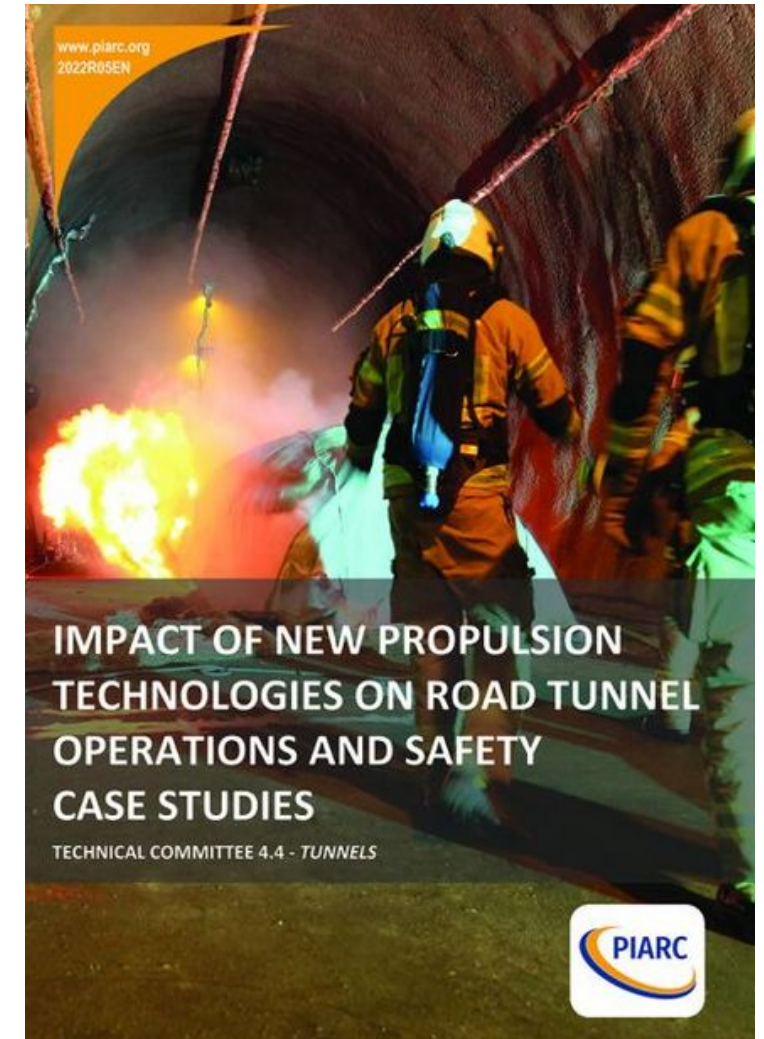
- **Collection of Case Studies Report (2022R06EN)**
  - 11 case studies collected, including
    - Implementation of the "quick responders" concept with different approaches,
    - Measures to organize work and to reduce nuisance to users during the renovation of tunnels,
    - New tools for maintenance and operation.
- **Full Technical Report (2022R34EN)**
  - Recommendations in the fields of traffic, operation maintenance, equipment, refurbishment strategies



# Activities in the current work cycle 2020 - 2023

## 3. Impact of new propulsion technologies on road tunnel operations and safety (topic 4.4.3)

- **Joint Workshop PIARC & ITA Cosuf: Webinar 20./21. October 2021,**
  - Successful event with more than 200 participants,
  - Report & presentations available at [www.ita-cosuf.org](http://www.ita-cosuf.org) & in the Case Studies Report
- **Case Studies Report (2022R05EN):**
  - Results of recent research projects and
  - Some limited information about accidents and fires in road tunnels involving NEC vehicles.
- **Full Technical Report (2023)**





# Activities in the current work cycle 2020 - 2023

## 4. Intelligent Transportation Systems in tunnels (topic 4.4.4)

- **Full Technical Report (2023)**

- Identification of technological advances in ITS and their impact on road tunnel operation and user safety
- Highlight of the main expectations of the tunnel community regarding these systems
- Current topics: Platooning, GPS pilot in Stockholm Southern link, UN regulation No. 157 for ALKS (automated lane keeping systems) – SAE Level 3



Photo: Trafikverket

# Activities in the current work cycle 2020 - 2023

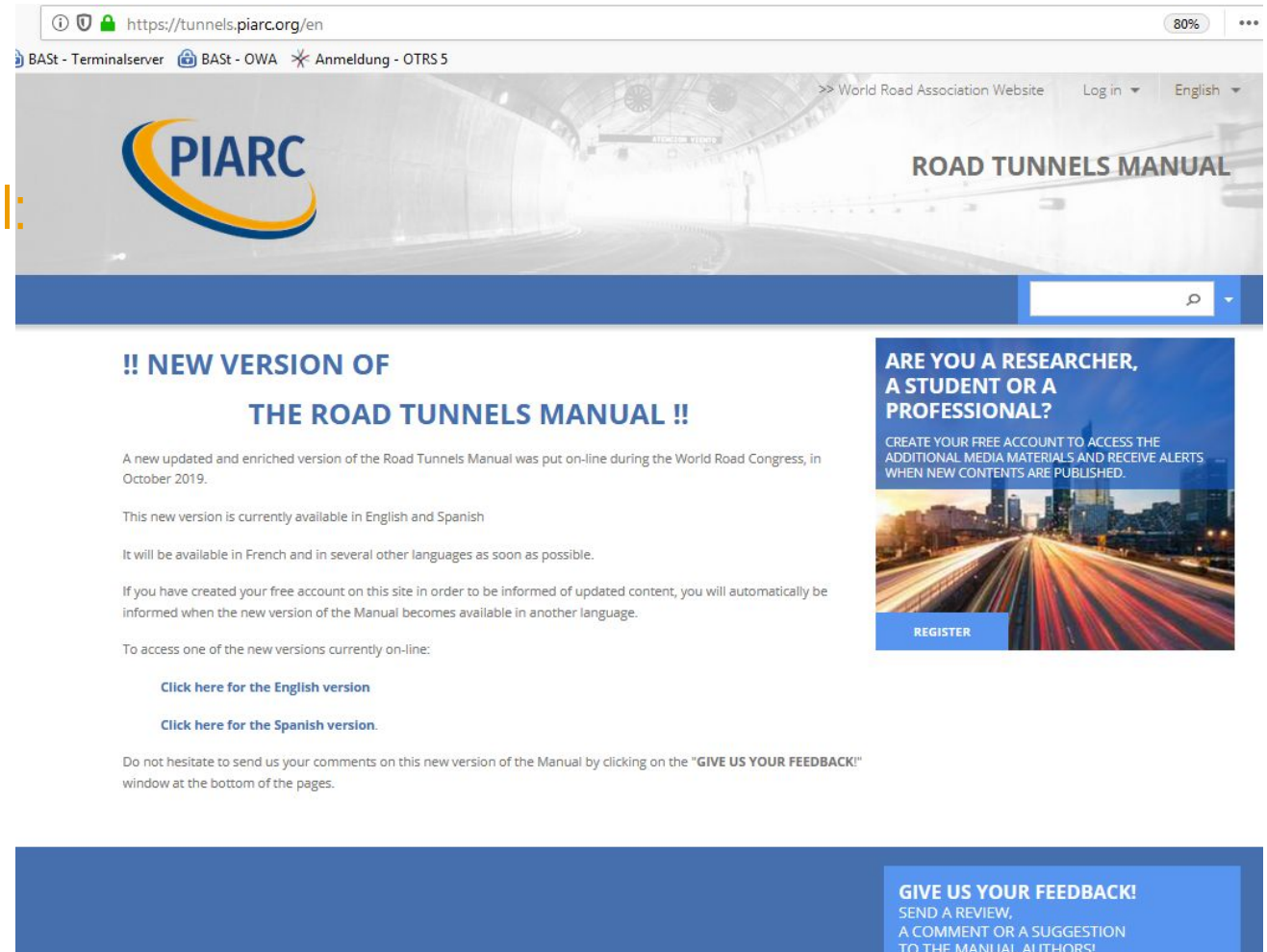
## 5. Update of the Online Road Tunnels Manual (topic 4.4.5)

Ongoing revision of the Road Tunnels Manual:

- NEW (2019) version available (English, Spanish, French)
- New pages on civil works in preparation
- Recent content will be added (e.g. hyperlinks to new reports)

-> All PIARC knowledge on tunnels

<https://tunnels.piarc.org/en>



The screenshot shows the homepage of the PIARC Road Tunnels Manual website. The header features the PIARC logo and the title 'ROAD TUNNELS MANUAL'. A navigation bar includes links for 'World Road Association Website', 'Log in', and 'English'. A search bar is located on the right. The main content area has a blue background with the text '!! NEW VERSION OF THE ROAD TUNNELS MANUAL !!'. Below this, it states: 'A new updated and enriched version of the Road Tunnels Manual was put on-line during the World Road Congress, in October 2019. This new version is currently available in English and Spanish. It will be available in French and in several other languages as soon as possible. If you have created your free account on this site in order to be informed of updated content, you will automatically be informed when the new version of the Manual becomes available in another language. To access one of the new versions currently on-line: Click here for the English version. Click here for the Spanish version. Do not hesitate to send us your comments on this new version of the Manual by clicking on the "GIVE US YOUR FEEDBACK!" window at the bottom of the pages.' On the right side, there is a blue box with the text 'ARE YOU A RESEARCHER, A STUDENT OR A PROFESSIONAL? CREATE YOUR FREE ACCOUNT TO ACCESS THE ADDITIONAL MEDIA MATERIALS AND RECEIVE ALERTS WHEN NEW CONTENTS ARE PUBLISHED. REGISTER'. At the bottom right, there is a blue box with the text 'GIVE US YOUR FEEDBACK! SEND A REVIEW, A COMMENT OR A SUGGESTION TO THE MANUAL AUTHORS!'.



# Activities in the current work cycle 2020 - 2023

## 6. 2<sup>nd</sup> International Conference on Tunnels (topic 4.4.6)

25 - 28 October 2022, Granada, Spain



# Activities in the current work cycle 2020 - 2023

## 7. Support for updating and improving of DG-QRAM Software (topic 4.4.7)

- Update phase 2 of the software is in progress
- New Software Version: DG-QRAM license V 4.04 (phase 1) could be ordered at PIARC ([www.piarc.org](http://www.piarc.org)). Discount if you are already a user of the software
- Video and presentations from the QRAM webinar available at [www.piarc.org](http://www.piarc.org)

Worldwide webinar on the DGQRAM software


**A dangerous goods transport risk assessment tool** that is being upgraded!



DGQRAM (Dangerous Goods Quantitative Risk Assessment Model) is a software developed under the aegis of PIARC (World Road Association). This software can be used to assess the societal risks of transporting dangerous goods through a tunnel or along a given route. It provides quantitative indicators and curves. Results can be aggregated and/or compared between one another and to given criteria. This software is currently used in 26 countries and is in the process of being upgraded.


**23rd June 2021 11:00 – 13:00 UTC**  
07:00 - 09:00 US-DC / 13:00 - 15:00 FRA / 19:00 - 21:00 CN  
20:00 - 22:00 JPN / 21:00 - 23:00 NSW  
Click [here](#) to register

World Road Ass



**Transport of Dangerous Goods through road tunnels: Quantitative Risk Assessment Model (v. 4.04)**

Technical Committee D5 Road Tunnel Operations  
World Road Association



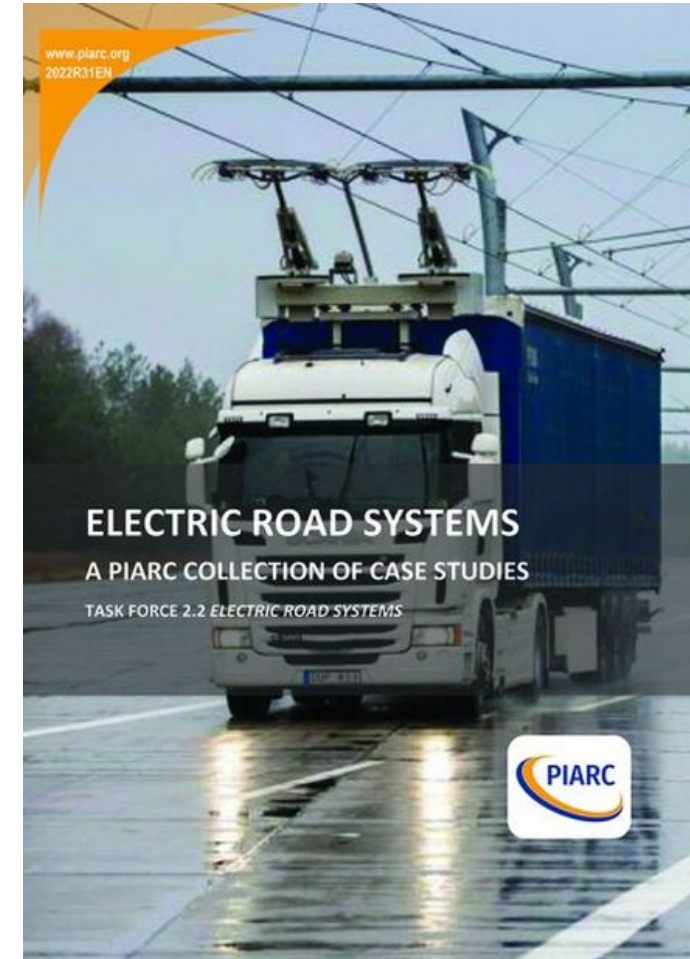
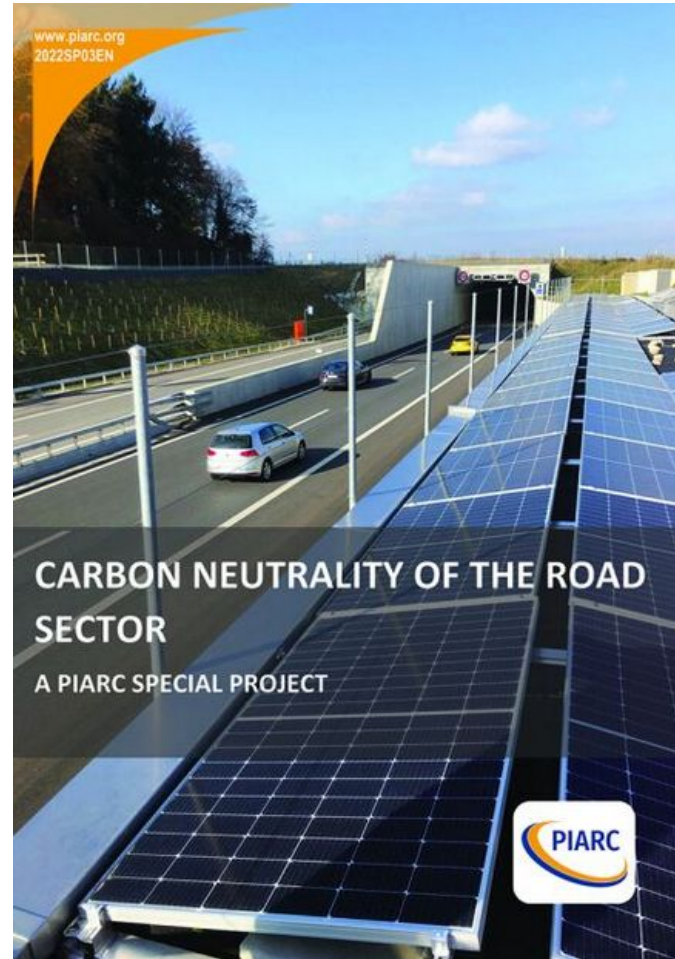
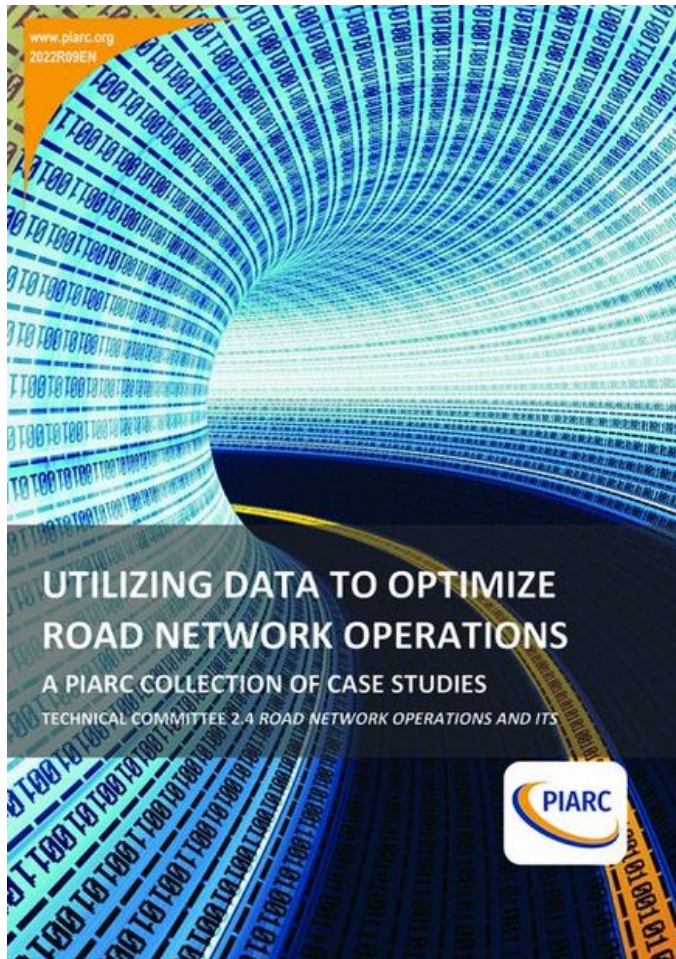
PIARC  
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# Activities in the current work cycle 2020 - 2023

## Other new interesting reports



# Future PIARC Tunnel events

- PIARC International Seminar "Advances in Design, Construction and Maintenance of Tunnels"  
19-21 April 2023 – Dehradun (India)  
(<https://www.piarc.org> and [www.irc.nic.in](http://www.irc.nic.in))
- 27th World Road Congress  
2-6 October 2023, Prague (Czech Republic)  
(<https://www.wrc2023prague.org/>)





# Possible topics for the work cycle 2024 - 2027

## Ongoing topics from current cycle

- Continuous updating of the Online Road Tunnel Manual,
- Further improvement of DG-QRAM,
- Preparation of the 3rd International Conference on Road Tunnel Operation and Safety (2026) and
- Organization of Seminars in low- and middle-income countries.



Photo: ENALOS



Photo: INVIAS / SCI

# Possible topics for the work cycle 2024 - 2027

## Ongoing topics from current cycle

- Road Tunnel Operation and Safety Issues related to the Usage of New Energy Carriers (NEC) in Road Vehicles,
  - Incidents with NEC vehicles, collection of data internationally, probability of incidents,
  - Intervention / incident management, implications of incidents (e.g. with busses),
  - Impact of NEC HGV vehicles,
  - Impact of NEC vehicles on existing regulation,
  - New developments: battery technologies, hydrogen vehicles.



Photo: TU Graz / BRAFA project



Photo: TU Graz / BRAFA project



# Possible topics for the work cycle 2024 - 2027

## NEW topics (under discussion)

- Impact of the development of soft modes of transport (walking, cycling) in (urban) road tunnels
  - Geometry, necessary cross sections, design aspects,
  - Retrofitting of existing urban road tunnels,
  - Safety measures to protect vulnerable road users (like pedestrians, cyclists),
  - Including also reduced mobility users aspects (e.g. electric wheelchairs).



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Photo: CETU

# Possible topics for the work cycle 2024 - 2027

## NEW topics (under discussion)

- Digitalization of Road Tunnel Design and Management
  - Digitalization of operation, maintenance and inspection (e.g. IoT sensors)
  - Digital twins,
  - Impact of new vehicle communications technologies on tunnel safety and operation (e.g. C2X).



  
Baden-Württemberg





# Possible topics for the work cycle 2024 - 2027

## NEW topics (under discussion)

- Sustainability of tunnel operation: new approaches
  - Energy efficiency and sufficiency (e.g. ventilation, lighting)
  - Decarbonization of tunnel equipment, operation & maintenance
  - Focus on new and existing / refurbished tunnels
  - Update of existing PIARC report



Photo: BAST



Photo: BAST

# Conclusions and outlook

- PIARC's Tunnel Committee will continue to monitor, analyze, and make recommendations regarding the current and very dynamic developments in all areas affecting road tunnel safety and operation
- Thank you very much to all committee members involved in the work!
- Please read and use our outputs!
- Interested to contribute to PIARC work? Join us!





Thank you for your kind attention!  
*Dziękujemy za uwagę!*



**Ingo Kaundinya**

Chair

PIARC TC 4.4 Tunnels

**PIARC.TC4-4@bast.de**

World Road Association (PIARC)  
Grande Arche – Paroi Sud – 5<sup>e</sup> étage  
92055 – La Défense Cedex – France



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