

PIARC & lessons learnt in France



*Marc Tesson - PIARC TC D.5 Chairman
International networks & research manager - CETU*

- 1. PIARC activities ... valuable inputs for the tunnel community**
- 2. Lessons learnt in France**

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Technical committee “Road tunnel operations” (D5)

73 TC members + 82 associated members (WGs)



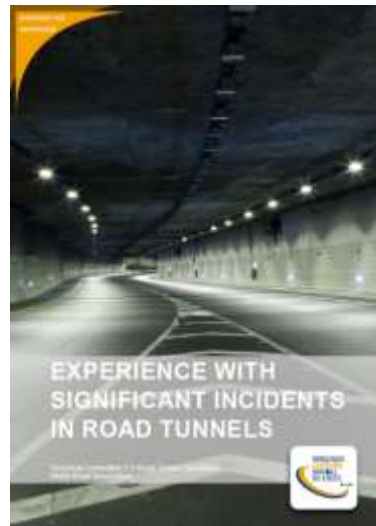
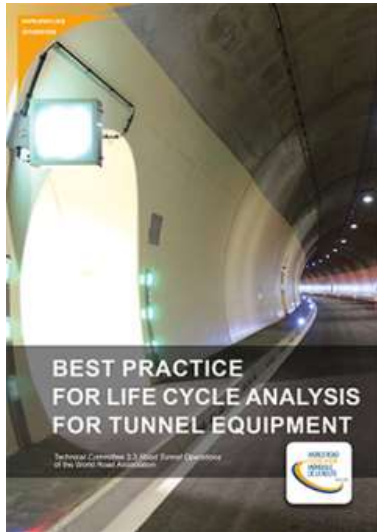
- Staff :**
- Chair : Marc Tesson
 - EN speaking secretary: Gary Clark
 - SP speaking secretary: Rafael Lopez Guargua
 - FR speaking secretary: Jean Claude Martin



Cycle 2016-2019: six Working Groups

	Leader	Co leader
WG1 Sustainable operations	Jean Claude Martin	Urs Welte
WG2 Safety	Ronald Mante	Bernhard Kohl
WG3 Human factors & ITS	Henric Modig	Olivier Martinetto
WG4 Vehicle emissions	Peter Sturm	Gary Clark
WG5 Large Underground Infra.	Bernard Falconnat	Frédéric Wallet
WG6 Knowledge management	Pierre Schmitz	Salvatore Giua

38 PIARC Technical reports available (8 published in 2012-2015)



Cycle 2016-2019: technical reports

- Reliability Availability Maintainability and Safety
- Prevention and Mitigation of Tunnel Related Collisions
- DGQRAM software
- Reduced Mobility Users
- Vehicle emissions
- Large underground and interconnected infrastructures



Cycle 2016-2019: technology watch documents

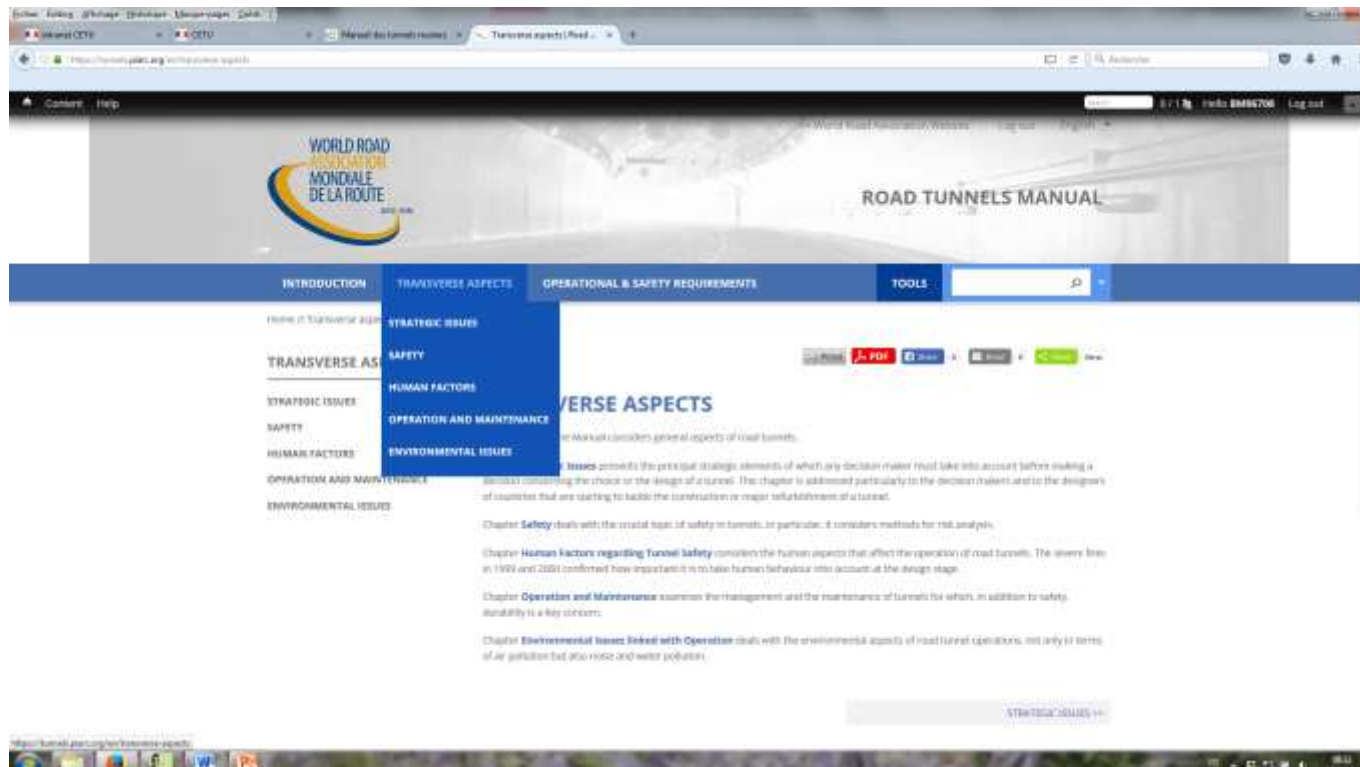
- Led lighting
- Intelligent Transports Systems
- New propulsion systems



38 PIARC Technical reports available

- Widely distributed, acknowledged by the profession
- Available in the current version of the “Road tunnels manual”

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




The screenshot shows the website for the Road Tunnels Manual. The header includes the PIARC logo and the title "ROAD TUNNELS MANUAL". The main navigation menu is divided into several sections: INTRODUCTION, TRANSVERSE ASPECTS, OPERATIONAL & SAFETY REQUIREMENTS, and TOOLS. Under TRANSVERSE ASPECTS, there are sub-sections for STRATEGIC ISSUES, SAFETY, HUMAN FACTORS, OPERATION AND MAINTENANCE, and ENVIRONMENTAL ISSUES. The main content area displays the "TRANSVERSE ASPECTS" section, which includes a list of chapters and their descriptions. The chapters listed are: Strategic Issues, Safety, Human Factors, Operation and Maintenance, and Environmental Issues. The website also features a search bar and a "PDF" icon.

Other activities:

- **International seminars:** South Africa (2017), Colombia (tbc)
- **Workshops:** Montréal (2017)



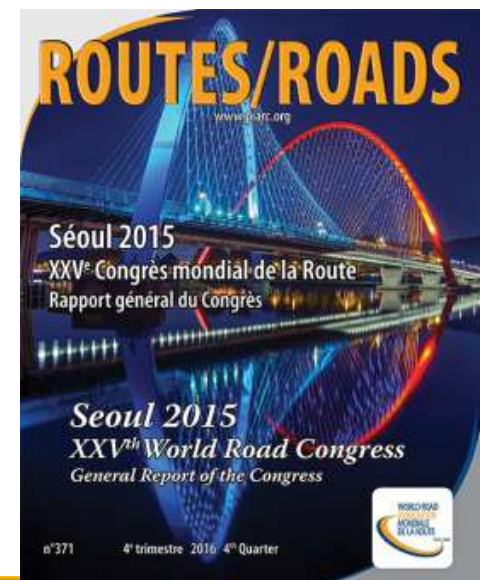
Other activities

- Cross-functional activities (Road tunnels manual, terminology, online training courses)
- Eco Roads project 
- Monitoring of possible future amendments to the « Tunnels » & « Road safety » directives

- Links with “ITA Cosuf”



- Routes/Roads (special tunnel issue: sept. 2018)



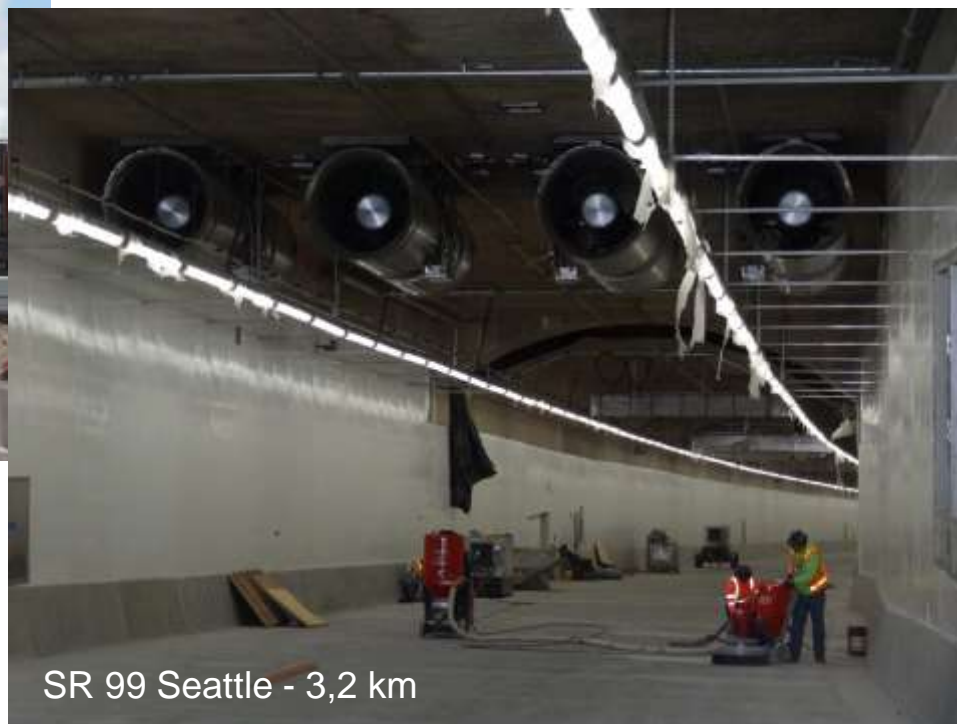
Technical visit: Huguenot tunnel (Cape Town)



Technical visit: Seattle (USA) – SR 99 – 3,2 km



Technical visit: Seattle (USA) – SR 99



Conference web site



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PIARC International Conference on Road Tunnel Operations and Safety

3rd - 5th October 2018
LYON CONVENTION CENTRE - FRANCE

161
Days

13
Hours

PIARC International conference Lyon Oct. 2018 (main objectives):

- Over 300 participants expected
- An internationally recognized platform where you can meet and exchange with a broad spectrum of industry stakeholders
- Presence of representatives from government road directorates and the European Commission
- High profile speakers who are top-level experts in their field
- A chance to keep up-to-date with the latest best practices and PIARC recommendations

PIARC International conference Lyon Oct. 2018 (main objectives):

- Lively round table discussions and debates on current key issues related to tunnel operation and safety
- A two-day exhibition showcasing the latest industry products and services
- Plenty of time to network over refreshment breaks, luncheons and an evening cocktail
- On-site visits

Web Site: <https://www.tunnel-conference-lyon.com/en/>

Contact: contact@tunnel-conference-lyon.com

PIARC International conference Lyon Oct. 2018 (main objectives):

Specifically designed for stakeholders involved in operational and safety aspects of tunnelling, this conference aims to bring together:

- Tunnel owners, designers and operators
- Government and local authority representatives
- Fire and rescue services
- Tunnel Safety Officers
- System providers
- Equipment manufacturers, suppliers and installers
- Consultants and solution providers

International PIARC conference Lyon Oct. 2018:

Two-day conference - 4 technical sessions

- 1. Safety management tools and systems
- 2. Sustainable tunnel operation
- 3. Systems and equipment for tunnel safety
- 4. Future tunnel safety challenges

2 round tables

Numerous time slots have been planned for discussions and networking

International PIARC conference Lyon Oct. 2018:

4 technical visits:



Lyon Convention Centre



How to become a PIARC member ?

Web Site: <https://www.piarc.org/en/>

Contact: info@piarc.org

Questions ... ?

1. PIARC activities ... valuable inputs for the tunnel community
- 2. Lessons learnt in France**

Lessons learnt in France

- 20 years after the major fires in the alpine tunnels
- 15 years after publication of the Tunnel EU Directive
- Non exhaustive list of lessons learnt in France
- Mainly based on the experience gained:
 - within French-speaking working group of road tunnel operators
 - at the Centre for Tunnel Studies (CETU)



Centre for Tunnel Studies

- A technical body of the French Ministry in charge of transport
- Approximately 85 staff members (42 engineers, 13 doctors)
- Involved in all technical aspects of road, rail and waterway tunnels



Multidisciplinary Activities

- Advice and expertise for all stakeholders involved in tunnels
- Development of methodologies, guidelines and regulations
- Research
- Engineering projects
- Training actions
- Networking



Added value of PIARC reports

Example 1: Human Factors

- An important topic dealt with by PIARC (2004/2015)
- Objective: improve our knowledge regarding HF in order to adapt tunnel design & operation accordingly



Added value of PIARC reports

Example 1: Human Factors

- An ambitious research programme carried out at CETU (2003-2018)
- Feedback, experiments, research, exercises, ...
- Objectives: (same as PIARC's objectives)



Effective interactions
between the 2 approaches



Added value of PIARC reports


Example 2: User education & information in France

- Based on PIARC report 20xx
- Training actions focused on professional drivers
- Other users: teasers shortly available on CETU web Site (<http://www.cetu.developpement-durable.gouv.fr/>):
 - in a normal driving situation
 - in case of breakdown
 - in case of fire



Added value of PIARC reports

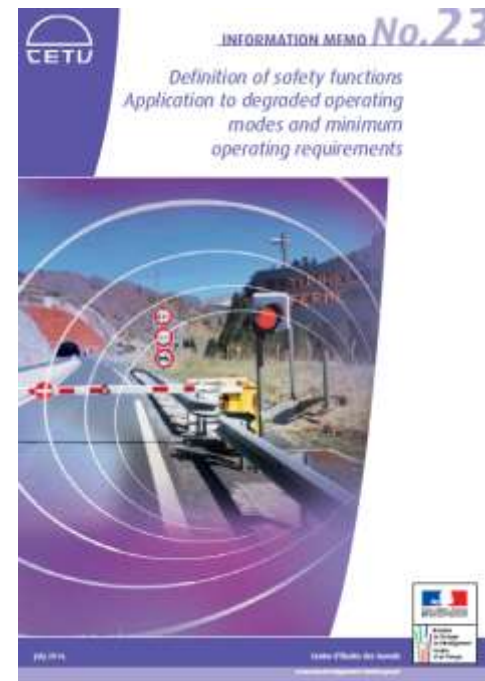
Example 3: Lay-bys

- Trigger: accident in Switzerland (Sierre tunnel - 2012)
- Benchmark / EU countries (PIARC Tunnel Committee)
- PIARC publication (2016)
- Eco Roads project 
- Slight amendments to the Tunnel Directive in order to encourage cooperation between road safety and tunnel experts (transition zone)



Minimum Operating Requirements

- Definition of safety functions - Application to degraded operating modes and minimum operating requirements (CETU - 2014)
- Available on CETU web site (English version)



<http://www.cetu.developpement-durable.gouv.fr/>

Minimum Operating Requirements

2 objectives:

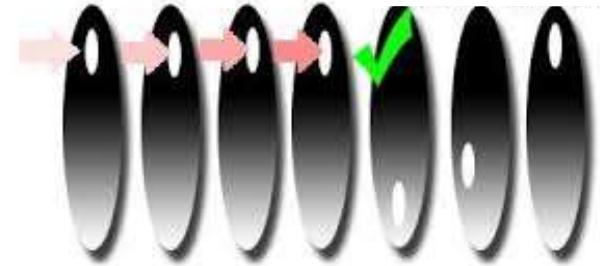
- contribute to work on the reliability of systems
- help develop practices in degraded operating modes and identify minimum operating requirements.



Minimum Operating Requirements

Approach based on safety functions:

- prevent incidents/accidents,
- detect incidents/accidents,
- alert and inform,
- limit the consequences of an incident/accident,
- ensure a return to normal



Consistent with approaches implemented in the context of “Specific Hazard Investigations” and the “Emergency Response Plans”

Minimal Operating Requirements

3 Correspondence between safety functions and resources

Resources		Safety Function	F1: prevent incidents/accidents				F2: detect		F3: alert and inform			F4: limit the consequences of the incident/accident				
			F1-2	F1-3	F1-4	F2-1	F2-2	F3-1	F3-2	F3-3	F4-1	F4-2	F4-3			
		monitor the structure, its equipment, the traffic in the tunnel														
		monitor weather conditions, traffic and the external environment														
		ensure safe, comfortable driving conditions														
		keep users informed of traffic conditions														
		detect an incident/accident														
		classify the incident/accident														
		alert the emergency services														
		alert users in the tunnels and at tunnel heads														
		inform users on the network outside the tunnel														
		minimise the number of users in the tunnel and avoiding subsequent accidents														
		limit escalation of the incident while waiting for the emergency services to arrive														
		facilitate evacuation, get users to safety (self-evacuation)														
M1: Civil engineering	M1-1	roadway and emergency stopping lane														
	M1-2	walkways														
	M1-3	drainage														
	M1-4	emergency exits - shelters														
M2: Centralised technical management and supervision	M2-1	Sensors and actuators														
	M2-2	Site network														
	M2-3	programmable logic controller (PLC)														
	M2-4	Transport and transmission network														
	M2-5	Tunnel Control Station (supervision)														
M3: Power supplies	M3-1	external electricity supply														
	M3-2	electrical substations and low voltage master distribution panel														
	M3-3	uninterruptible back-up power supply														
	M3-4	water supply														
M4: lighting	M4-1	normal lighting														
	M4-2	emergency lighting														
	M4-3	emergency-evacuation equipment lighting														
	M4-4	marker lights														
M5: ventilation	M5-1	sanitary														
	M5-2	smoke extraction														
	M5-3	emergency exits - shelters														
M6: Fire fighting equipment	M6-1	Fire extinguishers														
	M6-2	fire pipe and hydrant														
M7: Incident and fire detection	M7-1	closed-circuit television														
	M7-2	automatic incident detection (AID)														
	M7-3	smoke opacimeters and gas sensors														
	M7-4	anemometers														
	M7-5	fire detection (equipment rooms)														

Minimal Operating Requirements

3 Correspondence between safety functions and resources			Safety Functions	
Resources				
M1: Civil engineering	M1-1	roadway and emergency stopping lane	alert the emergency services	alert users in the tunnels and at tunnel heads
	M1-2	walkways		
	M1-3	drainage		
	M1-4	emergency exits - shelters		
M2: Centralised technical management and supervision	M2-1	Sensors and actuators		
	M2-2	Site network		
	M2-3	programmable logic controller (PLC)		
	M2-4	Transport and transmission network		
	M2-5	Tunnel Control Station (supervision)		
M3: Power supplies	M3-1	external electricity supply		
	M3-2	electrical substations and low voltage master distribution panel		
	M3-3	uninterruptible back-up power supply		
	M3-4	water supply		
M4: lighting	M4-1	normal lighting		
	M4-2	emergency lighting		
	M4-3	emergency-evacuation equipment lighting		
	M4-4	marker lights		

Tunnel safety officers

- A key stakeholder in the context of road tunnel safety
- Mentioned in article 6 of the EU tunnel Directive 2004/54/EC
- Likely to be involved in a wide variety of tasks & functions



Tunnel safety officers

A dynamic and interactive group of experts led by ITA-COSUF: <http://www.ita-cosuf.org/>

- Aims to be the platform for European Tunnel Safety Officers for exchange of experiences through its biannual forum and development of best practices.
- 5th European TSO Forum in Madrid (May 2018)



Tunnel safety officers

The Safety Officer shall perform the following tasks & functions:

- (a) ensure **coordination with emergency** services and take part in the **preparation of operational schemes**
- (b) take part in the planning, implementation and evaluation of **emergency operations**
- (c) take part in the **definition of safety schemes and the specification of the structure, equipment and operation** in respect of both new tunnels and modifications to existing tunnels
- (d) verify that **operational staff and emergency services are trained**, and he/she shall take part in the organisation of exercises held at regular intervals
- (e) give advice on the **commissioning of the structure**, equipment and operation of tunnels
- (f) verify that the tunnel structure and equipment are **maintained and repaired**;
- (g) take part in the **evaluation of any significant incident** or accident as referred to in Article 5(3) and (4).

Valuable inputs for road tunnel safety officers (ast cycle):



Art. 6.2 EU Dir	Life cycle analysis	Exp signif. incidents	Lay bys & obst.	Large Und. Interc. Infra.	RTC	FFFS	Design Fire scenarios	Sustainable opetation
(a)								
(b)								
(c)								
(d)								
(e)								
(f)								
(g)								

Valuable inputs for road tunnel safety officers (Current cycle):

Art. 6.2 EU Dir	RAMS	Tunnel related collisions	DGQRAM	Red. Mob. Users	Veh emissions	Large Und. Int. Infra	Leds	ITS	New Prop.
(a)									
(b)									
(c)									
(d)									
(e)									
(f)									
(g)									

Tunnel safety officers



Main lessons learnt in France:

- Added value of tunnel monitoring committee, which groups together operators, emergency services and the Prefecture at regular intervals,
- Objectives:
 - provide an update on tunnel operating conditions,
 - schedule safety exercises,
 - draw on feedback from events that have occurred in each tunnel.
- Safety officers have an essential role in the creation and the running of such a committee

French-speaking WG of Road tunnel Operators



- About 170 members operating 200 tunnels
- **Main objective:** collaboration between all actors involved in the management and operation of tunnels that are planned, under construction or in service
- **Based on:** exchange of experience, enables operators to be updated on the changes in tunnel regulations and techniques. Contributes to the validation of documents drawn up by the CETU.
- Close links with the UK Road Tunnel Operators forum (British equivalent of GTFE): mutual representative member, feedback on other group's activities in meetings

French-speaking WG of Road Tunnel Operators

2 meetings / year - main topics discussed:

- TSO missions
- Use of simulators to train operator personnel
- Energy savings for tunnel lighting
- Lateral (roadside) obstacles in tunnels
- AID: Presentation of CETU information document + functionalities, existing technologies, performance limitations (by manufacturers)
- Information on reports published by the PIARC TC on Road Tunnel Operations

French-speaking WG of Road Tunnel Operators

2 meetings / year - main topics discussed:

- Safety exercises and feedback
- Equipment maintenance policies
- Self evacuation and emergency exits
- Coordination between maintenance and monitoring
- Developments in lighting technologies and operator feedback
- The issue of over-sized vehicles in tunnels
- Emergency response plan, emergency response strategies (in coordination with emergency services and the French Academy for Fire, Rescue and Civil Protection Officers (ENSOSP))

Visit of the fire brigade training centre



French-speaking WG of road tunnel operators

Homogenization of communication tools for the tunnels in the Greater Lyon area

General organization

In the Greater Lyon area, there are **numerous tunnels** with **different operators**.

=> It was important to **homogenize** the practices of the fire brigades and the various operators, in terms of:

- terminology used, localisation
- the contents of the warning message,
- signage,

...



Main issues for the next PIARC cycle (2020-23)

- ITS & autonomous vehicles:
 - The development of autonomous vehicles in a non-urban environment is likely in the long term
 - Initially, only top-of-the-range vehicles are likely to be autonomous
 - Main avenues for their development in an urban environment:
 - autonomous public transport vehicles
 - autonomous taxi fleets
 - freight/ last kilometre



Main issues for the next PIARC cycle (2020-23)

- ITS & autonomous vehicles
 - PIARC objectives: identify the main expectations from the point of view of the tunnel community:
 - Inter-vehicle distances,
 - Location & identification of DG vehicles,
 - Lane departure warning systems
 - Platooning
 - ...



Main issues for the next PIARC cycle

- Reliability Availability Maintainability Safety
- New propulsion technologies. In case of major incidents: possible consequences, preliminary information & preparatory action for emergency services
- Risk reduction measures and associated risk analysis methods - current practices

... additional proposals might be discussed during the international conference in Lyon (October 2018).

Questions ... ?



Thank you for your attention

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