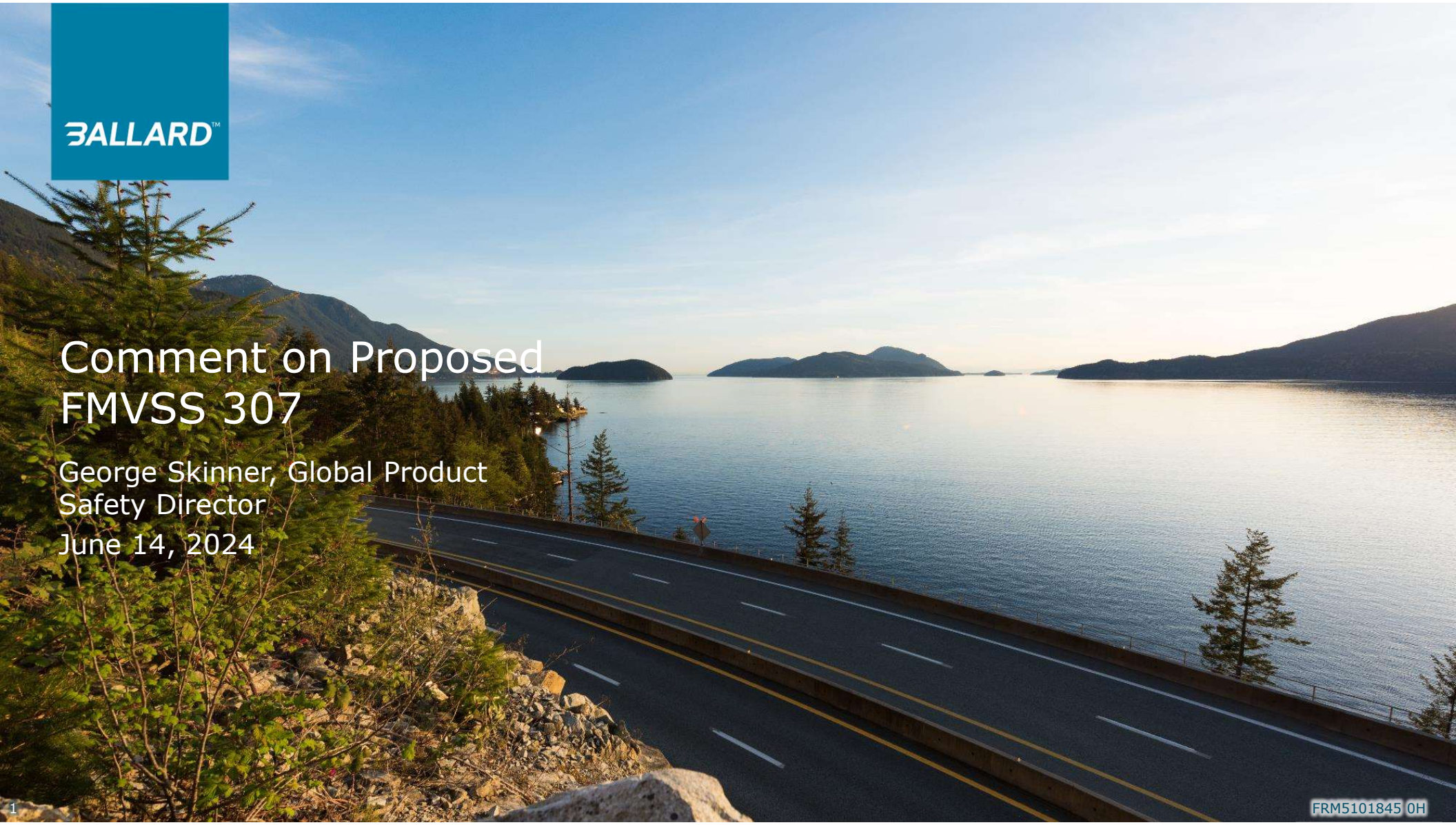

Comment on Proposed FMVSS 307

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Fuel System Leakage Requirements

- 1. Fuel system integrity during normal vehicle operations, e) Fuel system leakage
- "NHTSA is proposing that the fuel system leakage requirement for no leakage apply to the entire hydrogen fuel system downstream of the shut-off valve, which includes the fuel lines and the fuel cell system. NHTSA is further proposing to define fuel lines to include all piping, tubing, joints, and any components such as flow controllers, valves, heat exchangers, and pressure regulators. From a safety standpoint, there is no difference between a leak coming from fuel line piping, and a leak coming from a valve, pressure regulator, or the fuel cell system itself."
- "**While NHTSA is proposing a strict no leakage standard**, we are seeking comment on whether there is a safe level of hydrogen that may leak, and if so, what would be an objective leakage limit and how to accurately quantify hydrogen leakage from the fuel system."

- A strict no leakage standard is likely impractical for hydrogen fuel cell vehicles given extensive use of elastomeric seals and non-metallic materials in sealing system components.
  - Automotive fuel cell stacks typically have a leak rate of ~200 mL/min H2 at beginning of life
  - Allowable leak rate for hydrogen components in CSA HGV 3.1 standard is <10 Ncc/h
- Achieving a no leakage standard would typically require use of welded piping and/or metal seal elements that are prohibitively expensive for automotive manufacturing and may not be well suited for an automotive shock & vibration environment

Here for life

Alternative Proposal

- NHTSA should set a leakage requirement based on ensuring that flammable releases from the system are of a negligible extent
- Hazard of a hydrogen release is based on concentration of hydrogen release rather than quantity of hydrogen released
  - Gas mixtures with hydrogen concentration less than lower flammability limit will not introduce combustion hazards
  - Gas mixtures do not stratify after release

- Non-Flammable releases
  - Approach allows for the use of enclosures around components which are more prone to leakage
  - Typical mitigation techniques include ventilation of enclosure to dilute leaks, and hydrogen detection to support an emergency shutdown strategy in event of a flammable concentration (ties into requirements for maximum H2 concentration in enclosed & semi-enclosed spaces)
  - Hydrogen releases will be of a non-flammable concentration before exhausting into the surrounding, non-classified environment
- Flammable releases should be of negligible extent
  - Example: Use IEC60079-10-1 methodology Figure C.1 and Table D.1 to ensure size of release meets Zone 1 (NE) or Zone 2 (NE) based on typical passive ventilation in vehicle engine bay
  - Example: CSA/ANSI HGV 3.1 standard for vehicle hydrogen system components specifies a maximum leak rate type test not to exceed 10 Ncc/h