ISO/TC 197
Hydrogen technologies

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Hydrogen Dispenser

DEFINITION OF THE PROCESS TO DESIGN AND DEVELOP FUELING PROTOCOLS

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Introduction

Situation with Current Fueling Protocols and Protective Functions

- Ranges of application and limitations not well understood or documented.
- Verification of control strategies not necessarily complete and basis for global acceptance not clear.
- Implementation of fueling protocols in dispenser controls not understood.
- Reliability of communications needs improvement.
- No approach for accommodating technical improvements in future vehicle containers.

Goals

- Focus on the process to design and develop fueling protocol and protective functions (rather than the fueling protocol itself).
- Learn from past experience and streamline the development process.
- Clarify and document ranges of application for fueling protocols.
- Provide a basis for verification (and subsequent approval) of fueling protocols.
- Ensure that implementation of fueling protocols and protective functions in dispenser control strategies, hardware, and software result in acceptable risk.
- Provide for the insertion of new technologies as commercialization proceeds.

Terminology

- Fueling protocol
- Control strategy
- Dispenser controls
  - Supervisory controls
  - Sequential controls
  - Process (or continuous) controls
  - Protective functions
- Upper level technical descriptions and constructs
  - Assumptions and limits
  - Prescribed values, tables, and/or (reduced-order) models
- Planned implementation in dispenser control system considering hardware and software
- Actual implementation in dispenser control system
  - Hardware configuration and components
  - Software
  - Additional protective devices

Process for Definition and Verification of Hydrogen Dispenser Fueling Protocols and Protective Functions

OUTLINE

1. Scope
2. Normative References
3. Terms and Definitions
4. Abbreviations and Symbols
5. General description of fueling protocol design and development process
6. Definition of Requirements
7. Concept definition and evaluation
8. Development and Verification of the fueling protocol
9. Documentation of the fueling protocol
10. Implementation of the fueling protocol in the dispenser control systems

Definition of Requirements

Example of Complexity of the Fueling Envelope for Road Vehicles

ADDITIONAL CONSIDERATIONS

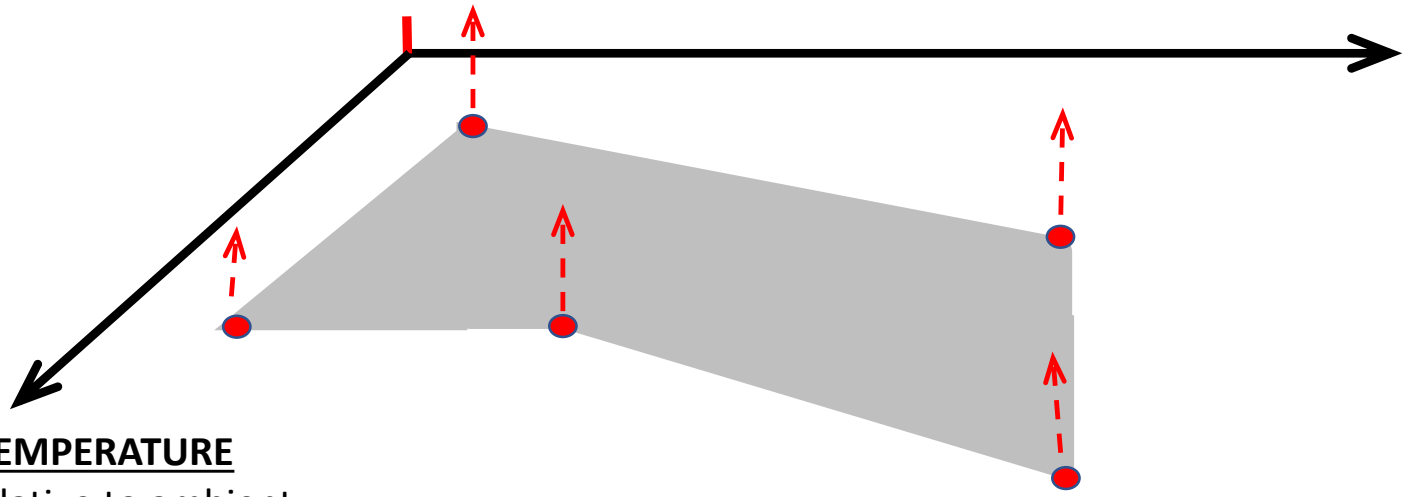
Vehicle Capabilities ---------->

Vehicle Assumptions ---------->

Dispensing Assumptions ----->

RANGES OF PARAMETERS TO BE ADDRESSED

- Operating conditions
- Max fill temperature and pressure
- Number of containers
- Size and type of container(s)
- Maximum dispenser flow
- Subcooling temperature
- Pressure losses in dispenser and vehicle fill lines



AMBIENT TEMPERTURE

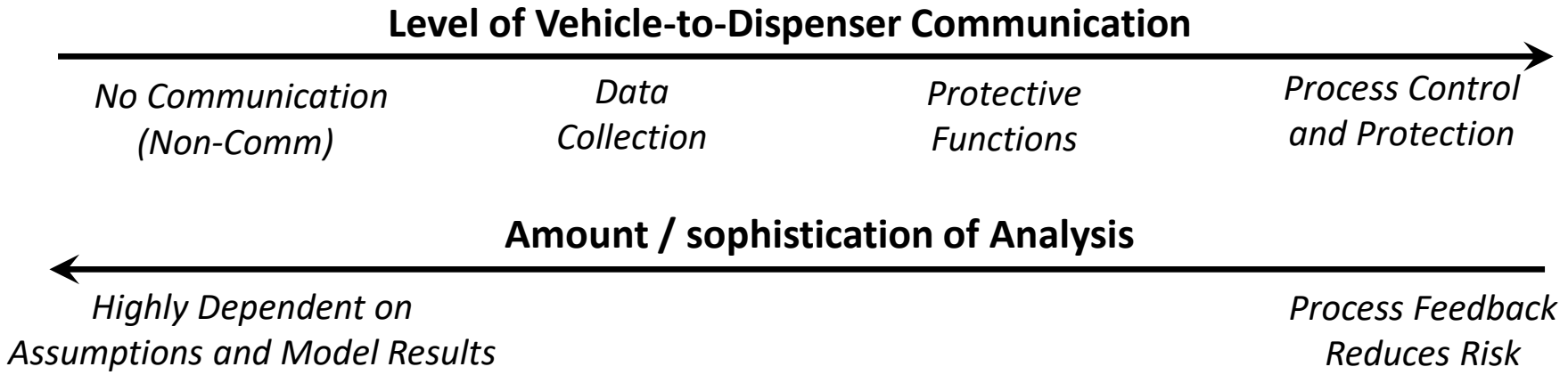
- Vehicle capability
- Max dispening temperature

INITIAL CONTAINER TEMPERATURE

- Heating/cooling relative to ambient

Fueling Protocol Development

- Shall provide acceptable fueling over the full range of expected operating conditions and configurations.
- Verification can be performed by a combination of analysis and/or test.



- After verification, the protocol should be documented and published for implementation in dispenser control systems.
  - In consensus-based standards by SDOs such as ISO, SAE, … are preferred
  - Describes the basis of verification in addition to defining the fueling protocol
  - Includes all assumptions, limitations, and requirements for proper use of the protocol

Summary and Conclusions

- A standard is required to define the design and development process (and requirements) of hydrogen fueling protocols and implementation in dispensers.

- Scope and purpose of this document “fits” within the ISO 19880 “family” of documents.
  - Streamlines 19880-1 and facilitates focus on basis requirements of the filling station.
  - Clears up the scope of 19880-2 for hydrogen dispensers by allowing focus on hardware.

- A multi-part set of documents on hydrogen fueling protocols is envisioned.
  - ISO 19880-7-1: Process for the Design and Development of Fueling Protocols and Verification of Dispenser Control Systems
  - ISO 19880-7-2: Vehicle-to-Dispenser Communications for Fueling Hydrogen Vehicles
  - ISO 19880-7-3: High Flow Fueling Protocol for heavy-duty vehicles as a commericially-relevant example of the fueling protocol consistent with ISO 19880-7-1 and 2.