What is NGVAmerica?

- NGVAmerica is the national trade organization dedicated to the development of a growing, profitable, and sustainable market for vehicles powered by natural gas or renewable natural gas.

- NGVAmerica represents the full value chain of the industry including more than 200 companies, environmental and government organizations interested in the promotion and use of natural gas as a transportation fuel.

- NGVAmerica members produce, distribute, and market natural gas and renewable natural gas across the country; manufacture and service natural gas vehicles, engines, and equipment; and operate fleets powered by clean-burning gaseous fuels.
Who is NGVAmerica?
Lead *advocacy efforts* with federal and state regulators and policymakers to advance the marketplace and level the playing field with other transportation fuels

Through *education & communications* be the most credible voice on NGVs and to support information sharing within the industry

Serve as forum for collaboration, discussion, & debate in the interest of *developing common standards and best practices* for safety and excellence in the NGV marketplace

Be the *convening authority* for NGV industry leaders to gather and discuss strategies with business peers, customers, technology experts, and thought leaders
NGV 6.1 – Recommended Practices For CNG Fuel Systems

NGV 6.1 Scope:

• Recommended practice applies to the design, installation, inspection, repair, and maintenance of the fuel storage and delivery system installed in on road vehicles for use with compressed natural gas (CNG)

• System Design Failure Modes & Effects Analysis (DFMEA) approach has been used as a starting point for writing the document.

• Multi-stage DFMEA process:
  • Working group initiated – Erick Girouard (Emcara), John Dimmick (CVEF), John Jordan (Agility Fuel Systems), John Eihusen (Hexagon Lincoln)
  • Functional block diagram
  • List of functions
  • DFMEA – Functions, Potential Failure Modes, Causes of Failure Modes and Effects of Failure (Prevention & Detection Design Controls not yet completed)
Functional Block Diagram

CNG Fuel System Functional Block Diagram

- **Body / Frame / Chassis**
  - 1. Support II-
  - 2. Support II-
  - 3. Support II-
  - 4. Support II-

- **Tank Cover / Box**
  - 1. Support II-
  - 2. Support II-
  - 3. Support II-
  - 4. Support II-

- **CNG Fuel Dispenser**
  - 1. Support II-
  - 2. Support II-
  - 3. Support II-
  - 4. Support II-

- **PCM**
  - 1. Support II-
  - 2. Support II-
  - 3. Support II-
  - 4. Support II-

- **Coolant (if used)**
  - 1. Support II-
  - 2. Support II-
  - 3. Support II-
  - 4. Support II-

- **Check Valve**
  - 1. Support II-
  - 2. Support II-
  - 3. Support II-
  - 4. Support II-

- **Fill Valve**
  - 1. Support II-
  - 2. Support II-
  - 3. Support II-
  - 4. Support II-

- **Fill Valve Cap**
  - 1. Support II-
  - 2. Support II-
  - 3. Support II-
  - 4. Support II-

- **CNG Tank Assy (if used)**
  - 1. Support II-
  - 2. Support II-
  - 3. Support II-
  - 4. Support II-

- **Manual Shut-Off Valve**
  - 1. Support II-
  - 2. Support II-
  - 3. Support II-
  - 4. Support II-

- **First Stage Pressure Regulation**
  - 1. Support II-
  - 2. Support II-
  - 3. Support II-
  - 4. Support II-

- **Pressure Measurement**
  - 1. Support II-
  - 2. Support II-
  - 3. Support II-
  - 4. Support II-

- **CNG Fuel Rail Assy (if used)**
  - 1. Support II-
  - 2. Support II-
  - 3. Support II-
  - 4. Support II-

- **Intake Manifold**
  - 1. Support II-
  - 2. Support II-
  - 3. Support II-
  - 4. Support II-

- **Engine**
  - 1. Support II-
  - 2. Support II-
  - 3. Support II-
  - 4. Support II-

- **Components below are part of overall system, however, the location will vary**
  - 1. Support II-
  - 2. Support II-
  - 3. Support II-
  - 4. Support II-

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Functional Block Diagram

1. Prevent Contamination:
   1.1 Prevent Contamination (I)
   1.2 Protect Fill Valve from Damage (I)
   1.3 Satisfy Ergonomics
   1.4 Provide Retention - Cap

2. Receive CNG:
   2.1 Receive CNG (I)
   2.2 Prevent CNG Back Flow Following disconnection
   2.3 Seal Fill Nozzle During Filling
   2.4 Provide Attachment for Fill Nozzle
   2.5 Receive CNG Nozzle
   2.6 Resist breakaway force
   2.7 Limit connection to appropriate nozzle
   2.8 Provide identification and pressure class of valve used

3. Prevent CNG Back Flow (I) (include chatter):
   3.1 Prevent CNG Back Flow (I)
   3.2 Store CNG
   3.3 Transport CNG (I)
   3.4 Manage BSR (NVH)
   3.5 Remove Part
   3.6 Install Part

(1) Fill Valve Cap
(2) Fill Valve
(3) Check Valve
<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
<th>Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 Fill Valve</td>
<td>Receive CNG (I)</td>
<td>ANSI/CSA NGV1, CSA B109-01, NFPA 52</td>
</tr>
<tr>
<td>2.2 Fill Valve</td>
<td>Prevent CNG Back Flow Following Nozzle Disconnect</td>
<td>ANSI/CSA NGV1, FMVSS 303, CSA B109-01, NFPA 52</td>
</tr>
<tr>
<td>2.3 Fill Valve</td>
<td>Seal Fill Nozzle During Filling</td>
<td>ANSI/CSA NGV1, CSA B109-01, NFPA 52</td>
</tr>
<tr>
<td>2.4 Fill Valve</td>
<td>Provide Attachment for Fill Nozzle</td>
<td>ANSI/CSA NGV1, CSA B109-01, NFPA 52</td>
</tr>
<tr>
<td>2.5 Fill Valve</td>
<td>Receive CNG Nozzle</td>
<td>ANSI/CSA NGV1, CSA B109-01, NFPA 52</td>
</tr>
<tr>
<td>2.6 Fill Valve</td>
<td>Resist Breakaway Force</td>
<td>ANSI/CSA NGV1, CSA B109-01, NFPA 52</td>
</tr>
<tr>
<td>2.7 Fill Valve</td>
<td>Limit connection to appropriate nozzle</td>
<td>ANSI/CSA NGV1, CSA B109-01, NFPA 52</td>
</tr>
<tr>
<td>2.8 Fill Valve</td>
<td>Provide identification and pressure class of valve used</td>
<td>ANSI/CSA NGV1</td>
</tr>
<tr>
<td>2.9 Fill Valve</td>
<td>Manage BSR (NVH)</td>
<td>ANSI/CSA NGV1, CSA B109-01, NFPA 52</td>
</tr>
<tr>
<td>2.10 Fill Valve</td>
<td>Remove Part</td>
<td>ANSI/CSA NGV1</td>
</tr>
</tbody>
</table>
Next step: Ensure that current either prevention or detection controls are in place to prevent, or reduce, the occurrence of the potential failure mode.

If not, capture them in NGV 6.1
Technology, Codes, Standards & Best Practices

- New NGVAmerica Technology & Development Committee
  - *Areas of Focus*
    - Safety & best practices
    - Codes and standards development
    - Incident investigation and root cause analysis
    - Stakeholder education
    - Ensuring safe deployment of new technology for the NGV industry
    - Awareness and support of industry innovation and technology advancements
Critical Issue #1: Indoor Gas Releases

Critical Issue #2: Cylinder Valve Issues

Critical Issue #3: Overpressure and Under-filling of Cylinders

Critical Issue #4: PRD Reliability, Location & Venting
Critical Issue #4: PRD Reliability, Location & Venting

Problem Statement: Reliability, location and venting of PRDs. Discharge from cylinder PRDs can result in additional hazards. PRDs are considered the lesser of two evils, the greater evil being rupture of a CNG cylinder in a fire.

- Review of PRD1 reliability requirements, incidents of PRD unintended activation, causes of unintended activation, interconnected and isolated PRDs, locating PRDs and triggers – extrapolating bonfire tests to vehicle fires, venting PRD discharges to minimize hazards to occupants, bystanders and first responders

Actions taken or currently in process to address critical issues:
A. CSA Group established NGV 6.1 RP/Standards task group to address many of these issues
B. Safety bulletins published by CVEF now on NGVA web site
C. NFPA completed an online First Responders training program based on CVEF’s evaluation of NGV incidents

Next steps to address these critical issues:
A. Relief valve design to replace use of pressure activated PRDs
B. In conjunction with CIs 2 and 3 address on board pressure management needs
C. Continue development of best practice for installation of TPRD’s and vent installations
D. Participate in a coordinated NGV industry/first responder/AHJ/government education program on NGV safety
What are the industry’s critical safety & technology issues?

- Tank Safety Best Practices
- Fire Marshall Training
- Home Refueling
- Gas Quality
- Modern Fuel Station Monitoring
- Maintenance Facility C&S
- Others
Technology & Development Committee

Research & Standards & Best Practices:

- Work with codes and standards to ensure new technologies are addressed.
- Participate in technical committees responsible for updating documents to include new technologies.

Research & Development:

- Work with companies developing new technology to ensure that it is safe and reliable.
- Identify paths to fund companies and universities working on programs to move the NGV industry forward.

Collaborative Programs:

- DOT/NHTSA on incident investigation and root cause analysis.
- DOE & California agencies on programs addressing current issues and future technologies.
- Collaborate with stakeholders on projects that improve the value proposition of NGVs.

Safety:

- Safety is the first priority.
- Codes and standards are being developed to ensure the component, system, and vehicle are safe for our customers.
Committee Organization

Chair: Ron Eickelman – Agility Fuel Systems
Co-Chair: Cherif Youssef – SoCal Gas

Committee members will represent the full value chain of the industry:

- LDCs
- HD & LD OEMs
- Engine OEMs
- Commercial Services
- Station Developers
- Equipment & Cylinder
- Manufacturers
- Vehicle Integrators
- Technology R&D
- Utilities
- Gas Producers
- Innovation Companies
- Codes & Standards
Next Steps – Open Discussion

1. Committee organization
2. Committee member input for direction of the Committee
3. Kick-Off Meeting
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