Policy response by AAR, DOT and industry consortium

- AAR CPC-1187 (AAR Tank Car Committee)
- FRA HM-246 (US DOT)
- Also, consortium effort led by Dow, Union Tank and Union Pacific to develop Next Generation Rail Tank Car (NGRTC)
- Each has pros and cons in terms of performance, price, technical feasibility, and timetable
Current TIH Tank Cars

Chlorine – 105A500W

Anhydrous Ammonia - 112J340W

- Cars shown at approximately the same scale
Graphical identification of point on Pareto-optimal curve that minimizes distance from Utopia Point
AAR CPC-1187

- **105J600W (enhanced)**
- **Enhanced Safety Features**
  - Head = 1.13”
  - Full-height head shield
  - Shell = 0.98”
  - Jacket and insulation
  - New, robust-design, top fittings protective housing
  - 1” thick housing
  - 8 reinforcing gussets
  - Strengthened manway cover

- **7% higher capacity car**
  - Fewer shipments
  - Increased quantity in car

Photos show TrinityRail prototype
Creighton, PA derailment 2005
Anhydrous hydrogen fluoride released into river
Enhanced top fittings protection design

- 1” thick housing compared to current 0.75”
- reinforcing gussets
- strengthened manway cover
- substantial tank mounting pad
- lower profile protective housing
Dynamic simulation analysis of the performance of top fittings protective design

- Trinity conducted dynamic modeling analysis
- Results indicate that the design performed 2.6 times better in simulated rollover analysis
Estimated performance of AAR CPC-1187 cars compared to current tank cars

- H & L indicate High and Low estimates of the effectiveness of the enhanced top-fittings protective design

<table>
<thead>
<tr>
<th>Car Type</th>
<th>Probability of Release</th>
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<tbody>
<tr>
<td>Current Ammonia Car</td>
<td>112J340W w/FHS</td>
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<tr>
<td>Current Chlorine Car</td>
<td>105A500W</td>
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Diminishing returns from further increasing steel tank thickness

- More cost effective to use alternative protective system designs in conjunction with conventional steel tank construction.

![Graph showing performance vs. cost for conventional and alternative design concepts](Image)
NGRTC - Generation 1

- Performance goal exceeds AAR CPC-1187
- R&D largely completed
- Industry involvement enhances likely feasibility
- Timetable meets or exceeds AAR CPC 1187
- Retrofit of existing cars may be feasible, reducing cost
NGRTC - Generation 2

- Performance goal substantially exceeds AAR CPC-1187
- R&D underway
- Industry involvement enhances likely feasibility
- Shipper, car-builder & government driven so better acceptance by them
- Timetable meets or exceeds AAR CPC 1187
- Greater risk reduction
- Higher cost

113/115 Sandwich Car
DOT HM-246

- HM-246 is a performance specification
- DOT Volpe Center developed design concept in hopes of demonstrating feasibility
- Probably will improve resistance to some types of damage more than CPC 1187
- Uncertainty about:
  - Reduction in risk
  - Practicality of construction and maintenance
  - Timetable for implementation
- Likely high cost
Does DOT design adequately account for small impactors?

- One cause of tank car failures in accidents are small, pointed objects such as rails.
- Concern has been expressed that DOT’s damage energy absorption design does not adequately protect against these.
- How commonly does this occur?

Photos courtesy of BNSF
Hypothetical comparison of relationship between impactor size and conditional probability of release: possible difference between CPC-1187 & HM-246
Effect of impactor geometry and shell thickness on puncture velocity

- From: Tang et al 2008
Ram car speed versus ram car energy

Curve shows the kinetic (moving) energy of a 286,000 pound rail car $KE = \frac{1}{2}mv^2$

DOT assumed impact speed to be about 50% speed of train at time of derailment

Present industry chlorine tank car - 105A500W
Baseline performance

AAR specified chlorine tank car under CPC-1187

HM-246 performance requirements
Accident damage energy compared to damage energy resistance
Different variance, equal mean performance
History (and future?) of chlorine tank car performance

- Conditional Probability of Release (CPR): Percentage of tank cars expected to release product when involved in an accident (number of cars releasing / number of cars in accidents)
Stay tuned!

- Much progress has been made
- Substantial new understanding of tank car performance and options for new design concepts
- But many issues still to be resolved
QUESTIONS?