The Jack Rabbit Program

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Problem: DHS and other agencies must better understand behavior and consequences of large-scale toxic inhalation hazard (TIH) chemical releases.

Need:
- Improve where modeling and predictions do not align with observations
- Validated data and modeling for large-scale TIH releases (Cl₂, NH₃, SO₂, etc.)
- Improved understanding of dense-gas behavior, chemical reactivity, source terms, toxicity and its proper application to consequence assessment
- Inform and emergency response and optimally define evacuation

Solution: Large-scale TIH field release experiments

Output: Knowledge products that are required for improved capabilities and efficiencies in planning, response and mitigation
- Experimentally informed, improved modeling
- Resiliency - better planning, emergency response
- Vulnerability and impact reduction - Risk mitigation
Jack Rabbit I Trials

- Conducted during 4 weeks in Apr-May 2010 with Chlorine and Ammonia (Cl₂ and NH₃)
- Total of 10 successful trials (2 pilot, 8 record)
- Extensive array of instrumentation deployed, empirically recording a wide range of data
- High-definition and standard video documentation captured from multiple angles
- Chlorine exposure studies with Navy and Air Force electronics, equipment, and materials
- Eval. of Gvt. & Commercial detectors
- First recorded observation of previously unreported violent chemical eruptions or explosions after chlorine releases
- Weather variation provided a range of different conditions
• Turbulent mixing is initially resisted by dense gas, resulting in cloud persistence near release in low wind conditions

• Cold, dense gas is held up near release site and collects in low-lying areas

• Rapid Phase Transition (RPT) eruptions present a *previously unknown hazard* & are more likely with impingement

• Chemical reactivity of chlorine can result in significant losses with soil, vegetation, and other organics

• Up to 50% of a 2-ton Cl₂ release could be removed within 20 m for soil with high organic matter (43%) water content (29%).

Conduct a new series of open-air chlorine release trials in a multi-agency effort, building upon the work achieved in Jack Rabbit I

- Large volume chlorine field releases from 5 to 20 tons
  - Continuing evolution of higher quantity releases – scaling is non-linear
  - 20 tons represents 100% of tanker truck transport volume, and a large fraction of a railcar release
- Urban Test Grid constructed at Dugway to be impacted by release cloud
- Largest & most comprehensive source term study
- Longest down-wind dispersion study of its kind
- Quantitative determination of chlorine removal via reactivity with soil, atmosphere, vegetation, metals, urban surfaces, and photolysis

Anticipated Jack Rabbit II Results
- Tanker size Source Terms
- Downwind Concentrations
- Soil and Vegetation Effects
- Data on Mitigation Strategies
- Equipment & Detector Validation
JR II Site – Dugway Proving Ground
JR II - Urban Test Grid
Extended Grid

- **11-km Arc**
  - Instruments: ToxiRAE (19)

- **5-km Arc**
  - Instruments: ToxiRAE (18), MiniRAE (19)

- **2-km Arc**
  - Instruments: MiniRAE (19)

- **1-km Arc**
  - Instruments: MiniRAE (18)

- **500-m Arc**
  - Instruments: MiniRAE (19)

- **200-m Ring**
  - Instruments: UV Canary (4), MiniRAE (18)

- **UV Sentry**
  - Instruments: UV Sentry (3)

- **Midac OP-FTIR**
  - Instruments: Midac OP-FTIR (1)
Jack Rabbit II - Timeline

- **FY15:** First series of release trials
  - 13-14 July – Dry Runs
  - 21 Aug 2015 – 12 Sept 2015 Record Testing (5 to 10 tons) – 6 to 9 trials
  - 02-03 Sept – VIP Observation of Live 10-Ton Release

- **FY16:** Analysis of initial release trials; planning and execution of second series of release trials
  - 01 July – 30 September – Record Testing (10 to 20 tons) – 12 trials

- **FY17:** Analysis Phase
  - Data quality
  - Data reduction
  - Data distribution

- **FY17+:** Transition Phase
  - Emergency responders
  - Emergency planners
  - Trainers
  - Industry
  - Modeling community – enhanced methodologies