



10-Ton Chlorine release during Jack Rabbit II,  
Phase 1, 2015

### Large-Scale Outdoor Chlorine Release Field Trials

The Department of Homeland Security (DHS) Science and Technology Directorate (S&T) Chemical Security Analysis Center (CSAC) led the Jack Rabbit project of large-scale outdoor chlorine release trials, with a collaborative team of partners and cosponsors from government, industry and academia. These field trials and follow-on studies filled critical data gaps for toxic inhalation hazard (TIH) chemical release modeling and emergency response procedures. Phase 1 was completed in September 2015, with the execution of five chlorine release trials ranging from five to 10 tons. Phase 2 was completed in September 2016, with four additional chlorine release trials ranging from 10 to 20 tons each.

### Problem Statement

DHS and other agencies expressed a need to better understand the behavior and consequences of large-scale releases of TIH chemicals.

- Millions of tons of TIH chemicals are transported in bulk every year, often through urban areas.
- Chemicals in transport are at risk of being accidentally or deliberately released.

### Key Customers

- DHS, Department of Defense, Department of Transportation, Environmental Protection Agency, Department of Justice, Transport Canada, and the Defence Research and Development Canada
- International Association of Fire Chiefs, International Association of Fire Fighters, National Fire Protection

Association, InterAgency Board, and other partners in the emergency response community

- Private-sector stakeholders in the chemical, rail, highway and shipping industries

### Experimental Design

- Executed multiple outdoor chlorine release trials ranging from five to 20 tons, utilizing release mechanisms and rates relevant to catastrophic large-scale release scenarios.
- Conducted chlorine release trials in a test grid equipped with mock urban layouts and structures.
- Measured chlorine cloud concentrations using sensors deployed at incremental distances up to seven miles (11 km).
- Conducted chlorine exposure and impact experiments with deployed emergency response equipment and vehicles.

### Outputs

- Quantitatively measured long-range downwind chlorine cloud concentrations.
- Experimentally defined and validated large-scale chlorine release source terms.
- Collected empirical data of cloud movement and meteorology for Atmospheric Transport and Dispersion modeling input, evaluation and validation.
- Captured unprecedented high-definition video footage for scientific studies and use in new HazMat and industrial safety training products.
- Obtained targeted data from experiments to directly address prioritized data and knowledge gaps defined by the emergency response community.

### Project Impact

- Improved chemical hazard modeling.
- Better planning for release incidents.
- More effective emergency response.
- Improved mitigation measures to reduce the impact to affected populations and infrastructure.
- Improved HazMat and industrial safety.
- Improved guidance and data for emergency response procedures and validation of protective action distances.