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DETAILED TEST PLAN
FOR
JACK RABBIT (JR)II

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UNDER CONTRACT NO. W911S6-06-D-0001

Plan Produced by
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Plan Produced for
Department of Homeland Security (DHS)
Aberdeen Proving Ground – Edgewood Area, MD 21010-5424

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DEPARTMENT OF THE ARMY
HEADQUARTERS, U.S. ARMY DUGWAY PROVING GROUND
DUGWAY, UT 84022-5000

TEDT-DPW-SP 19 August 2015

MEMORANDUM FOR US Army Test and Evaluation Command (ATEC), Test Operations Division (CSTE-TM/M. Joiner), 2202 Aberdeen Boulevard – First Floor West, Aberdeen Proving Ground, MD 21005-5055

SUBJECT: Detailed Test Plan for Jack Rabbit (JR)II, US Army Test and Evaluation Command (ATEC) Project Number 2015-DT-DPG-SNIMT-F9735, West Desert Test Center (WDTC) Document Number WDTC-TP-15-029

1. Subject document is forwarded to you for information and retention.

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RYAN W. HARRIS
Director, West Desert Test Center

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SECTION 1. INTRODUCTION

1.1 SYSTEM DESCRIPTION

None. This is not a system test.

1.2 SUMMARY

1.2.1 Testing Authority

On 5 March 2014, US Army Test and Evaluation Command (ATEC), Aberdeen Proving Ground (APG), Maryland, issued a test support order (Appendix C) through the ATEC Decision Support System (ADSS) authorizing West Desert Test Center (WDTC), US Army Dugway Proving Ground (DPG), Utah, to conduct the Jack Rabbit (JR)II Planning, ATEC Project Number 2015-DT-DPG-SNIMT-F9735.

1.2.2 Test Concept

a. The JRII test program will be conducted at DPG from August through September 2015 and from July through September 2016. The program is sponsored by the Department of Homeland Security (DHS) Science and Technology (S&T) Directorate, Washington, DC, with program oversight provided by the Chemical Security Analysis Center (CSAC, APG, Maryland) and with contributions from Defense Threat Reduction Agency (DTRA, Fort Belvoir, Virginia). Test execution is provided by WDTC.

b. This plan provides an overview of the tasks required to conduct the, planning, preparation, procurement, methodology, setup, test conduct, and data analysis for the JRII test program. The project objectives support improvements to the manner in which DHS and its partners address toxic inhalation hazard (TIH) risks. Building on the success of the 2010 JRI chlorine and ammonia trials (Reference 1), project goals will enable the following:

(1) Improved chemical hazard modeling.

(2) Better planning and resilience for release incidents.

(3) More efficient and effective emergency responses.

(4) Improved mitigation measures to reduce the impact to affected populations and infrastructure.

1.2.2.1 Background

The previously executed JRI test was conducted to develop, test, and evaluate the physicochemical characteristics of a disseminated gas and aerosol cloud (Reference 1). JRI evaluated the dissemination system for the controlled, rapid release of pressurized gases. Additionally JRI investigated the cloud's TIH, gas transport, dispersion, mitigation via deposition, and reactions with water and soil. The project evaluated instruments, test methods, and strategies for future industrial-scale tests. Two pilot tests and eight record tests were completed in 2010 with a chlorine or ammonia mass of 907 or 1814 kg (1 or 2 tons) used for each test (Reference 1). The results demonstrated the following:

(1) Downwind transport and turbulent mixing are initially reduced by a dense persistent gas/aerosol cloud under low wind conditions.

(2) Rapid phase transition (RPT) eruptions present a previously unobserved chlorine spill hazard.

(3) Source phenomena are nonlinear with increasing release volumes.

(4) Reactivity with soil containing water and organic matter is an important removal mechanism for chlorine.

1.2.2.2 <u>Scope</u>

a. JRII will expand upon the work of JRI (Reference 1) with controlled chlorine field experiments on a larger scale. It should be noted that JRI involved a geographic depression and it is still unclear whether the same cloud hold-up phenomena will persist without the depression.

(1) A tanker truck and a specialized storage tank will be used to disseminate a mass of chlorine from 4536 to 18144 kg (ranging from 5 to 20 tons) during each in a series of trials. The goals of JRII are to collect data on the release source, cloud transport and dispersion, chemical reactions with the environment, exposure effects on equipment and infrastructure, and to assess urban impacts.

(2) The project proposes to collect the data in real time via ground-based and unmanned aerial system video and spectroscopic instruments, point detectors, standoff detectors, and concentration and dosage determination instruments. The data will be shared with all project participants. The data and findings will drive an improved understanding of the basic science, an improved operational hazard prediction modeling, more effective emergency response and training, and improved national preparedness and mitigation strategies.

b. The purpose of the DPG JRII test is to:

(1) Improve understanding and fill critical knowledge gaps for chlorine releases through operationally relevant large-scale releases as represented by tanker truck and storage tank release scenarios.

(2) Support the DHS (Washington, D.C) enterprise and stakeholders through transitioning of quality-assured data, scientifically based guidance, and knowledge products to guide and advance the following:

(a) Provide modeling data for release source, atmospheric transport and dispersion (AT&D), hazard and risk, consequence assessment.

(b) Enhance emergency preparedness, planning, and response.

(c) Provide safety and security in the use, transport, and storage of TIH chemicals.

(d) Assess hazard and risk mitigation strategies.

(e) Enhance the nation's resiliency to accidental or intentional TIH release disasters.

(f) Provide information for policy decisions.

c. During testing, 4536 through 18144 kg (5 through 20 tons) of chlorine will be released. The trials will support the requirements to satisfy the stated program goals and objectives (e.g., enhance confidence in modeling data, revise emergency response guidelines, and improve emergency response related to a large chlorine release).

d. The JRII test program will be conducted with a collaborative team of partners from government, industry, and academia. The field trials plus subsequent data analysis will fill critical knowledge, data, and capability gaps for TIH chemical release modeling and emergency response procedures. Such procedures are yet to be experimentally tested or validated at scale levels represented by rail car, tanker truck, barge, or storage tank release scenarios. The data collected will provide great benefit and value to stakeholders.

e. Testing will be conducted on the DPG Urban Test Grid (UTG), located approximately 12 km (7.5 mi) west of the 777 test site. The test site will be composed of an elevated 122- × 183-m (400- × 600-ft) gravel pad with a concrete dissemination pad [25 m (82 ft) in diameter] where chlorine will be released from a 9072-kg (10-ton) specialized dissemination tank (during 2015 and 2016 trials) and a modified 18144-kg (20-ton) tanker trailer (during 2016 trials only). The gravel pad will house various conex containers and trailers to represent an urban environment. Point and standoff detection instrumentation within and surrounding the gravel pad area will collect gas and aerosol data. The dissemination pad will be instrumented for the collection of data such as temperature and liquid chlorine pool size.

1.2.2.3 Required Documentation for Test Support

a. Test Criteria. This is not a system test and no test criteria are provided (Appendix A). No test criteria were provided in previous JRI testing (Reference 1).

b. Test Schedule. The dates of major test activities are listed in Appendix B, such as planning, provisioning, holding the final command review (FCR) and preoperational safety survey (POSS)/operational readiness inspection (ORI), executing testing and reporting.

c. Test Support Order. The ADSS test support order (Appendix C) contains the test authority and scope of work.

d. Record of Environmental Consideration (REC). The WDTC Office of Environmental Technology has addressed the potential environmental consequences of the proposed action in both a REC and an Environmental Assessment (EA) on file at DPG. Based on the JRII EA, DPG concluded that the environmental effects of the proposed action will not be individually or cumulatively significant and the preparation of an environmental impact statement is not warranted. All testing will be conducted within the boundaries of DPG and testing will have no adverse effect on the DPG environment. The RECs and EA signature pages are in Appendix D. All hazardous waste generated by the execution of this test will be disposed of in accordance with (IAW) the state hazardous waste permit (Reference 2) the installation hazardous waste management plan (Reference 3), and all other applicable WDTC procedures. **NOTE**: DPG will use a 208-L (55-gal) drum to contain the waste which will consist of used titration kits and gloves.

e. Operations Security (OPSEC). This test program is unclassified. The OPSEC review sheet for the JRII testing program is in Appendix E. All raw data will be treated as for official use only (FOUO) by DPG. The data package will be provided to DHS who will be responsible for providing the data to other applicable organizations.

f. Safety Procedures and Risk Management. WDTC safety procedures and risk management are in Appendix F.

g. Drawings of the chlorine dissemination tank system are in Appendix G.

1.2.3 Test Objectives

Test objectives are in Table 1.

Table 1. Test Objectives; JRII.

Item	Originating Organization	Objective
1	Department of Homeland Security (DHS)	Safely perform the controlled release of compressed, liquefied chlorine to the atmosphere in a series of up to 21 trials in masses ranging from 4536 to 18,144 kg (5 to 20 tons) from simulated chlorine tank ruptures. **NOTE**: Only 4536- and 9072-kg (5- and 10-ton) releases will be conducted during 2015 trials.
2	DHS	Use standard methodology to ensure relevant data precision, accuracy, validity, and quality in a common format. **NOTE**: This objective applies to 2015 and 2016 trials.
3	DHS	Observe and measure the simulated ruptured tank thermodynamic and mass parameters during dissemination to improve model source terms. **NOTE**: This objective applies to 2015 and 2016 trials.
4	DHS	Quantitatively monitor and collect gas cloud concentration data from the initial phase of a very dense, two-phase cloud near the source to dispersion of the cloud further downwind using point detectors and standoff spectroscopic instruments. Data collection from the release will allow personnel to quantify and characterize cloud retrograde. **NOTE**: This objective applies to 2015 and 2016 trials.

Table 1. Test Objectives; JRII (Cont'd).

Item	Originating Organization	Objective
5	DHS	Characterize and quantitatively measure chlorine cloud removal by deposition on vertical and horizontal surfaces, hydrolysis, photolysis, reaction with organic and inorganic constituents of soil, and reaction with vegetation. **NOTE**: This objective will be addressed primarily in 2016 trials with minimal testing in 2015 trials.
6	DHS	Investigate the small-scale movement of a chlorine cloud through, around, and above a mock urban environment. **NOTE**: This objective applies to 2015 trials.
7	DHS	Study building infiltration rates in a mock urban environment. **NOTE**: Defense Threat Reduction Agency (DTRA) is responsible for the study. This objective applies to 2015 trials.
8	DHS	Assess exposure and damage effects in a mock urban setting. **NOTE**: This objective applies to 2015 trials.
9	DHS	Validate and characterize rapid phase transition (RPT) events observed in Jack Rabbit (JR)I tests (Reference 1). **NOTE**: This objective will be addressed in 2016 trials.
10	DHS	Study exposure impacts on equipment and materials. **NOTE**: DHS is responsible for the study. This objective applies to 2015 and 2016 trials.
11	DHS	Study emergency response guidelines. **NOTE**: DHS is responsible for the study. This objective applies to 2015 and 2016 trials.
12	DHS	Study industrial risk and hazard mitigation procedures. **NOTE**: DHS is responsible for the study. This objective applies to 2015 and 2016 trials.
13	DHS	Provide a realistic observable hazardous release environment for the education and training of emergency response personnel. **NOTE**: DPG will provide the training environment. This objective applies to 2015 and 2016 trials.
14	Emergency Response Group	Determine the origin and character of the RPTs phenomenon. **NOTE**: This objective will be addressed in the 2016 testing.
15	Emergency Response Group	Determine the effectiveness of sheltering in place, including concentration and duration, to determine probable survivability. **NOTE**: This objective applies to 2015 trials.
16	Emergency Response Group	Determine a reliable vertical concentration gradient (i.e., the gas density of chlorine at a concentration gradient in which a responder can survive above the cloud will be considered). **NOTE**: This objective applies to 2015 and 2016 trials.

Table 1. Test Objectives; JRII (Cont'd).

Item	Originating Organization	Objective
17	Emergency Response Group	Determine if internal combustion engines (gas and diesel) can operate in high concentrations of chlorine (consider the behavior of the combustion engine and determine the probability of driving out of the plume as an emergency tactic). **NOTE**: This objective applies to 2015 trials.
18	Emergency Response Group	Determine if low wind speeds increase the probability of retrograde creep of the cloud. Further validate that the initial isolation zones [at a ground distance of 1000 m (3281 ft)] and downwind protective action recommendations contained in the *2012 Emergency Response Guidebook* (Reference 4) are appropriate. **NOTE**: This objective applies to 2015 and 2016 trials.
19	Emergency Response Group	Determine the significance of various urban barriers and plume behavior when encountering those barriers. **NOTE**: This objective applies to 2015.
20	Emergency Response Group	Determine the possibility of secondary post-release cloud evolution if contaminated surfaces are disturbed and the duration of long-term off-gassing. **NOTE**: This objective applies to 2015 trials.
21	Emergency Response Group	Determine the level to which flash freezing and thawing occur on the surface at the release point. **NOTE**: This objective applies to 2015 and 2016 trials.
22	Emergency Response Group	Determine the behavior of common building components and urban surfaces. Specifically, determine the behavior of both new and aged asphalt when in contact with high concentrations of chlorine gas or liquid chlorine. Assess the absorption of chlorine gas into water. **NOTE**: This objective applies to 2015 and 2016 trials.

NOTE: Test objectives came directly from DHS or were requested through DHS by members of the first responder community. Objectives from the first responders are identified as the Emergency Response Group.

1.3 UNIQUE TEST PERSONNEL REQUIREMENTS

a. This test requires personnel who are:

(1) Trained and capable of safely working with liquefied chlorine and in the vicinity of chlorine operations (e.g., storage, transportation, and transfer operations). These personnel should have the ability to transport, store, and transfer chlorine between different types of tanks.

(2) Trained and capable of responding to emergency situations involving chlorine leaks.

(3) Able to handle and install explosive devices and mitigate unexploded ordnance (UXO). Specific personnel on this test must be able to transport, install, and detonate Class 1 explosive devices and respond to any UXO.

(4) Trained in the use of the self-contained breathing apparatus (SCBA). These personnel must be able to respond to and mitigate unplanned chlorine releases, which may require the use of personal protective equipment (PPE) up to Level-A with a SCBA. **NOTE**: PPE levels required for each test location, along with plans for movement on the range (e.g., traffic routes) are described in the DPG operations plan (OPLAN, Reference 5).

(5) Trained in all-terrain vehicle (ATV) operations. Specific personnel must be trained in the operation of ATVs and be able to operate them in a desert environment during night and day operations.

(6) Able to wear a respirator, if necessary.

b. Specific training requirements for test personnel are referenced in the Program Management Plan (Reference 6) and Training Required for Participants Document (Reference 7).

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SECTION 2. SUBTESTS

2.1 URBAN CONFIGURATION TEST

2.1.1 Objectives

> **NOTE**: Test objectives came directly from DHS or were requested through DHS by members of the first responder community. Objectives from first responders are identified as the Emergency Response Group.

a. DHS Objectives

(1) Safely perform the controlled release of compressed, liquefied chlorine to the atmosphere in a series of up to 21 trials in masses ranging from 4536 to 18,144 kg (5 to 20 tons) from simulated chlorine tank ruptures. **NOTE**: Only 4536- and 9072-kg (5- and 10-ton) releases will be conducted during 2015 trials.

(2) Use standard methodology to ensure relevant data precision, accuracy, validity, and quality in a common format. **NOTE**: This objective applies to 2015 and 2016 trials.

(3) Observe and measure the simulated ruptured tank thermodynamic and mass parameters during dissemination to improve model source terms. **NOTE**: This objective applies to 2015 and 2016 trials.

(4) Quantitatively monitor and collect gas cloud concentration data from the initial phase of a very dense, two-phase cloud near the source to dispersion of the cloud further downwind using point detectors and standoff spectroscopic instruments. Data collection from the release will allow personnel to quantify and characterize cloud retrograde. **NOTE**: This objective applies to 2015 and 2016 trials.

(5) Characterize and quantitatively measure chlorine cloud removal by deposition on vertical and horizontal surfaces, hydrolysis, photolysis, reaction with organic and inorganic constituents of soil, and reaction with vegetation. **NOTE**: This objective will be addressed primarily in 2016 trials with minimal testing in 2015 trials.

(6) Investigate the small-scale movement of a chlorine cloud through, around, and above a mock urban environment. **NOTE**: This objective applies to 2015 trials.

(7) Study building infiltration rates in a mock urban environment. **NOTE**: DTRA is responsible for the study. This objective applies to 2015 trials.

(8) Assess exposure and damage effects in a mock urban setting. **NOTE**: This objective applies to 2015 trials.

(9) Validate and characterize RPT events observed in JRI tests (Reference 1). **NOTE**: This objective will be addressed in 2016 trials.

(10) Study exposure impacts on equipment and materials. **NOTE**: DHS is responsible for the study. This objective applies to 2015 and 2016 trials.

(11) Study emergency response guidelines. **NOTE**: DHS is responsible for the study. This objective applies to 2015 and 2016 trials.

(12) Study industrial risk and hazard mitigation procedures. **NOTE**: DHS is responsible for the study. This objective applies to 2015 and 2016 trials.

(13) Provide a realistic observable hazardous release environment for the education and training of emergency response personnel. **NOTE**: DPG will provide the training environment. This objective applies to 2015 and 2016 trials.

b. Emergency Response Group Objectives

(1) Determine the origin and character of the RPTs phenomenon. **NOTE**: This objective will be addressed in the 2016 testing.

(2) Determine the effectiveness of sheltering in place, including concentration and duration, to determine probable survivability. **NOTE**: This objective applies to 2015 trials.

(3) Determine a reliable vertical concentration gradient (i.e., the gas density of chlorine at a concentration gradient in which a responder can survive above the cloud will be considered). **NOTE**: This objective applies to 2015 and 2016 trials.

(4) Determine if internal combustion engines (gas and diesel) can operate in high concentrations of chlorine (consider the behavior of the combustion engine and determine the probability of driving out of the plume as an emergency tactic). **NOTE**: This objective applies to 2015 trials.

(5) Determine if low wind speeds increase the probability of retrograde creep of the cloud. Further validate that the initial isolation zones [at a ground distance of 1000 m (3281 ft)] and downwind protective action recommendations contained in the *2012 Emergency Response Guidebook* (Reference 4) are appropriate. **NOTE**: This objective applies to 2015 and 2016 trials.

(6) Determine the significance of various urban barriers and plume behavior when encountering those barriers. **NOTE**: This objective applies to 2015.

(7) Determine the possibility of secondary post-release cloud evolution if contaminated surfaces are disturbed and the duration of long-term off-gassing. **NOTE**: This objective applies to 2015 trials.

(8) Determine the level to which flash freezing and thawing occur on the surface at the release point. **NOTE**: This objective applies to 2015 and 2016 trials.

(9) Determine the behavior of common building components and urban surfaces. Specifically, determine the behavior of both new and aged asphalt when in contact with high concentrations of chlorine gas or liquid chlorine. Assess the absorption of chlorine gas into water.
NOTE: This objective applies to 2015 and 2016 trials.

2.1.2 Urban Configuration Test Criteria

None.

2.1.3 Urban Configuration Test Procedures

The test will be conducted IAW the test matrix (Table 2). **NOTE**: Trials 7 through 9 are optional. The date of 2 September 2015 will be reserved for a trial addressing emergency responder group objectives. Exact trial dates have not been scheduled yet.

2.1.3.1 Command and Operations Setup

Four command post (CP) locations will be set up and are as follows.

(1) Surface Layer (SL) Test Site. Site will include one primary CP and two administrative trailers (Figure 1).

Table 2. Mock Urban Test Matrix for 2015; JRII.

Trial Number	Amount of Chlorine [kg (tons)]	Pad Orientation	Nozzle Orientation	Release Point Size [cm (in)]
1	4536 (5)	No tall structure upwind	0 degrees (downward)	15.24 (6)
2	4536 (5)	No tall structure upwind	0 degrees (downward)	15.24 (6)
3	9072 (10)	No tall structure upwind	0 degrees (downward)	15.24 (6)
4	9072 (10)	No tall structure upwind	0 degrees (downward)	15.24 (6)
5	9072 (10)	Tall structure upwind	0 degrees (downward)	15.24 (6)
6	9072 (10)	Tall structure upwind	0 degrees (downward)	15.24 (6)
7	9072 (10)	Tall structure upwind	0 degrees (downward)	15.24 (6)
8	9072 (10)	Tall structure upwind	0 degrees (downward)	15.24 (6)
9	9072 (10)	Tall structure upwind	0 degrees (downward)	15.24 (6)

NOTE: Trials 7 through 9 are optional. The date of 2 September 2015 will be reserved for a trial addressing emergency responder group objectives. Exact trial dates have not been scheduled yet.

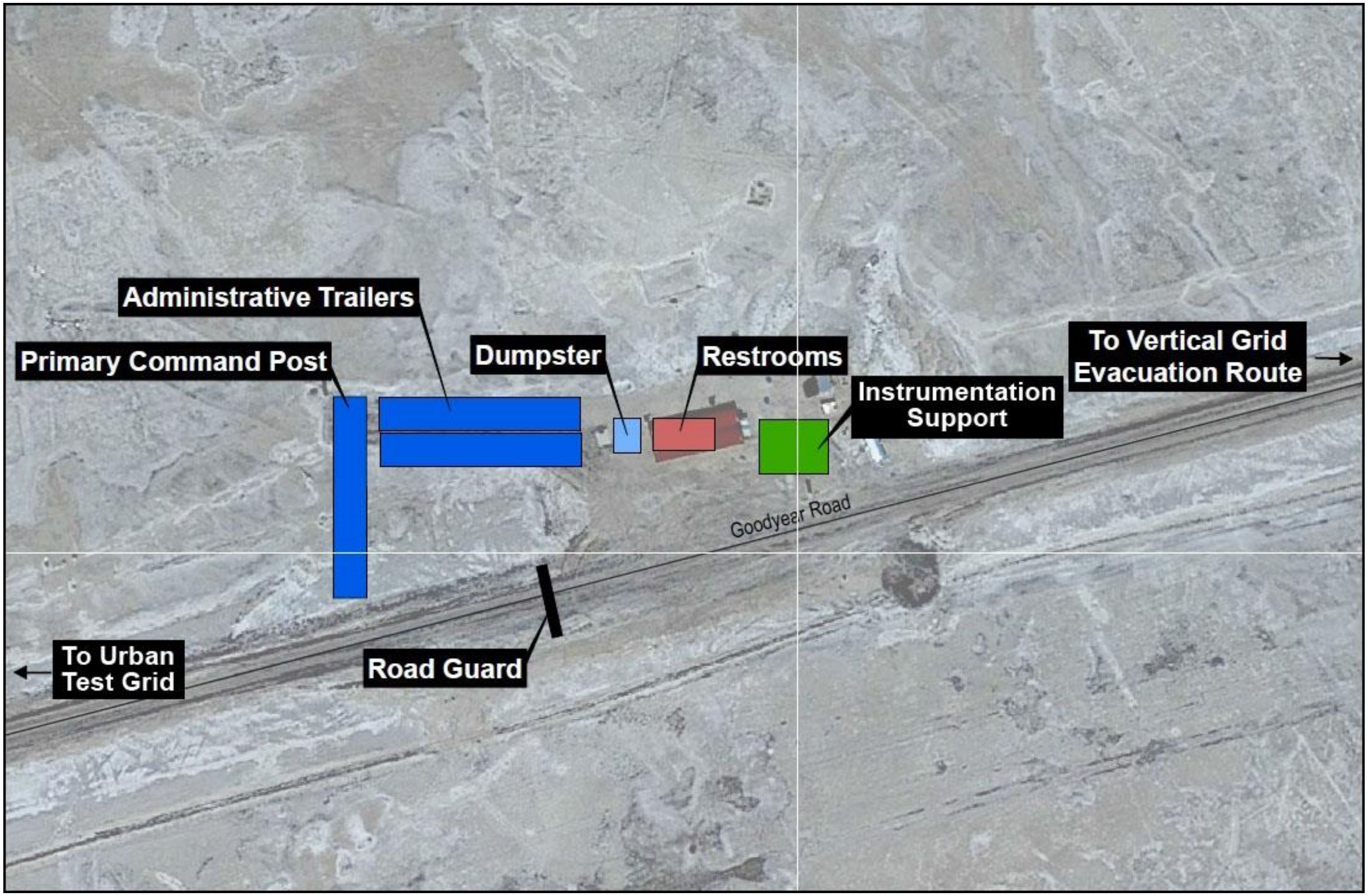


Figure 1. Map of Surface Layer (SL) Test Site Trailer Locations; JRII.

(2) Vertical (V)-Grid. Site will include one operations CP and one administrative trailer (Figure 2).

(3) Sprung® (Sprung Instant Structures, Aldersyde, Alberta) Facility. Site will include one instrumentation trailer (Figure 3).

(4) Distributed Test Control Center (DTCC). The DTCC will be the primary location for non-DPG modeling efforts, and visualization of test events by very important persons (VIPs). **NOTE**: The DTCC is located in the Ditto technical area at DPG and is not pictured in any of the figures in this plan.

2.1.3.2 UTG Site Layout

a. The UTG (Figure 4) area is a 122- × 183-m (400- × 600-ft) gravel pad that will have one concrete dissemination pad for testing (Figures 5 and 6). The concrete dissemination pad will be aligned in the horizontal middle of the UTG area and located 91 m (300 ft) vertically from the southern edge of the UTG. A layer of geotextile fabric will be spread on the ground where the pad will be poured, followed by a 30.5-cm (12-in) depth of gravel/fill mixture (also used for the access roads) for support of the concrete pad. A concrete pad will then be poured [with a 25-m (82-ft) diameter and 15.2-cm (6-in) thickness] and reinforced with rebar. The pad will have a 2.54-cm (1-in) lip at the outside edge made of a material that is chlorine-resistant and can be removed or replaced as needed based on operational or test requirements. **NOTE**: The coordinates for grid center are Northing 4445633.945 and Easting 288109.182.

b. There will be a 3.7- × 793-m (12- × 2600-ft) access road that connects Goodyear Road to the UTG area (Figure 5). The height of the UTG and access road will be 61 cm (24 in) above the playa (the same height as Goodyear Road). The access road will be graded using a gravel/fill mixture that has a high compaction rate (greater than 90 percent). **NOTE**: The grade will be level within a tolerance of one degree.

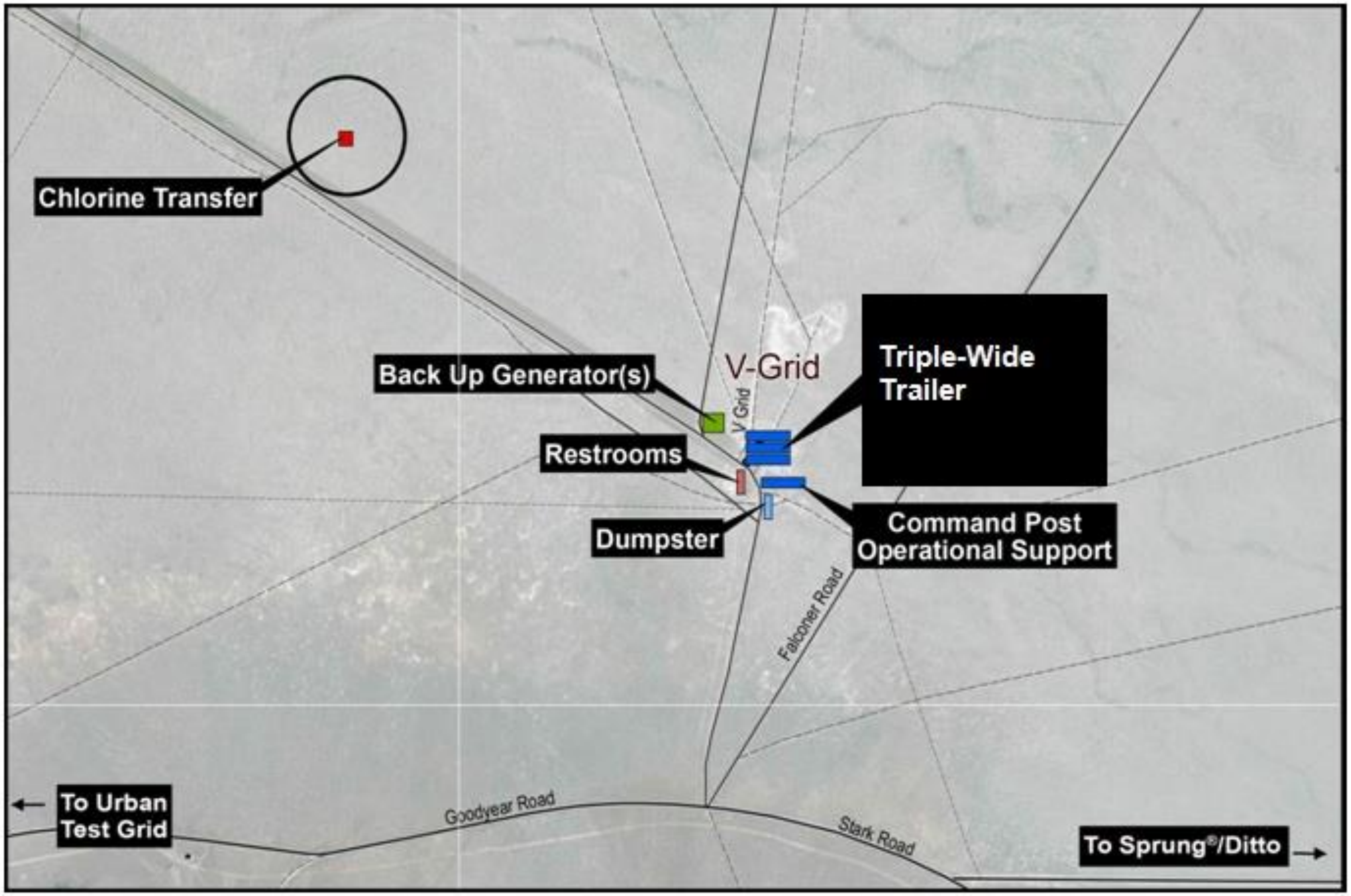
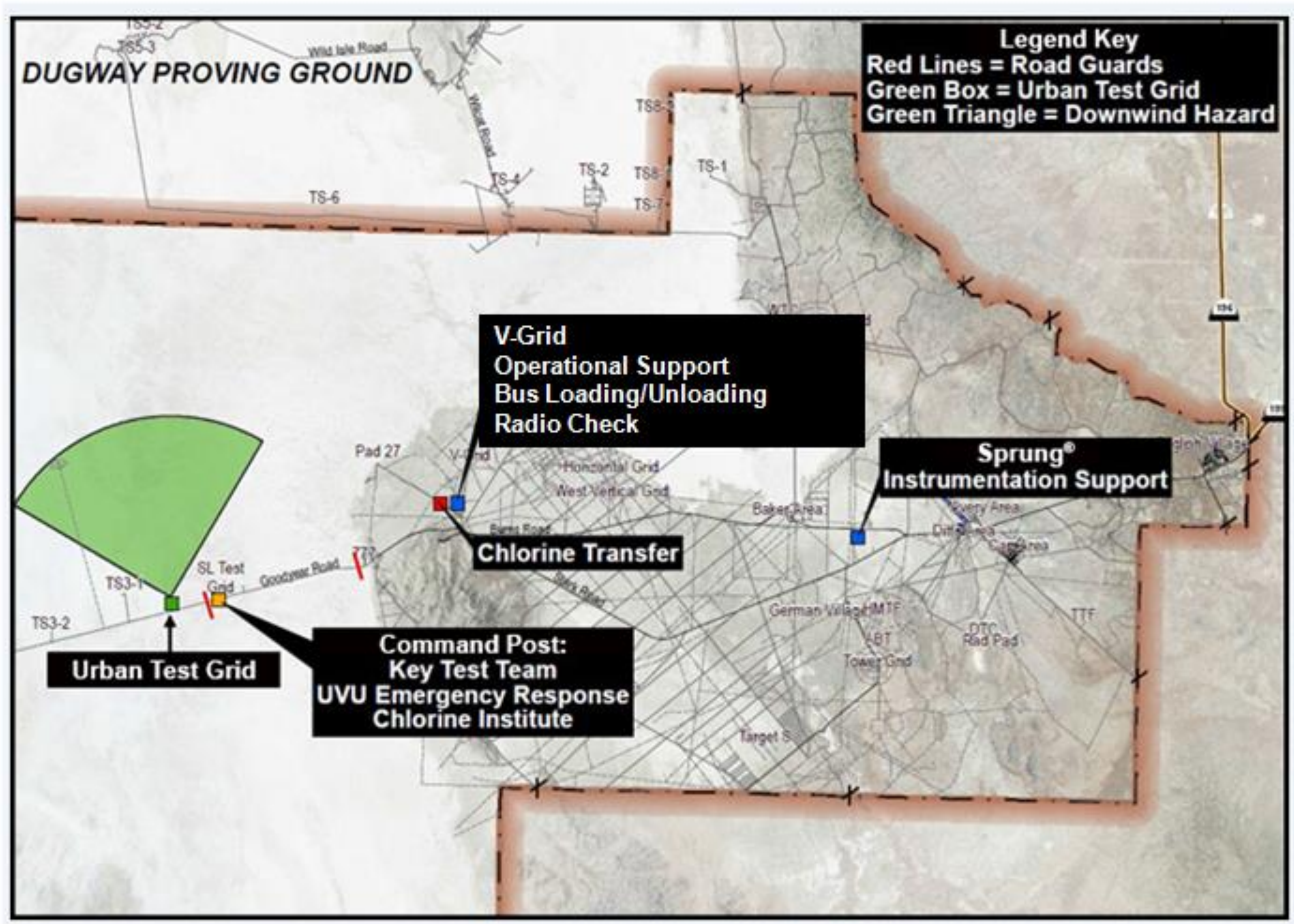


Figure 2. Vertical (V)-Grid Staging Facility Layout; JRII.

Figure 3. Map of Sprung® Site; JRII.

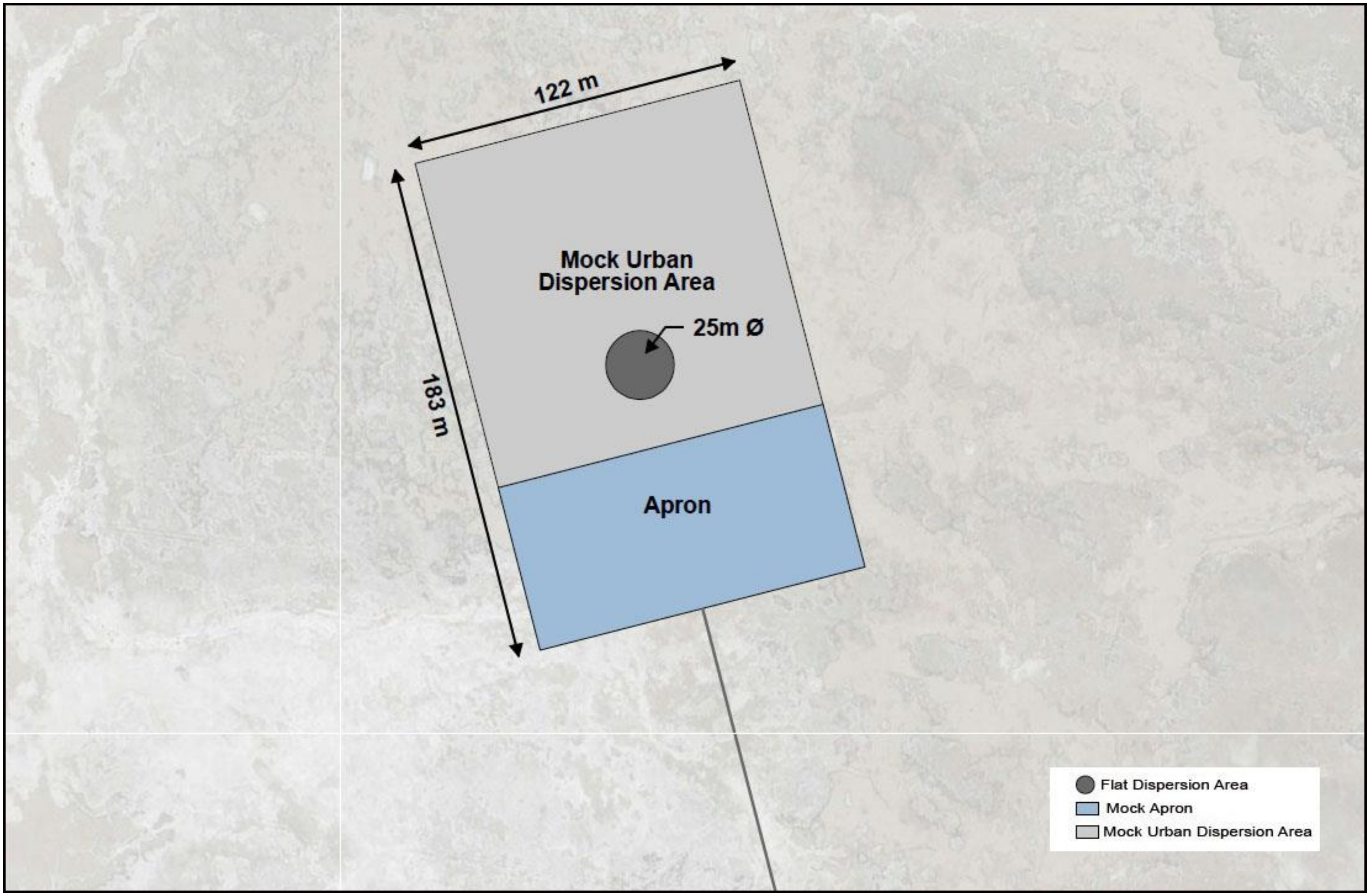


NOTE: V-Grid – Vertical Grid; UVU – Utah Valley University.

Figure 4. Jack Rabbit (JR)II Test Site; JRII.

NOTE: The apron is 61 m (200 ft) from north to south.

Figure 5. View of Urban Test Grid (UTG); JRII.



NOTE: The apron is 61 m (200 ft) from north to south.

Figure 6. Closeup View of Urban Test Grid (UTG); JRII.

2.1.3.3 Urban Environment Grid Setup

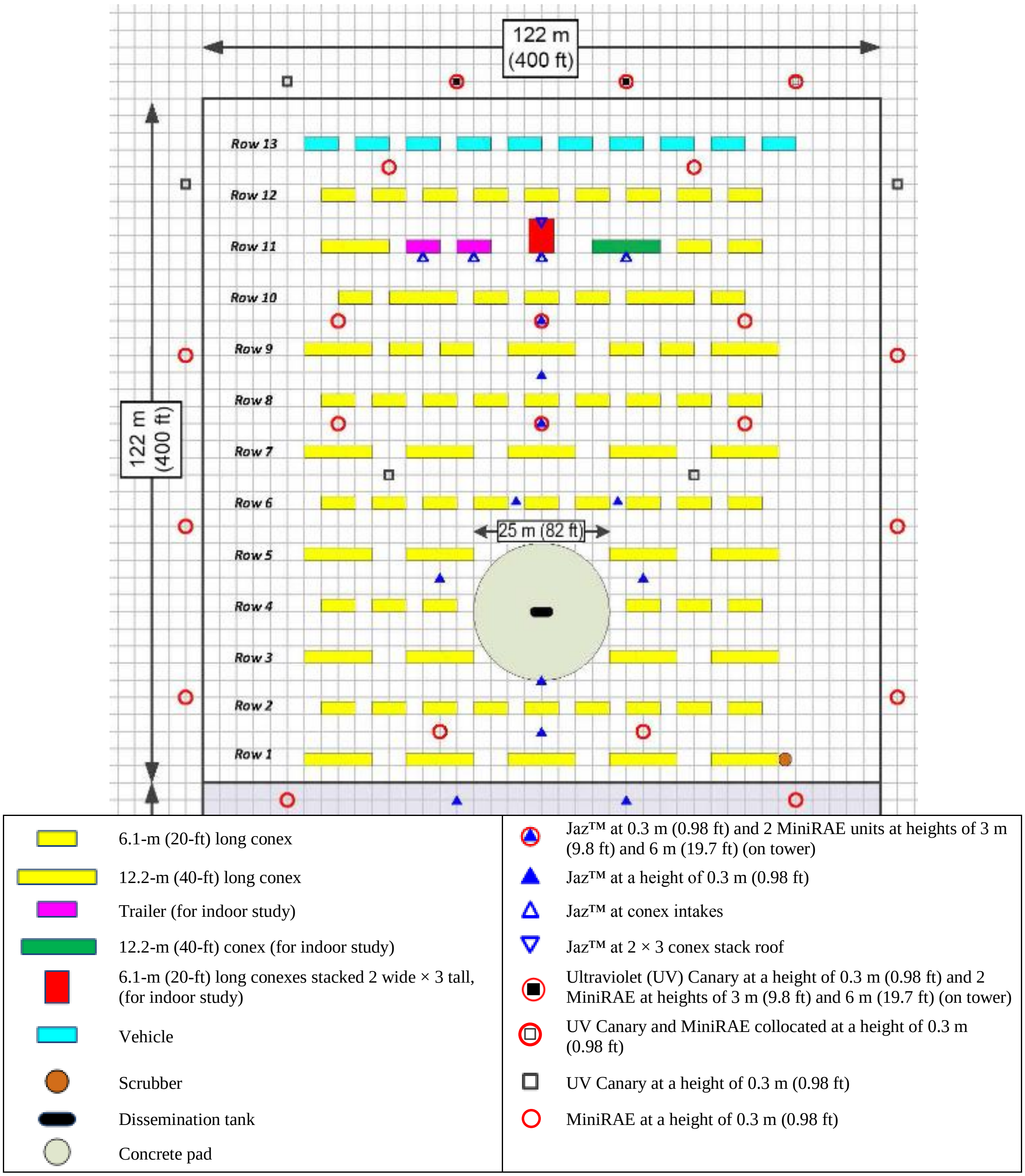
a. Conex Container Setup

(1) The UTG will be set up using a combination of conex containers that are 6.1- and 12.2-m (20- and 40-ft) long, in addition to two 5.5- × 2.7-m (18- × 9-ft) rolling trailers. The rolling trailers will be set up individually in a housing and office configuration. The conex containers will be a minimum of 610 m (2000 ft) in combined length (i.e., end to end) and will be set up on the UTG in one of four configurations as depicted in Figures 7 through 10. The final layout for each of the two trial groups (Table 2, Trials 1 through 4 and Trials 5 through 9) will be determined by the number of conex containers received before the UTG is set up and will be reported in the final test report. **NOTE**: Conex position numbers are not shown in Figures 7 through 10; however, the conex positions will be enumerated from left to right by row number (e.g., row 1 will have conex numbers 1.1, 1.2. 1.3, etc.). Figures 7 through 10 have been adapted from original layouts developed at Homeland Security Studies and Analysis Institute (Falls Church, Virginia) (Reference 8).

(2) For Trials 1 through 4, two different conex layouts will be considered (Figures 7 and 8). In either layout, most of the conex containers will placed on the grid unstacked, but six of the 6.1-m (20-ft) conex containers will be stacked in a 2- × 3-conex configuration. This stack will be aligned perpendicular to the rest of the conex containers and placed downwind from the dissemination tank (Figures 7 and 8). There will be no tall structure upwind from the dissemination tank in this layout (Figures 7 and 8). The number of conex rows varies between the two layouts (i.e., either 11 or 13 rows) and will depend on the number of conex containers available for the test.

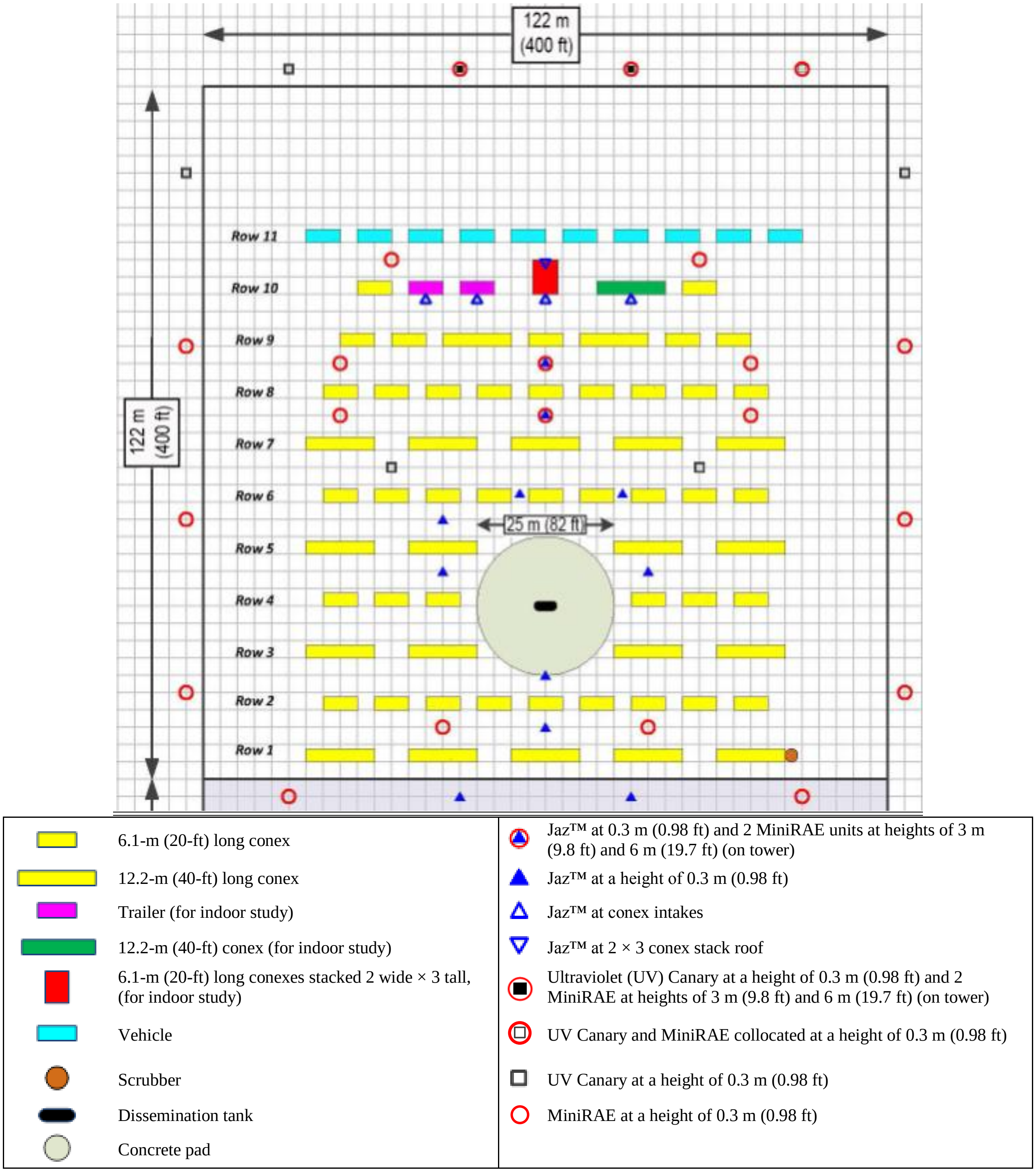
(3) For Trials 5 through 9, two different conex layouts will be considered (Figures 9 and 10). The conex container locations will be the same as those used for Trials 1 through 4 [Paragraph 2.1.3.3.a(2)] except that conex container 2.5 (i.e., row 2, container 5) will be replaced by an additional 2- × 3-conex container stack that will be oriented perpendicular to the dissemination tank. The additional conex stack will represent a tall structure upwind from the tank (Figures 9 and 10). The number of conex rows vary between the two layouts (i.e., either 11 or 13 rows) and will depend on the number of conex containers available for the test. Conex containers for the additional stack will be taken from various rows within the setup unless extra conex containers are available at test time.

(4) Instrumentation will be installed on the downwind 2- × 3-conex container stack, one 12.2-m (40-ft) conex container, and two mobile office units to support indoor modeling/contamination mapping efforts.



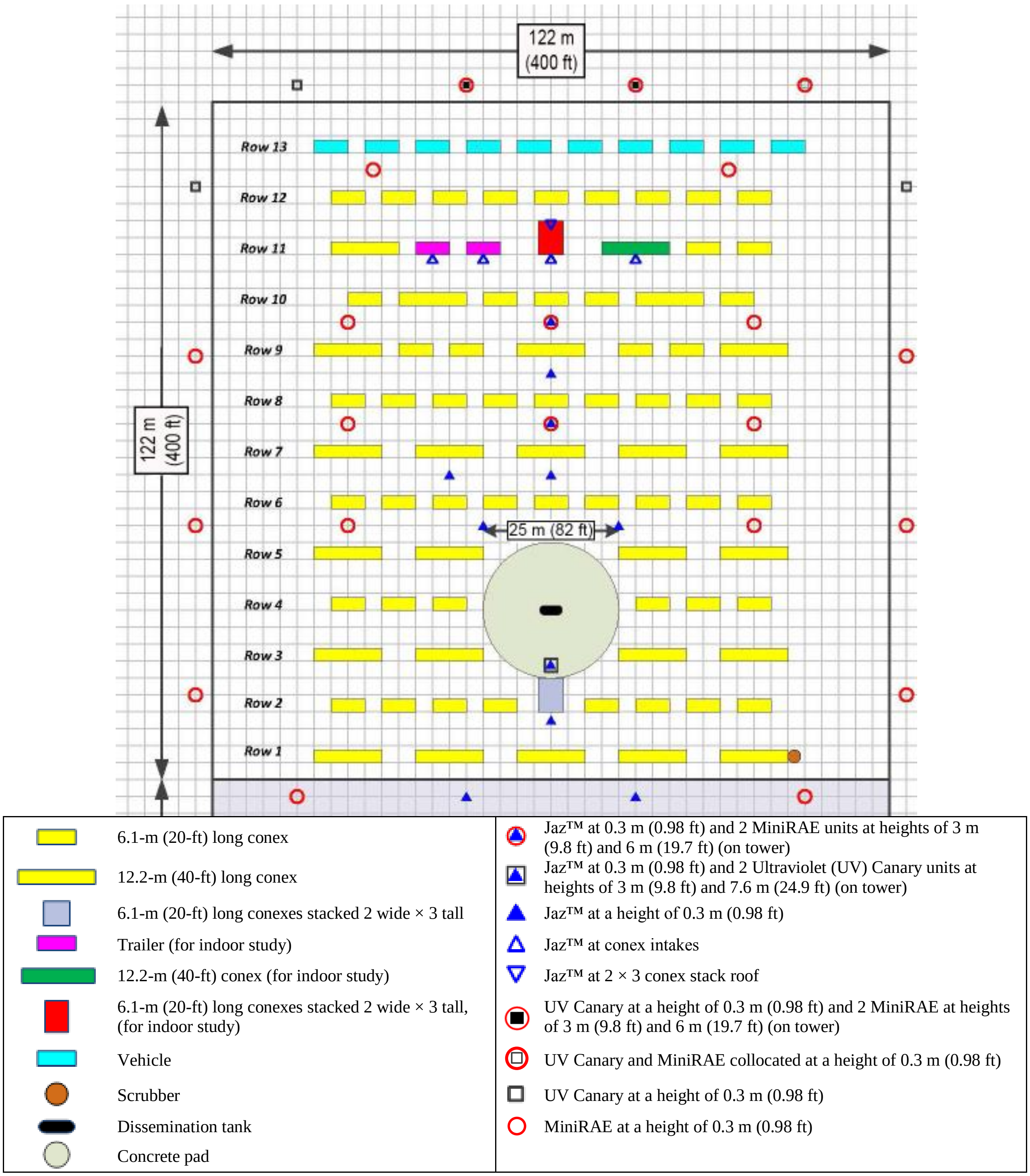
NOTE: A description of the instrumentation is in Paragraph 2.1.3.4. This figure was provided by Homeland Security Studies and Analysis Institute (Falls Church, Virginia) and adapted by US Army Dugway Proving Ground (DPG).

Figure 7. Mock Urban Layout 1 With No Tall Structure Upwind; JRII.



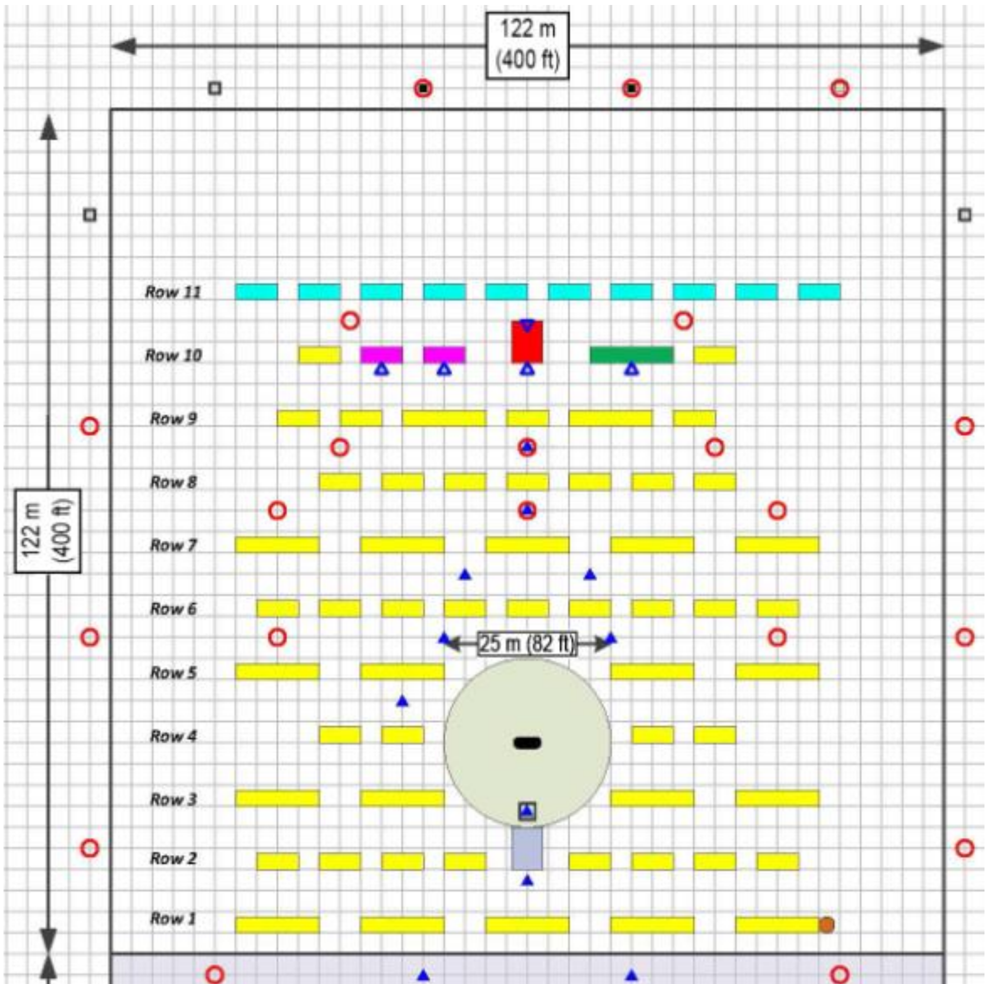
NOTE: This is the minimum layout based upon the current quantity of conex containers available. A description of the instrumentation is in Paragraph 2.1.3.4. This figure was provided by Homeland Security Studies and Analysis Institute (Falls Church, Virginia) and adapted by US Army Dugway Proving Ground (DPG).

Figure 8. Mock Urban Minimum Layout 1 With No Tall Structure Upwind; JRII.



NOTE: This is the desired layout if enough conex containers are available. A description of the instrumentation is in Paragraph 2.1.3.4. This figure was provided by Homeland Security Studies and Analysis Institute (Falls Church, Virginia) and adapted by US Army Dugway Proving Ground (DPG).

Figure 9. Mock Urban Layout 2 With Tall Structure Upwind; JRII.



6.1-m (20-ft) long conex	Jaz™ at 0.3 m (0.98 ft) and 2 MiniRAE units at heights of 3 m (9.8 ft) and 6 m (19.7 ft) (on tower)
12.2-m (40-ft) long conex	Jaz™ at 0.3 m (0.98 ft) and 2 Ultraviolet (UV) Canary units at heights of 3 m (9.8 ft) and 7.6 m (24.9 ft) (on tower)
6.1-m (20-ft) long conexes stacked 2 wide × 3 tall	Jaz™ at a height of 0.3 m (0.98 ft)
Trailer (for indoor study)	Jaz™ at conex intakes
12.2-m (40-ft) conex (for indoor study)	Jaz™ at 2 × 3 conex stack roof
6.1-m (20-ft) long conexes stacked 2 wide × 3 tall, (for indoor study)	UV Canary at a height of 0.3 m (0.98 ft) and 2 MiniRAE at heights of 3 m (9.8 ft) and 6 m (19.7 ft) (on tower)
Vehicle	UV Canary and MiniRAE collocated at a height of 0.3 m (0.98 ft)
Scrubber	UV Canary at a height of 0.3 m (0.98 ft)
Dissemination tank	MiniRAE at a height of 0.3 m (0.98 ft)
Concrete pad	

NOTE: This is the minimum layout based upon the current quantity of conex containers available. A description of the instrumentation is in Paragraph 2.1.3.4. This figure was provided by Homeland Security Studies and Analysis Institute (Falls Church, Virginia) and adapted by US Army Dugway Proving Ground (DPG).

Figure 10. Mock Urban Minimum Layout 2 With Tall Structure Upwind; JRII.

b. Vehicle Setup. Four fire trucks, four cars, and one ambulance will be available for placement on the north end (last row) of the urban grid behind the conex containers. There are 10 possible vehicle positions in Rows 11 and 13 (Figures 7 through 10); however, only three vehicles (e.g., one fire truck, one car, and one ambulance) will be used for each trial. These vehicles will be stationary; however the engines and ventilation systems may be operational. **NOTE**: The date of 2 September 2015 will be reserved for a trial addressing emergency responder group objectives. Exact trial dates have not been scheduled yet.

2.1.3.4 Instrumentation Setup

a. Instrument locations will be surveyed and included in the final report. The proposed layout for the far-field, towers, and near-field instrumentation are shown in Figures 11 through 13.

b. Maps for Far-Field Instrumentation. The locations of the far-field instrumentation are shown in Figure 11. The tower locations are shown in Figure 12.

c. Maps for Near-Field Instrumentation. The locations of the near-field instrumentation are shown in Figure 13.

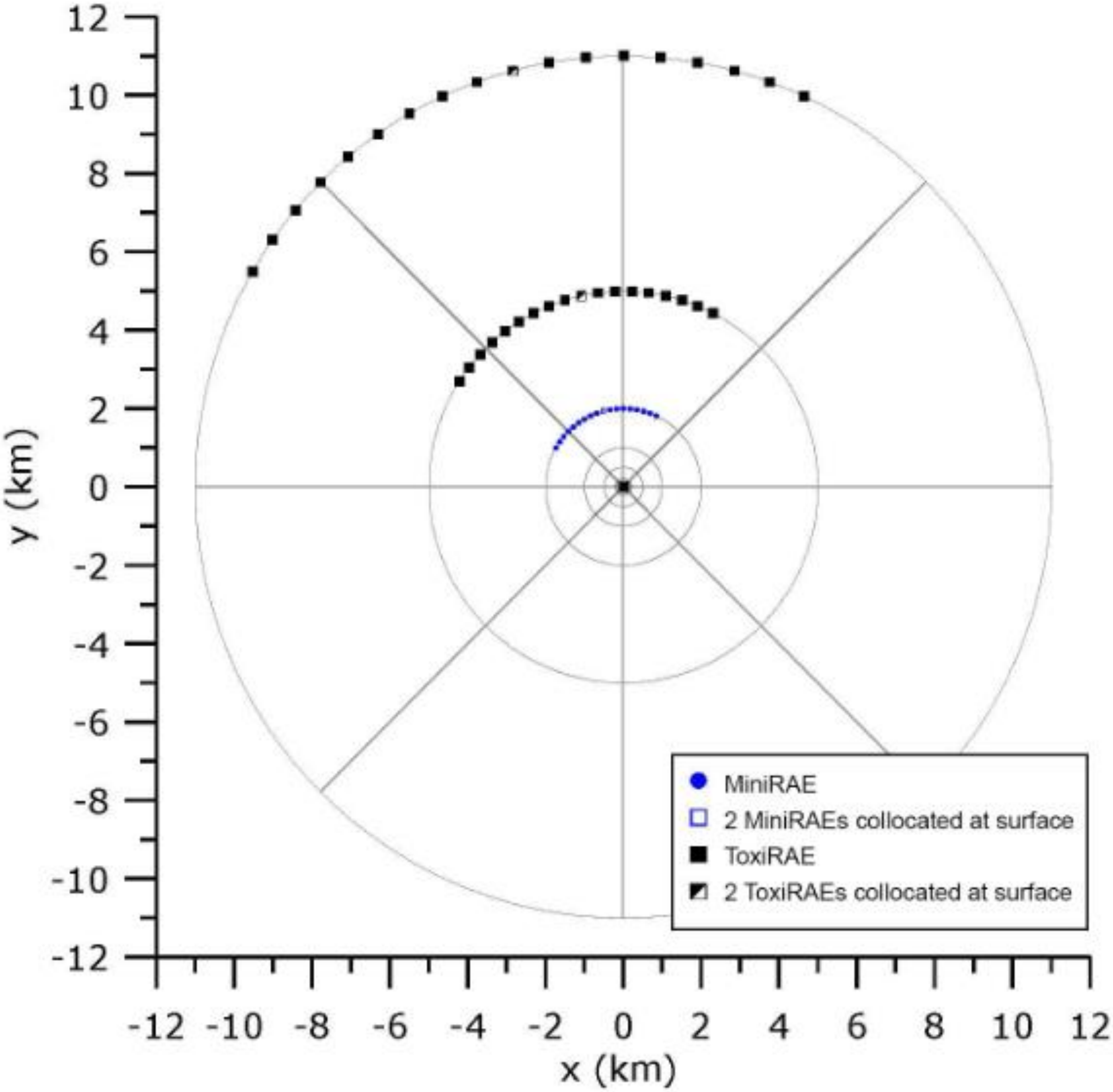
d. Point Sensors

(1) MiniRAE 2000. MiniRAE 2000 (PGM-7600) detectors (RAE® Systems, San Jose, California) are handheld volatile organic compound (VOC) photoionization detectors. The MiniRAE 2000 units will have 11.7-electron volt (eV) lamps for detection of chlorine gas and will be calibrated by using methods that will be determined in a laboratory experiment and the results will be documented in the FTR. The outcome will determine if DPG will use chlorine gas or isobutylene gas for calibration. During the experiment, the detector baseline will be set at the zero point by challenging the unit with clean air passed through a charcoal filter. **NOTE**: Because of scheduling constraints, a portion of the experiment will be conducted after the test to validate the methods.

(a) The MiniRAE 2000 units will be operated IAW the operations manual (Reference 9). The MiniRAE data will provide the concentration of any ionizable chlorine and any organic vapors at discrete short time intervals to show concentration changes throughout the progression of the test event. The MiniRAE 2000 units are nonselective detectors; therefore, the detectors will not discriminate among any detected VOCs.

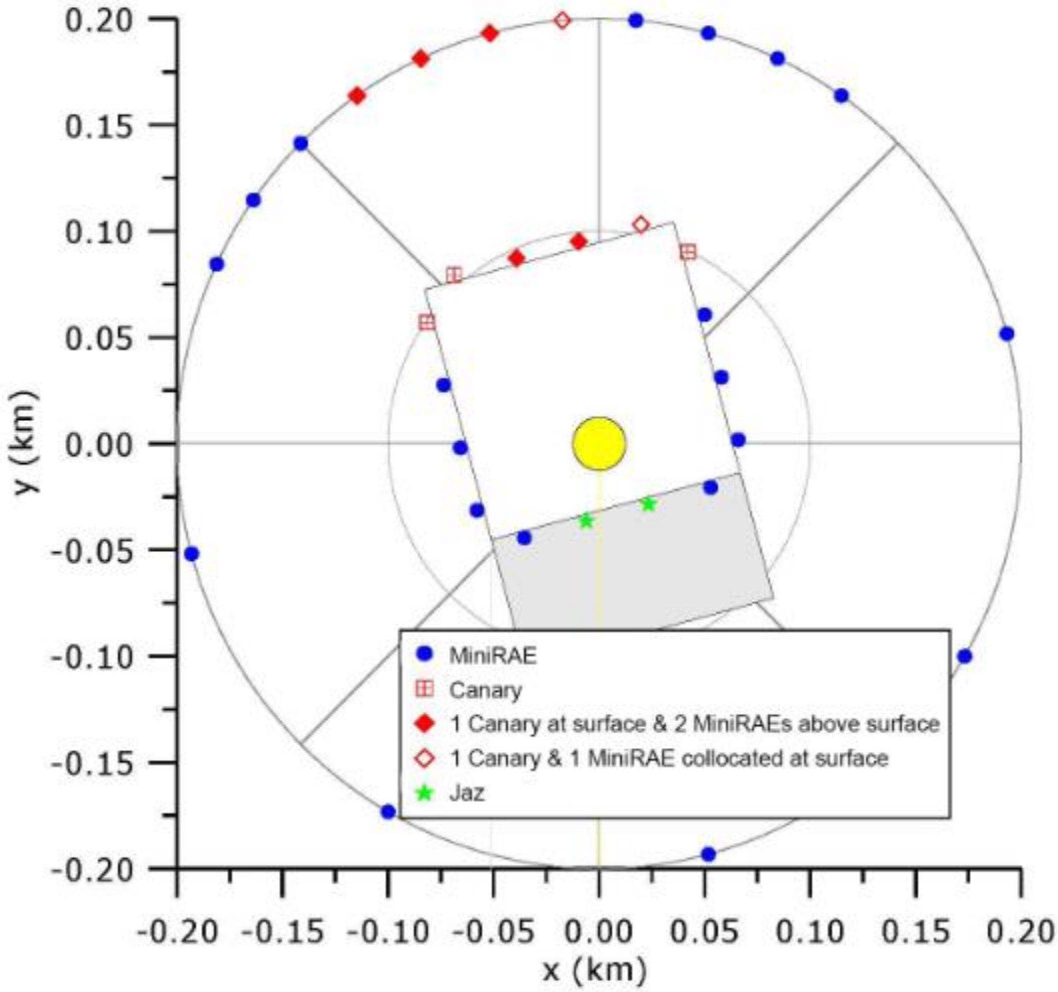
(b) The data will be collected in the onboard data loggers for all of the MiniRAE 2000 detectors and downloaded after each trial.

(1) The data will be logged for the required period and reported in the final test report. Each data logger will record data for 4, 8, or 12 hours depending on whether the collection rate is 1 data point per second, per 2 seconds, or per 3 seconds, respectively. Because the data logger's memory capacity is limited, the start time for data collection will be critical when determining the MiniRAE sampling rate. The MiniRAE cannot be time-synchronized to the second; therefore, the timing of each instrument will be observed and recorded to determine the correction to seconds.



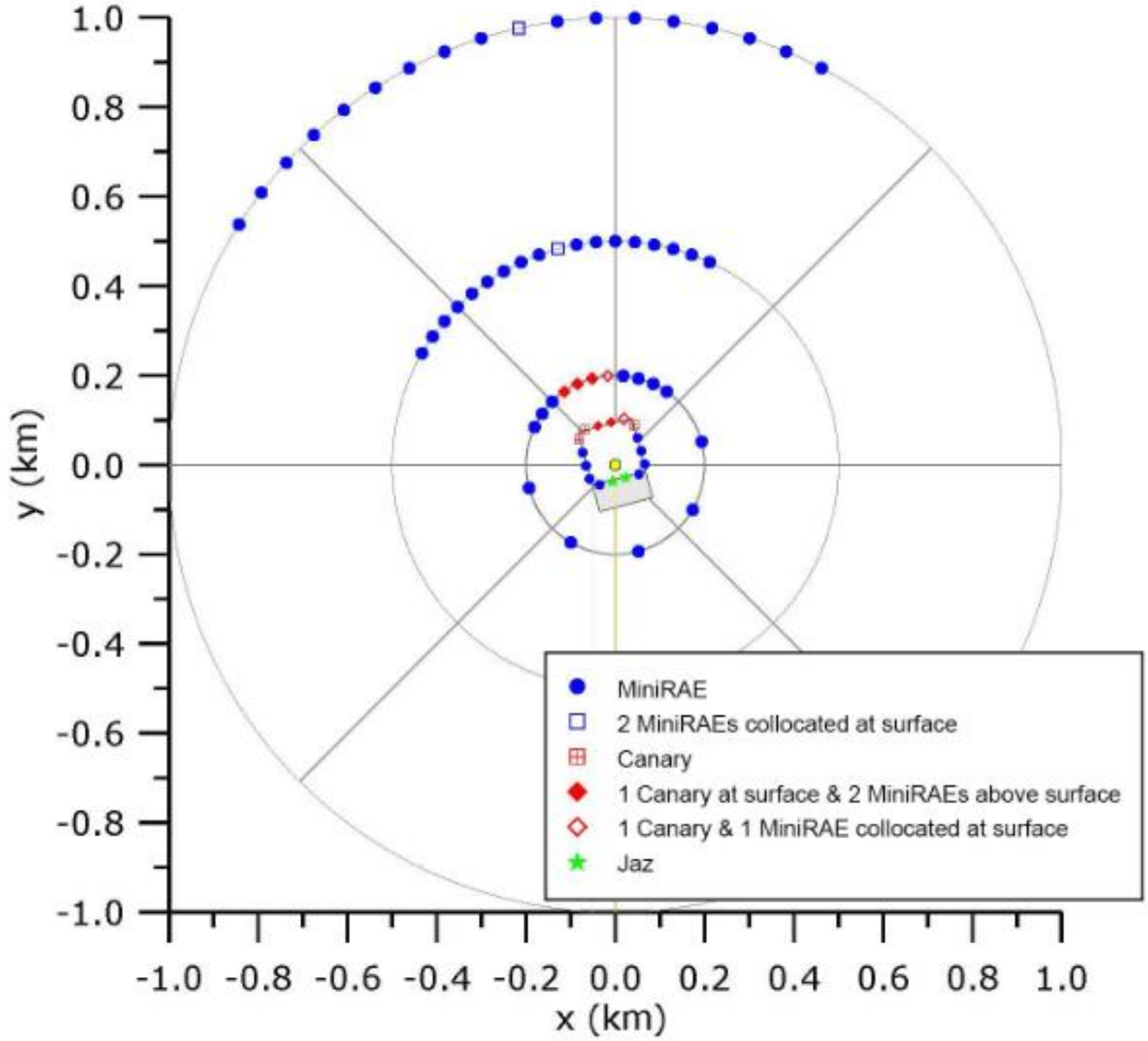
<u>NOTE</u>: The instrumentation will be equally spaced. This figure was provided by Homeland Security Studies and Analysis Institute (Falls Church, Virginia) and adapted by US Army Dugway Proving Ground (DPG).

Figure 11. Far-Field Instrumentation; JRII.



NOTE: This figure does not include the towers within the obstacle array. The yellow circle is grid center. Azimuth of grid centerline is 345 degrees. Canary – Ultraviolet (UV) Canary. This figure was provided by Homeland Security Studies and Analysis Institute (Falls Church, Virginia) and adapted by US Army Dugway Proving Ground (DPG).

Figure 12. Tower Locations; JRII.



NOTE: The yellow circle is grid center. Azimuth of grid centerline is 345 degrees. This figure was provided by Homeland Security Studies and Analysis Institute (Falls Church, Virginia) and adapted by US Army Dugway Proving Ground (DPG).

Figure 13. Near-Field Instrumentation Arcs and Radials; JRII.

(2) The range of chlorine concentration measurements will be approximately 100 to 2000 parts per million (ppm). Lower concentration levels may be detectable, but the accuracy of measurement falls off significantly for concentrations less than 100 ppm. The lab experiment will better characterize the effective concentration range for the MiniRAEs. All units will be calibrated before trials and checked with a chlorine bump test after calibration. Units that do not meet calibration specifications will not be used. A bump test with chlorine will be performed after each trial is completed to verify that it is still within the acceptable calibration range. Data collected before each trial will be used to verify whether background VOCs are present. A data quality template has been uploaded to the Homeland Security Information Network (HSIN). **NOTE**: Access to the HSIN must be requested through the customer.

(2) MiniRAE 3000. MiniRAE 3000 (PGM-7320) detectors (RAE® Systems, San Jose, California) are handheld VOC photoionization detectors. The MiniRAE 3000 units will have 11.7-eV lamps for detection of chlorine gas. The MiniRAEs will be calibrated by using the methods determined in a laboratory experiment. The outcome will determine if DPG will use chlorine gas or isobutylene gas for calibration. During the experiment, the detector baseline will be set at the zero point by challenging the unit with clean air passed through a charcoal filter. **NOTE**: Because of scheduling constraints, a portion of the experiment will be conducted after the test to validate the methods.

(a) The MiniRAE 3000 units will be operated IAW the operations manual (Reference 10) and the operating procedure developed by DPG (Reference 11). The MiniRAE data will provide the concentration of any ionizable chlorine and any organic vapors at discrete short time intervals to show concentration changes throughout the progression of the test event. The MiniRAE 3000 units are nonselective detectors; therefore, the detectors will not discriminate among any detected VOCs.

(b) The data will be collected in the onboard data loggers for all of the MiniRAE 3000 detectors and downloaded after each trial.

(1) The data will be logged for the required period and reported in the final test report. The data logger will record data for 72 hours when collecting 1 data point per second. Because the memory storage is larger than that of the MiniRAE 2000, the start time for data collection will not be as critical in determining what sampling rate is used. The MiniRAE 3000 units will be time synchronized to the second.

(2) Chlorine concentration measurements are expected to be within the range of 100 to 2000 ppm. Lower levels may be detected, but the accuracy of the reported concentration falls off significantly for concentrations less than 100 ppm. The lab experiment will characterize the effective concentration range that the MiniRAE 3000 units will measure. All units will be calibrated before trials and checked with a chlorine bump test after calibration. Units that do not meet calibration specifications will not be used. A chlorine bump test will be performed after the trial is completed to verify the MiniRAE 3000 units remain within the acceptable calibration range. A data quality template has been uploaded to HSIN. **NOTE**: The data collected before the trial will be used to verify whether background VOCs are present.

(c) The MiniRAE 2000 and 3000 units will be located throughout the grid (Figures 7 through 10 and 11 through 13). The MiniRAEs will be distributed as follows: 22 units for indoor study, 12 units within the obstacle array, 13 units on the perimeter of the concrete pad, 19 units on the 200-m (656-ft) ring, 20 units on the 500-m (1640-ft) arc, 19 units on the 1-km (0.62-mi) arc, and 20 units on the 2-km (1.24-mi) arc. The MiniRAEs will be placed at 0.3 m (1 ft) above grade level (AGL) at all locations except for locations on towers within the obstacle array and on the grid, and inside the indoor study test fixtures. The angle of the outer arcs will be 90 degrees (spanning from 300 to 30 degrees). Two MiniRAEs will be collocated at three locations. There will be a total of 152 MiniRAEs available (79 MiniRAE 2000 units and 23 MiniRAE 3000 units provided by DPG and an extra 50 MiniRAE 3000 units provided by RAE Systems). Only 125 MiniRAEs will be used for the test and the remainder will be used for backups.

(3) ToxiRAE Pro. ToxiRAE Pro (PGM-7320) electrochemical detectors (RAE® Systems, San Jose, California) sample ambient air and measure concentrations of chlorine gas. The ToxiRAE Pro will provide measurements of approximate chlorine concentrations in the downrange (far-field) cloud and/or urban challenge/breakthrough locations, including state-required environmental measurements off post (Paragraph 2.1.3.4.g).

(a) ToxiRAE Pro concentration data (in ppm) will be logged on a set time scale. ToxiRAE Pro units will be time-synchronized to the second by manually entering the time into each instrument. Each evening, before beginning instrument calibration, an official local time (to the second) will be communicated to the lead instrumentation person at the Sprung® Facility, who will set a clock. All instruments will be set to that time.

(b) The ToxiRAE Pro has a detection limit of approximately 0.1 to 50 ppm per manufacturer specifications; however the 0.1-ppm detection limit will be verified by DPG.

(c) There will be 137 ToxiRAE Pro units available; 61 will be used on the test grid and 76 will be used for safety monitoring, backups, and environmental monitoring south of the test site at Fish Springs Wildlife Preserve, along Interstate (I)-80, and along the northern and western borders of DPG. Four ToxiRAE Pro units will be used for indoor studies, 18 units for monitoring in vehicles, 19 units for the 5-km (3.1-mi) arc, and 20 units for the 11-km (6.8-mi) arc. The ToxiRAE Pro units will be located at 1 ft (0.3 m) AGL at all locations except those on towers within the obstacle array (Figure 11). The ToxiRAE Pro units will be operated IAW the operations manual (Reference 12) and the operating procedure developed by DPG (Reference 13). A data quality template has been uploaded to HSIN.

(4) Gasmet™. The Gasmet™ DX-4000 multicomponent Fourier-transform infrared spectrometer (FTIR) gas analyzer (Gasmet Technologies Inc., Oy, Helsinki, Finland) will be used as a point detector to measure the concentration of sulfur hexafluoride (SF_6) for the indoor/outdoor transport of a dense gas study (Paragraph 2.1.3.6.h). The detection limit is 0.1 ppm.

(5) Ultraviolet (UV) Canary

(a) The UV Canary is a portable point detector manufactured by Cerex Monitoring Solutions, Inc. (Atlanta, Georgia) that uses UV differential optical absorption spectroscopy (UV-DOAS). The chlorine-specific UV Canary has a detection range of 10 to 10,000 ppm. DPG maintains an inventory of 20 UV Canary units. The UV Canary units will be calibrated in advance of testing. **NOTE**: Concentration measurements will be referenced to ambient temperature and pressure.

(b) Twenty UV Canary units will be placed on the test grid and eight units will be used for the indoor study (Figures 7 through 10, 12, and 13). Two units will be in the obstacle array, six units on the urban pad ring, and four units on the 200-m (656-ft) ring. The UV Canary units will sample at a height of 0.3 m (1 ft) AGL except for those used for the indoor study or in the obstacle array. A data quality template has been uploaded to HSIN.

(6) Jaz™

(a) The Jaz™ is a portable point detector manufactured by Signature Science, Inc. (Houston, Texas) that uses UV-DOAS. The Jaz™ is a chlorine-specific detector with a detection range of 100 to 100,000 ppm-volume (v). DHS will provide 16 Jaz™ instruments, which will be calibrated in advance of testing, and spot-checked daily with 5000-ppm-certified chlorine gas standards. **NOTE**: The concentration will be referenced to ambient temperature and pressure.

(b) Sixteen Jaz™ instruments will be emplaced on the grid, five will be used outside the structure intakes, nine will be within the obstacle array, and two will be on the urban pad perimeter (Figures 7 through 10, 12, and 13). The Jaz™ units will sample at a height of 0.3 m (1 ft) AGL except for units located on towers within the obstacle array.

(c) The Jaz™ instruments will be operated and maintained by Signature Science, Inc. A data quality template has been uploaded to HSIN.

e. Standoff Detectors

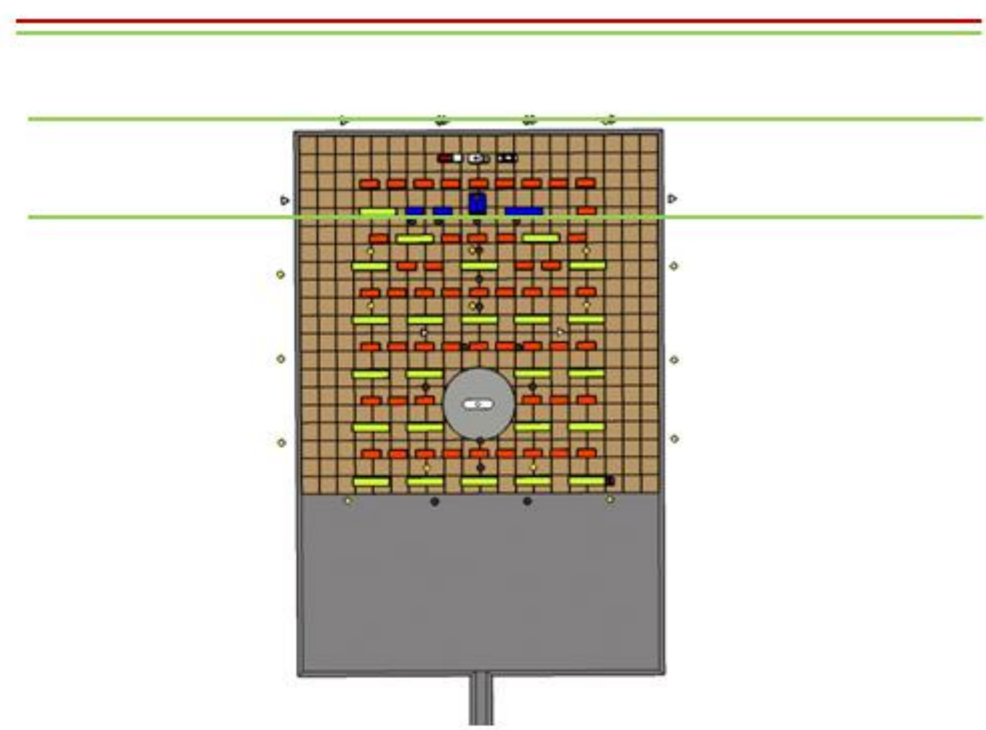
(1) UV Sentry. The UV Sentry is a portable standoff detector manufactured by Cerex Monitoring Solutions, Inc. (Atlanta, Georgia) that uses UV-DOAS. It is a chlorine-specific detector with a detection range of 10 to 10,000 ppm-meters (ppm-m). DPG maintains an inventory of three UV Sentry systems. The UV Sentry systems will be calibrated in advance of testing, even though UV-DOAS technology makes calibrations unnecessary.

(a) Each UV Sentry consists of two units: the sender unit and the receiver unit. The sender unit is a xenon (Xe)-arc lamp mounted on a tripod. The receiver unit has a receiving optic on a tripod, spectrometer unit (normally on the ground), and a length of fiber optic that transmits the incoming signal from the optical receiver to the spectrometer unit. The sender and receiver units are normally more than 1 km (more than 0.62 mi) apart. Because the UV light travels some distance from the sender to the receiver, the resulting signal and subsequent calculated concentration are path-averaged (ppm-m). **NOTE**: The concentration is referenced to ambient temperature and pressure.

(b) During the Fiscal Year 2015 (FY15) urban area releases, the UV Sentry will have a path length down the following locations: immediately upwind of the indoor study containers, immediately downwind of the last row of downwind conex containers, and 100 m (328 ft) downwind of the last row of downwind conex containers. The locations of the UV Sentry are shown in Figure 14. A data quality template has been uploaded to HSIN.

(2) <u>UV Light Detection and Ranging (LIDAR) System</u>. The UV LIDAR (DPG) is a laser-based ranging and detection instrument that will be used to measure chlorine gas concentrations. The UV LIDAR provides particle information in binned (grouped) measurement distance ranges. The concentration is integrated over the bin size.

(a) The UV LIDAR operates on the principle of measuring absorption of the 355-nm laser beam near the absorption maximum of chlorine from the background of aerosol signal. There are two known limits to this method. First, if the concentration of chlorine exceeds some maximum, then effectively all the background signal is absorbed and no further concentration measurement can be discerned above this level. Second, if the background aerosol concentration is low or not existent, then there is limited ability to determine concentration.



<u>NOTE</u>: The horizontal lines represent the FOV for the UV Sentry systems.

Figure 14. Ultraviolet (UV) Sentry Field of View (FOV); JRII.

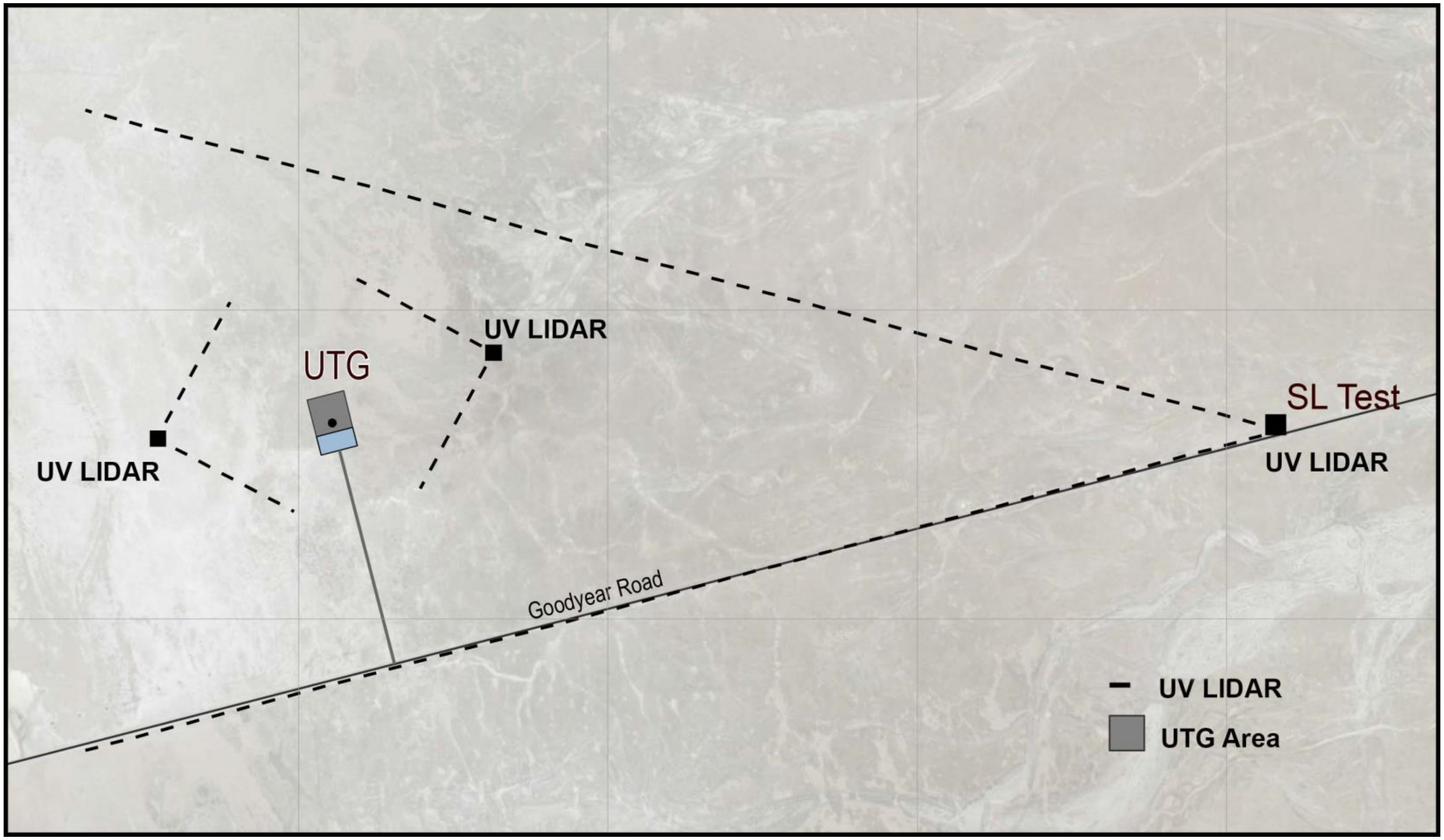
(b) Three UV LIDAR systems will be deployed during FY15 testing. It is expected that the three UV LIDAR systems will become saturated at 50 ppm or less and this will enable determination of a three-dimensional (3D) concentration boundary for the cloud. **NOTE**: The LIDAR will not be calibrated before the test because a known concentration of chlorine gas cannot be produced outdoors before testing; however, point sensors may be used during the trial to verify the LIDAR concentration. The UV LIDAR has a safety fan for the scan of 300 m (984 ft) (Figure 15). The appropriate scanning method will be implemented for testing (e.g., using a vertical, horizontal or sawtooth pattern, etc.). A data quality template has been uploaded to HSIN.

f. Optical Instrumentation. There will be a variety of high-definition (HD), high-speed (HS), and infrared (IR) cameras positioned throughout the test grid to visualize and record the chlorine release and resulting plume. Optical equipment will be remotely operated from SL test site using an unmanned optics control trailer located on Goodyear Road at the turnoff to the UTG area. The locations of the HD, SD, and IR cameras are shown in Figures 16 and 17. A data quality template has been uploaded to HSIN.

(1) HD. HD video cameras will be used to record chlorine dispersion and downwind transport of the chlorine cloud. Sony® NXCAM Real-Time video cameras (Sony®, New York City, New York) will be placed at each HS and IR camera position for visual documentation of the plume and will capture optical data at the rate of 30 frames per second (fps) for the wider view of the tank and plume growth. All HD videos will be converted to Windows Media Video (WMV) or H.264 (MP4) formats after each trial (as needed). Field of view (FOV) will be determined the day of testing based on current weather conditions. **NOTE**: An IR/HS and a wide-angle HD camera will be mounted on a pole on top of the 6.1-m (20-ft) conex container located on the southeast side of the concrete pad to record the dissemination effects and the plume as it flows north of the UTG.

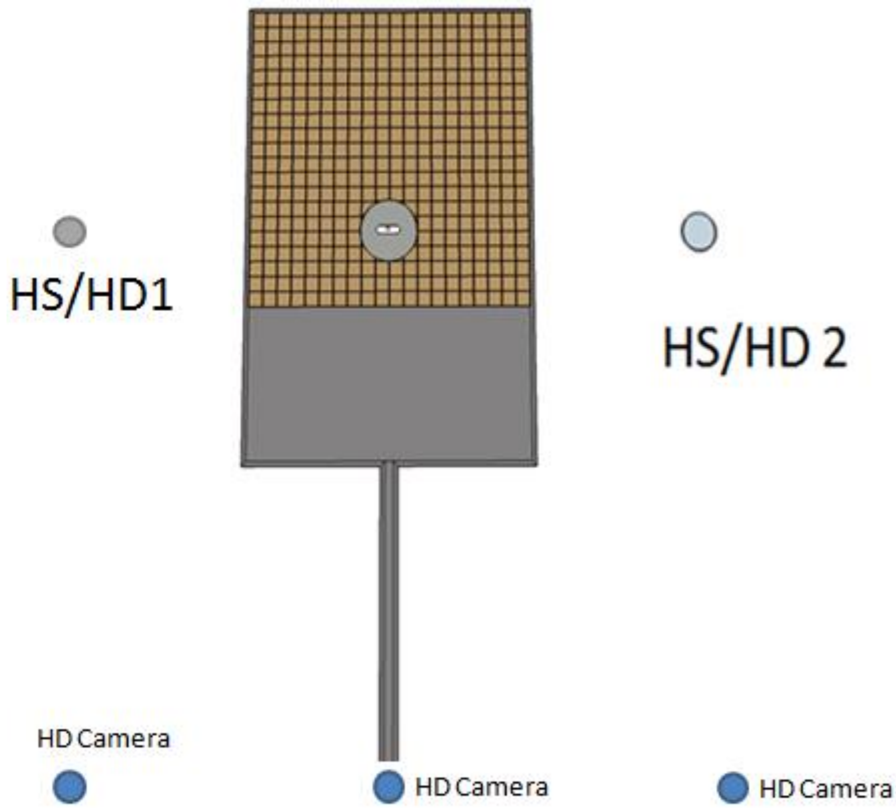
(2) HS. HS Phantom® V711 video cameras (Vision Research, Wayne, New Jersey) will be used primarily to record chlorine dispersion at the release point and downwind transport of the chlorine cloud. HS video will also be used to document and characterize the breach of the 18144-kg (20-ton) chlorine tank on the final chlorine release.

(a) The HS video cameras will be located outside of the plume area and remotely operated from appointed locations. The HS video cameras will capture close-focus images of the tank at the rate of 1000 fps with a run time of approximately 21 seconds. The actual optics and the respective FOVs for the HS cameras will be determined during test-site preparation and documented in the test control officer (TCO) logbook. The locations of the photography target boards will be surveyed and recorded.



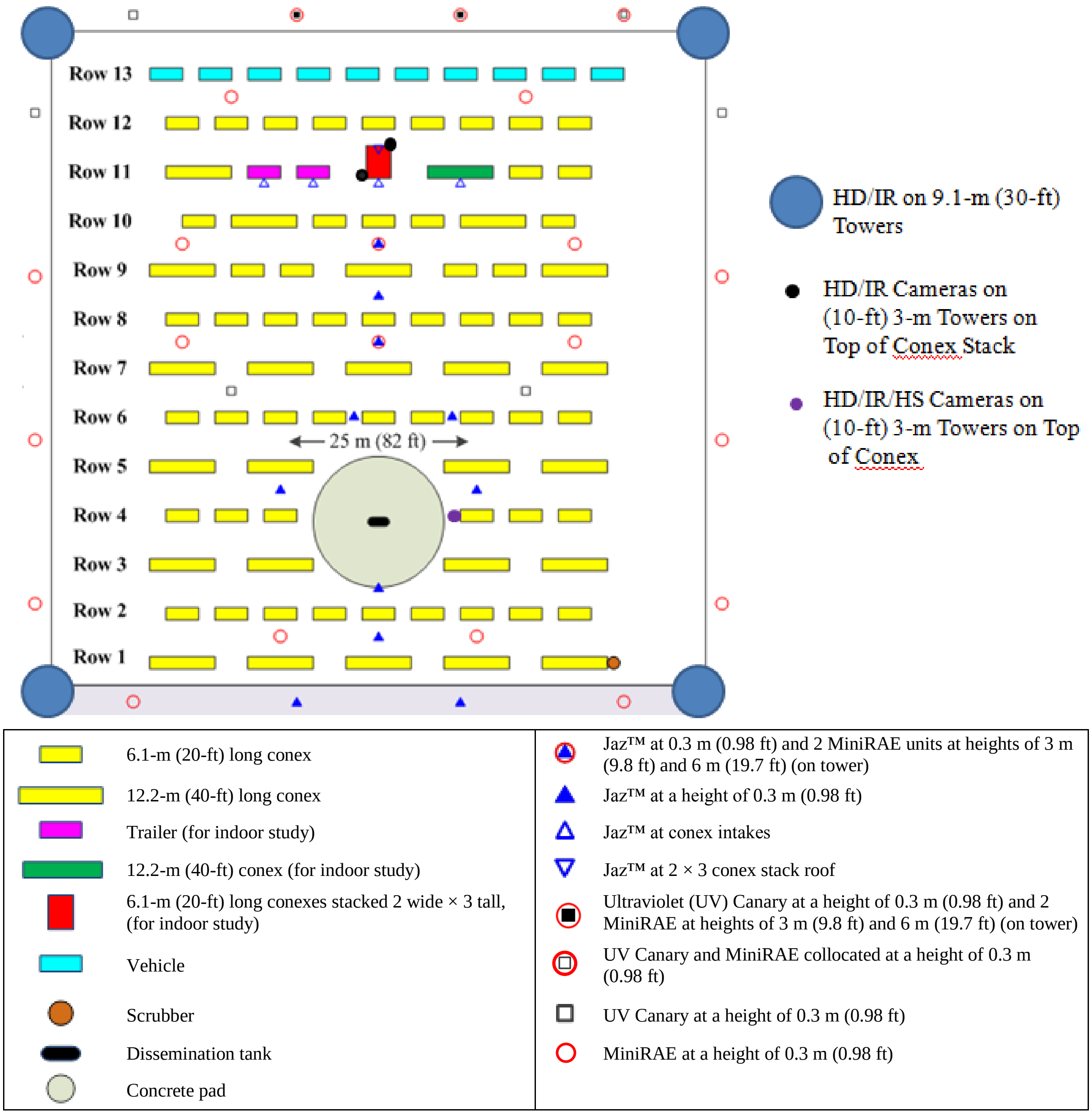
NOTE: SL – SL Surface Layer; UTG – Urban Test Grid.

Figure 15. Ultraviolet (UV) Light Detection and Ranging (LIDAR) Safety Fan; JRII.



NOTE: The HS/HD camera positions will be located within the UTG area because the specialized dissemination tank will be located inside the obstacle array. Final camera locations will be determined as the UTG layout is completed. Conex container locations will also be updated.

Figure 16. Locations of High-Speed (HS) and High-Definition (HD) Cameras on the Urban Test Grid (UTG); JRII.



NOTE: HD – high definition; IR – infrared; HS – high-speed. This figure was provided by Homeland Security Studies and Analysis Institute (Falls Church, Virginia) and adapted by US Army Dugway Proving Ground (DPG).

Figure 17. Locations of Cameras; JRII.

(b) All HS video will be captured in the Phantom® camera's proprietary format (.cine) and released to the customer in that format after each test. Select files will also be released in WMV format. Two laterally located HS cameras will be used to document flange release and the initial flow of liquid chlorine and will be placed 150 m (492 ft) away from the chlorine tank in order to avoid being damaged by high concentrations of chlorine. A third HS camera will be mounted on a pole on top of the 6.1-m (20-ft) conex container located on the southeast side of the concrete pad to record the dissemination effects.

(3) IR. A FLIR® IR Camera SC660 microbolometer (FLIR®, Wilsonville, Oregon) and an HD camera will be used together as a set for temperature analysis and to record visible video of the area surrounding the chlorine tank before, during, and after the release. **NOTE**: The IR cameras will be mounted on a pole on top of the 6.1-m (20-ft) conex container located on the southeast side of the concrete pad and at the four corners of the UTG to document the dissemination effects and monitor the temperature variation on the concrete pad caused by the liquid chlorine.

(4) Unmanned Aerial System (UAS). A UAS will be flown to provide a bird's-eye view of the test grid before, during, and after each chlorine release. The optical payload is yet to be determined for this application and will depend on the type of UAS that is used.

(5) Still Camera. All photographers onsite will have a professional-grade, still-frame, digital camera to take photographs. These cameras will be used to collect documentation photographs. The cameras will offer the capability of continuous shooting at a rate of 5 to 8 fps. The cameras will be equipped with a zoom lens with a focal-length range from 18- to 200-mm (0.71 to 7.87 in) (for general site documentation) or with a fixed lens that has a focal length of 600 mm (23.6 in) (for detonation documentation). Photographs will document test site setup and will be taken before, during, and after releases.

g. Meteorology

NOTE: A data quality template has been uploaded to HSIN for all of the meteorology instrumentation.

(1) Portable Weather Instrumentation Data System (PWIDS). The WDTC-developed PWIDS consists of mobile meteorological measurement stations capable of collecting and displaying weather information at a predetermined rate. Each station consists of a tripod-mounted propeller-vane wind monitor, a temperature/humidity sensor mounted in a naturally aspirated radiation shield, a data logger, an optically isolated RS-232 interface, and a spread-spectrum radio/modem. Power is supplied by a solar panel and battery combination.

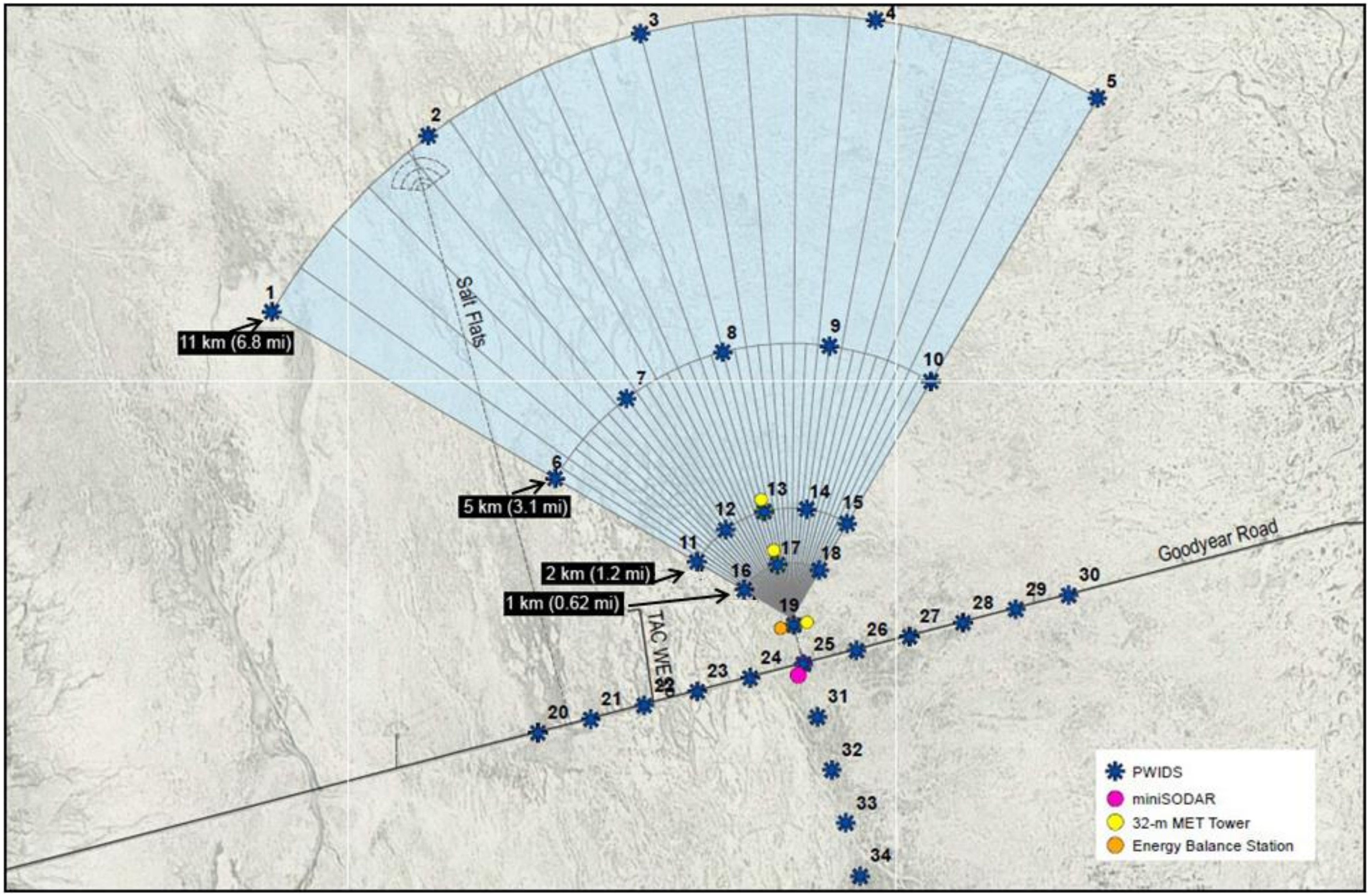
(a) Typically, the measurement height is 2 m (6.56 ft) AGL, although many other configurations have been fielded. In most uses, the PWIDS data acquisition rate is 1 hertz (Hz), and the data collected are averaged to 10-sec intervals. The wind monitor (product 05103, R.M. Young Company, Traverse City, Michigan) has a wind speed accuracy of ±0.2 m/sec (0.66 ft/sec) and a wind direction accuracy of ±3 degrees. The Vaisala HMP-45 temperature/humidity probes (Vaisala, Helsinki, Finland) are accurate to ±0.4°C (33±°F) for temperatures ranging from -20° through 55°C (-4° through 131°F) and to ±2 percent for relative humidity

(RH) ranging from 0 to 90 percent. Pressure is measured with the Vaisala PTB-101B pressure sensor (Vaisala, Helsinki, Finland), which has an accuracy rating of ±2 hectopascal (hPa) over the temperature range from -20° through 45°C (-4° through 113°F).

(b) PWIDS data are processed by the Campbell Scientific® CR1000 data logger (Campbell Scientific® Logan, Utah) and forwarded via a FreeWave® 1370 to 1390 megahertz (MHz) spread spectrum transceiver (FreeWave® Technologies, Boulder, Colorado) to the WDTC Weather Station via a radio link and then routed to the test site through the DPG computer intranet or through a second radio network. PWIDS software displays aerial photographs or a computer-aided design (CAD) map of an area designated for data collection with meteorological parameters superimposed on the display. It also provides the user with a table of numeric data for collected parameters. Another feature of the software is the ability to display trend patterns for any given station. Automatic data archival is accomplished during data collection by directly porting information into a relational database.

(c) DPG will deploy 49 PWIDSs on the JRII test site. Three 32-m towers will be deployed with the PWIDSs at the 2-, 4-, 8-, 16-, and 32-m (6.56-, 13.12-, 26.3-, and 105-ft) levels for a total of 15 tower-mounted PWIDSs. An additional 34 tripod-mounted PWIDSs will be deployed within the test grid and along Goodyear Road. All data from the 49 PWIDS will be viewable in real time at the CP. A photograph of the PWIDS is provided in Figure 18 and the PWIDS positions are illustrated in Figure 19.

Figure 18. Typical Portable Weather Instrumentation Data System (PWIDS) on a Tripod; JRII.



NOTE: TAC – tactical; PWIDS – Portable Weather Instrumentation Data System; SODAR – sonic detection and ranging; MET – meteorological.

Figure 19. Locations of Meteorological Instrumentation; JRII.

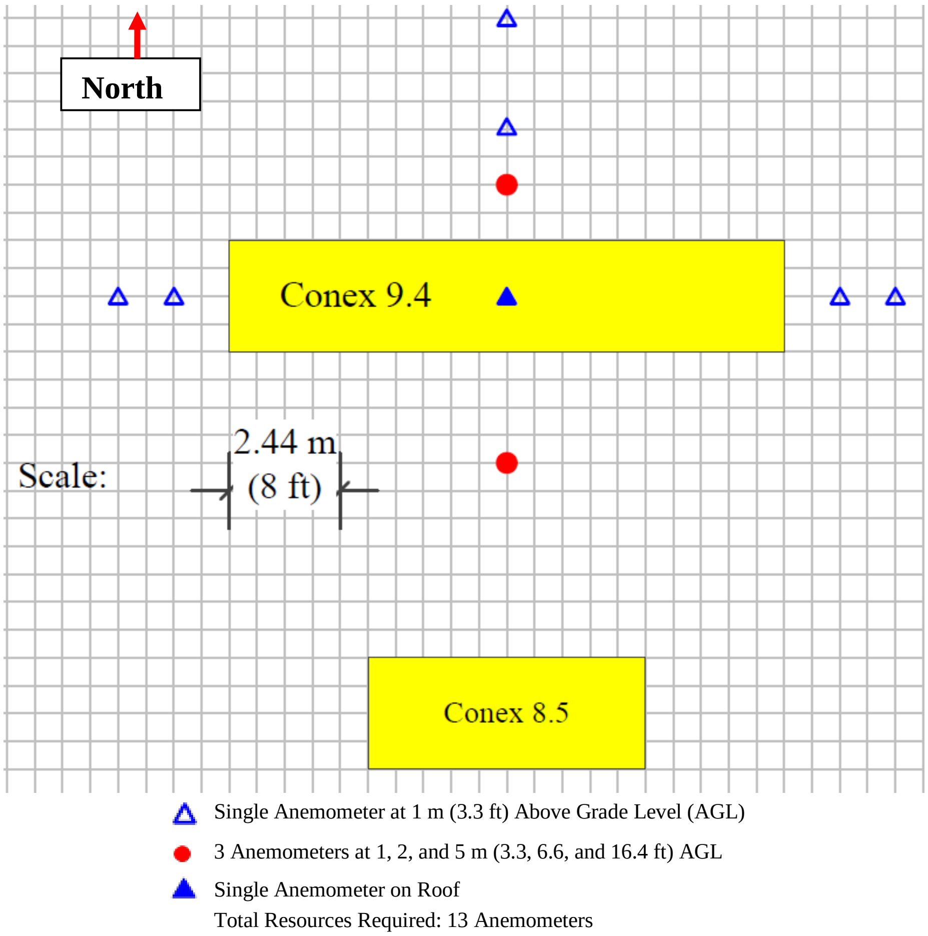
(2) Ultrasonic Anemometer. DPG will provide 30 ultrasonic anemometers to be used for turbulence characterization after the completion of chlorine releases. A representative photograph of an ultrasonic anemometer is in Figure 20. Ultrasonic anemometer data will be collected for 7 days. The ultrasonic anemometers will be mounted on 2-m (6.6 ft) tripods and on 5- and 10-m (16.4- and 32.8-ft) towers and placed within the UTG in the vicinity of two unique obstacle designs. The first obstacle design will be a single 12.2-m (40-ft) conex container centrally located at conex container position 9.4 (row 9, conex 4) and the second obstacle design will be a 2 × 3 stack of conex containers located at position 2.5 (row 2, conex 5) in Mock Urban Layout 2 (Figures 21 and 22). Each obstacle design will make use of 13 to 15 ultrasonic anemometers, which will be placed on each side and on top of the obstacles. Locations of the ultrasonic anemometers for the two obstacle designs are depicted in Figures 21 and 22. A description of the obstacle designs is as follows:

(a) First Obstacle Design [With 12.2-m (40-ft) Conex Container]

(1) Two single 1-m (3.3-ft) tall tripods with one ultrasonic anemometer each at a height of 1 m (3.3 ft) AGL at a distance of 2.4 m (8 ft) and 4.9 m (16 ft) from the northern side of the conex (Figure 21).

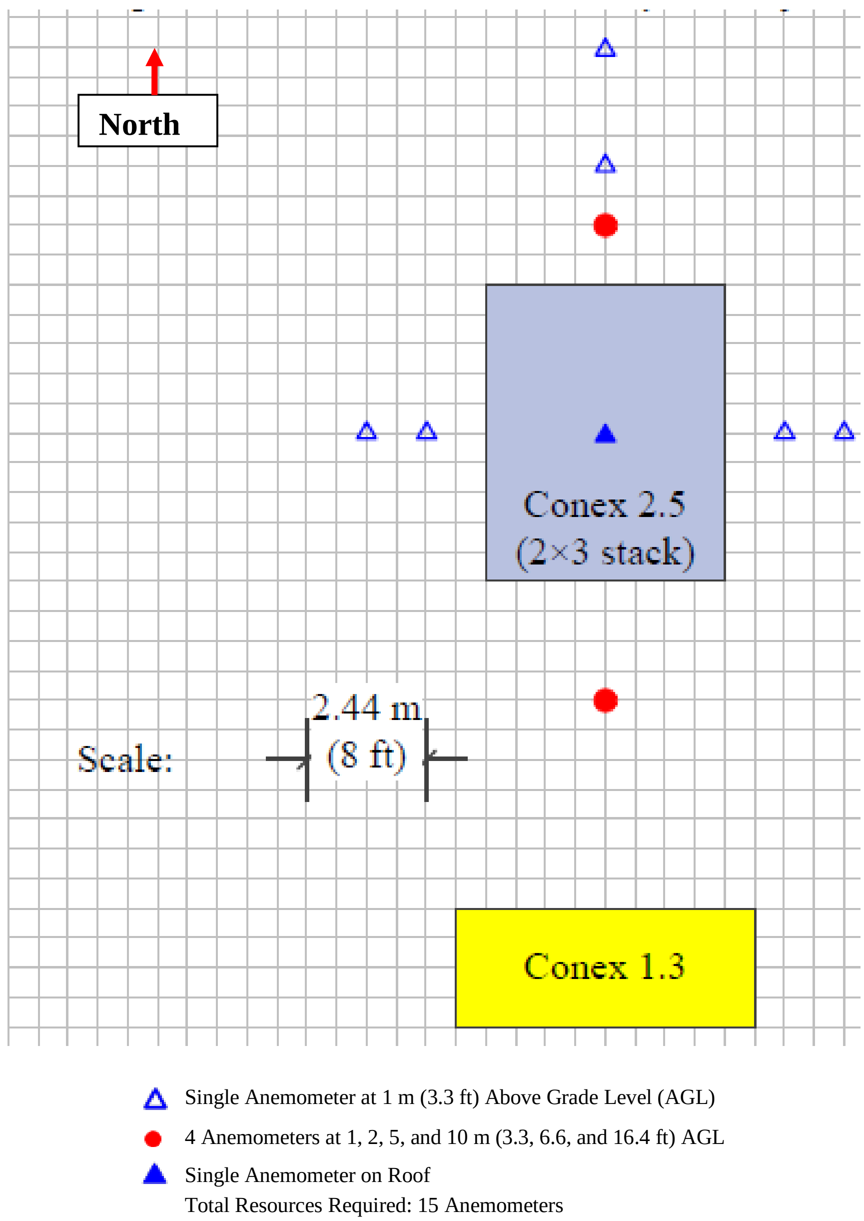
(2) Two single 2-m (6.6-ft) tall tripods with one ultrasonic anemometer each at a height of 1 m (3.3 ft) AGL at distances of 2.4 m (8 ft) and 4.9 m (16 ft) from the western and eastern sides of the conex (Figure 21).

Figure 20. Ultrasonic Anemometer Mounted on a 3-m (9.8-ft) Tall Tripod; JRII.



NOTE: This figure was provided by Homeland Security Studies and Analysis Institute (Falls Church, Virginia) and adapted by US Army Dugway Proving Ground (DPG).

Figure 21. First Obstacle Design for Ultrasonic Anemometer Positions Relative to Conexes; JRII.



NOTE: This figure was provided by Homeland Security Studies and Analysis Institute (Falls Church, Virginia) and adapted by US Army Dugway Proving Ground (DPG).

Figure 22. Second Obstacle Design for Ultrasonic Anemometer Positions Relative to Conexes; JRII.

(3) One single 2 m (6.6 ft) tall tripod with one ultrasonic anemometer centered on the top of the conex container at a height of 1.5 m (3.3 ft) above top of conex (Figure 21).

(4) One single 5-m (16.4-ft) tall tower with three ultrasonic anemometers at heights of 1, 2, and 5 m (3.3, 6.6, and 16.4 ft) AGL at a distance of 1.2 m (4 ft) from the northern side of the conex (Figure 21).

(5) One single 5-m tall tower with three ultrasonic anemometers at 1-, 2-, and 5-m (3.3-, 6.6-, and 16.4-ft) AGL at a distance of 2.4 m (8 ft) from the southern side of the conex container (Figure 21).

(b) Second Obstacle Design (2 × 3 Conex Container Stack)

(1) Two single 1-m (3.3-ft) tall tripods with ultrasonic anemometers at a height of 1 m (3.3 ft) AGL at distances of 2.4 m (8 ft) and 4.9 m (16 ft) from the northern side of the conex container (Figure 22).

(2) Two single 1-m (3.3-ft) tall tripods with one ultrasonic anemometer each at a height of 1 m (3.3 ft) AGL, at distances of 1.2 m (4 ft) and 2.4 m (8 ft) from the western and eastern sides of the conex container (Figure 22).

(3) One single 1-m (3.3-ft) tall tripod with an ultrasonic anemometer centered on the top of the conex container at a height of 1 m (3.3 ft) (Figure 22).

(4) One single 10-m (32.8-ft) tall tower with four ultrasonic anemometers at heights of 1, 2, 5, and 10 m (3.3, 6.6, 16.4, and 32.8 ft) AGL at a distance of 1.2 m (4 ft) from the northern side of the conex container (Figure 22).

(5) One single 10-m (32.8-ft) tall tower with four ultrasonic anemometers at 1, 2, 5, and 10 m (3.3, 6.6, 16.4, and 32.8 ft) AGL at a distance of 2.4-m (8 ft) from the southern side of the conex container (Figure 22).

(3) 32-m (105-ft) Tall Meteorological Tower

(a) Three 32-m (105-ft) tall towers will be used for the JRII test. PWIDSs and ultrasonic anemometers will be collocated on these towers at heights of 2, 4, 8, 16, and 32 m (6.6, 13.1, 26.2, 52.3, and 105 ft). The PWIDS will send real-time data to the CP, but the ultrasonic anemometer datasets will be collected after each daily test event.

(b) An ultrasonic anemometer consists of an array of three sets of ultrasonic transducer pairs designed to alternately transmit and receive pulses of acoustic energy, a system clock, and circuitry designed to measure transit time between the transmission and reception of acoustic signals between transducer pairs. Ultrasonic anemometers typically have 2- or 3-dimensonal arrays for measuring two wind components or the full-vector wind. The anemometers to be used for JRII are 3D sensors (model 81000) manufactured by R.M. Young Company. Ultrasonic output will include wind components and speed of sound at a rate of 10 Hz. Ultrasonic data will be processed to produce wind and turbulence statistics and fluxes of heat and momentum.

(c) The 32-m (105-ft) tall towers will be deployed along the centerline of the test grid at a distance of 100 m (328 ft) upwind of the UTG and 1 and 5 km (0.62 and 3.1 ft) downwind of the UTG. A photograph of the 32-m (105-ft) tower is provided in Figure 23 and tower positions are illustrated in Figure 19.

(4) Energy Balance Station (EBS). The EBS will provide in situ measurements of the surface vertical fluxes of sensible heat, latent heat, net radiation, and soil surface heat flux. The fluxes will be obtained by the energy balance eddy covariance technique, a method that uses covariances between the vertical wind speed and temperature, and the vertical wind speed and gas density in combination with point measurements of net radiation and soil heat flow from five sets of soil sensors. This method is direct and simple assuming the measurements of the appropriate variables are made sufficiently fast to capture the turbulent structure of the fluxes.

(a) The primary quantities to be measured are:

(1) The vertical wind speed [Campbell Scientific (Logan, UT), Part Number CSAT-3 ultrasonic anemometer).

(2) Atmospheric moisture (Campbell Scientific, Part Number KH20 UV krypton hygrometer).

(3) Upwelling and downwelling IR and visible radiation [Kipp and Zonen (Delft, Netherlands) Model CNR1 net radiometer].

Figure 23. 32-m (105-ft) Tall Meteorological Tower; JRII.

(4) Average soil temperature (Campbell Scientific®, Part Number TCAV soil thermocouples).

(5) Soil heat flux plates (Campbell Scientific®, Part Number HFT3 heat flux plate).

(6) Soil moisture (Campbell Scientific®, Part Number CS615 water content reflectometer).

(b) A diagram of the EBS is in Figure 24 and positions (on towers) are illustrated in Figure 19.

(5) MiniSODAR™. The miniSODAR™ (Scintec Corporation, Louisville, Colorado) is a high-frequency Doppler acoustic sounding system that is designed to measure the atmospheric vertical wind profile in the altitude range from 15 m (49 ft) to approximately 200 m (656 ft), depending on conditions, above the surface in 5-m (16.4-ft) increments. Data are often available for altitudes up to 250 m (820 ft) under ideal conditions. The system operates by generating a short tone burst of 30 to 100 milliseconds duration in the frequency range of 4 to 6 kHz. The acoustic signal processor monitors the acoustic signal echoed by the atmosphere. The echo signal is processed to determine its frequency content. The shift in the received frequency with respect to the transmitted frequency (the Doppler shift) is directly related to the radial motion of the echo volume with respect to the fixed miniSODAR™ acoustic antenna. The miniSODAR™ samples the atmosphere in three independent directions. These data are combined to deduce the horizontal and vertical wind profile directly above the antenna.

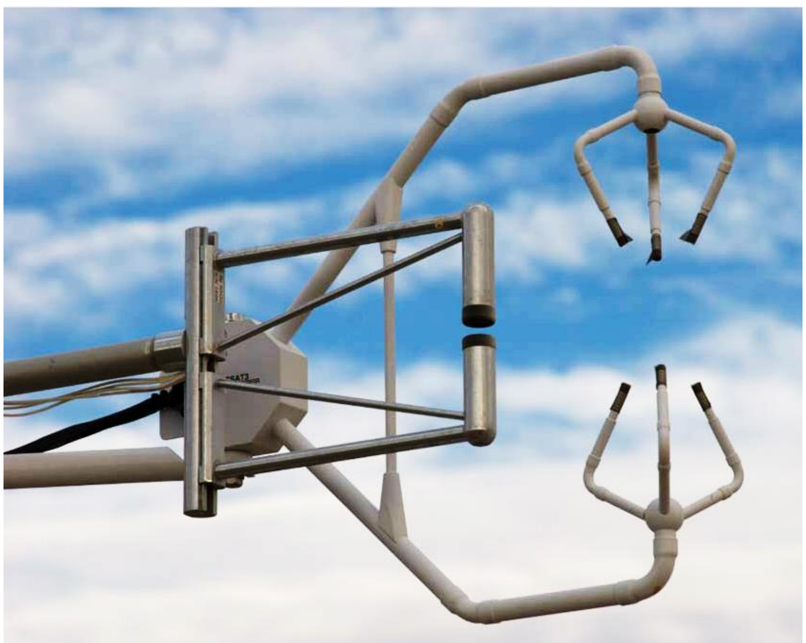


Figure 24. Energy Balance Station (EBS); JRII.

(a) The miniSODAR™ antenna uses a single, electrically-steered (phased) speaker array to create three independent orthogonal beam patterns. The antenna consists of 32 piezo-ceramic acoustic transducers excited with phase-controlled electronics to provide the appropriate beam steering. A pulse of acoustic energy is generated for each beam which propagates through the atmosphere at approximately 340 m/sec (1115 ft/sec). The back-scattered signal is produced by the interaction of the transmitted acoustic steered pulse with small-scale atmospheric turbulence. This signal, as received by the speaker array, is analyzed by the acoustic signal processor for both energy and frequency content using spectral processing techniques. The energy in the scattered portion of the detected signal is related to the strength of the atmospheric inhomogeneities. The received frequency is related to the radial motion of the signal scatters relative to the antenna.

(b) System specifications are in Table 3. A photograph of the miniSODAR™ is in Figure 25 and locations are shown in Figure 19.

Table 3. MiniSODAR Summary; JRII.

Description	Specification
Maximum sampling altitude	250 m (820 ft)
Minimum sampling altitude	10 m (33 ft)
Height resolution	5 m (16.4 ft)
Transmit frequency (approximate)	4500 Hz
Averaging interval	1 to 60 minutes (selectable)
Wind speed range	0 to 45 m/sec (0 to 148 ft/sec)
Wind speed accuracy	<0.5 m/sec
Wind direction accuracy	±5 degrees

Figure 25. MiniSODAR™ With Solar Power Unit Deployed; JRII.

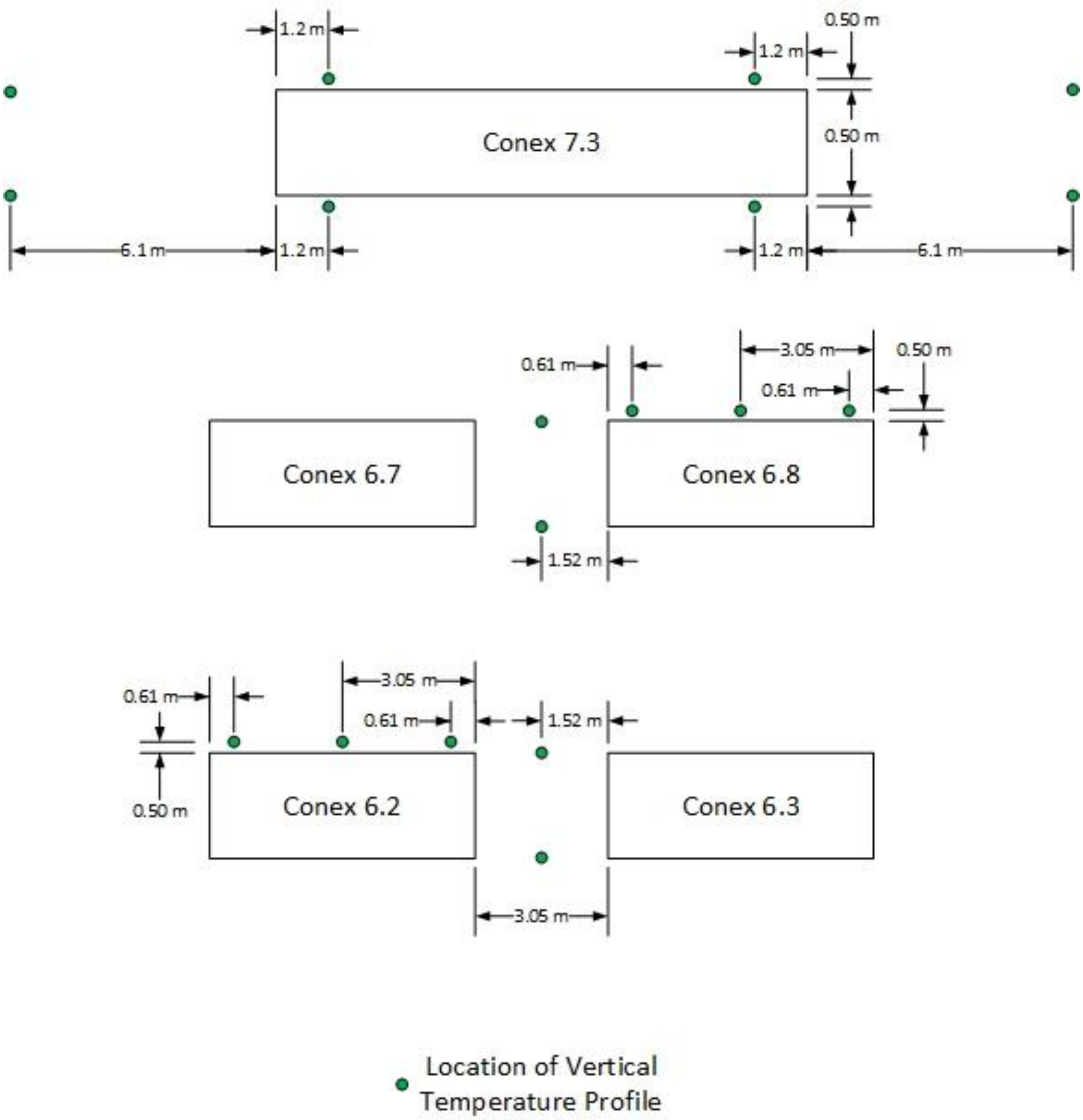
(6) Modeling. DPG will provide real-time and posttest modeling of the downwind hazard using the Hazard Prediction and Assessment Capability (HPAC) software developed under DTRA sponsorship. Although HPAC is not actually a type of instrumentation, it is a valuable tool for use at the CP and has a verified and validated dense gas capability. In 2003, ATEC mandated that all test programs releasing any chemical or biological simulant will have near real-time modeling support during the conduct of the test in order to assess potential exposures to populated work areas downwind of the release location. During JRII, an onsite meteorologist will run the HPAC model and provide the test officer with a time series of model plots before, during, and after each of the releases. Templates for the HPAC model will be constructed before the test conduct that will simulate the type, duration, and amount of release. Meteorological data from the test grid will be used as inputted into the HPAC model. Model results can be provided in a few minutes upon request from the test officer.

h. Exterior Thermocouples

(1) WDTC will deploy up to 50 thermocouple arrays during the JRII test. Each array consists of six thermocouple profiles. Data from the arrays will be collected at a rate of 8 Hz. Although the data collection software will have a time resolution of 1 sec, the data will be reliable at a faster collection rate because the data will be recorded in sequence by the computer software. Data will be collected after each test event. The thermocouples will be type K with 24 American Wire Gauge (AWG) wiring. Tentative thermocouple positions are shown in Figure 26.

(2) Vertical Temperature Profile. Vertical configuration of thermocouples will be collocated with concentration measurements (Jaz™ and UV Canary) in the near field (Figure 13). For concentration sensors located on the gravel pad, vertical measurement locations proposed are at 2 cm (0.8 in) below grade and at elevations AGL of 15 cm (5.9 in), 30 cm (11.8 in), 0.06 m (0.2 ft), 1.2 m (3.9 ft), and 2.4 m (7.9 ft) (corresponding to the 2.4 m (8 ft) height of a conex container)]. For concentration sensors located on the playa, the lowest thermocouple will be 5 cm (1.97 in) AGL. **NOTE**: Near field is anything on pad and within 500 m (1640 ft) of pad.

(3) Mean Cloud Arrival Speed. A set of vertical profile measurements will be obtained in the space between a set conex containers. At the initial arrival of the cloud, this configuration will allow an estimate of the mean along-wind cloud velocity and quantify the lateral mean velocity (perpendicular to the wind field) that might be observed from gravity spreading of the dense chlorine cloud. Also, this configuration will aid in understanding the mean flow when obstacles are interacting with the dense cloud and generating wakes that delay arrival of the cloud at particular locations. To ensure that time records between data loggers are synchronized, measurements at a single location will be recorded, so the vertical temperature profile measurements at these locations are at 2 cm (0.8 in) below grade and at elevations AGL of 30 cm (11.8 in), 60 cm (23.6 in), 1.2 m (3.9 ft), and 2.6 m (8.5 ft). The collocated temperature measurements between data loggers should be at the 2.6 m (8.5 ft) location so that the data loggers are on the top of a conex to minimize chlorine exposure. The redundant 2.6 m (8.5 ft) measurements should be interconnected to others in the same area so that if a single data logger fails, all other data loggers will still be operational. This would interconnect data loggers at three locations, Conex 6.2/6.3, Conex 6.7/6.8, and Conex 7.3.



NOTE: This figure was provided by the University of Arkansas (Fayetteville, Arkansas). The dimensions were provided in meters.

Figure 26. Thermocouple Array Located on Grid; JRII.

i. Aerosol Instrumentation

(1) GRIMM Aerosolspectrometer. The GRIMM Aerosol portable laser aerosolspectrometer and dust monitor model 1.108 (Ainring, Bavaria, Germany) is a particle sizing instrument that measures mean size diameters using laser scattering. The aerosolspectrometer is a field instrument and will be calibrated using the methods determined in the laboratory experiment before being used for any trials. The aerosolspectrometer will be operated IAW the operations manual (Reference 14). Collected data will provide continuous particle-size information throughout the progression of the test event. The aerosolspectrometer is a nonselective detector and does not discriminate among detected particles and aerosols (e.g., dust, background aerosols, chlorine, chlorohydrates, or water).

(a) The data will be logged for the required period of time and reported in the test report. The data logger will record data at a rate of 1 data point per second. Time synchronization will be done before each trial using Global Positioning System (GPS) time.

(b) The aerosolspectrometer will be deployed within 10 to 200 m (33 to 656 ft) of the release point to identify what will presumably be chlorine aerosols.

(2) West Desert LIDAR (WDL) System. The DPG West Desert LIDAR system is an elastic-backscatter based LIDAR system that uses a 1064-nm-wavelength neodymium-doped yttrium aluminum garnet (Nd:YAG) laser. The purpose of the WDL in the JRII test will be to detect and track chlorine aerosols. The WDL is capable of 1.5-m (4.9-ft) range-resolved bins at 6+ km (3.7+ mi) and measures condensed-phase particles. The WDL will be located at the SL test site for all releases (Figure 27). Because the release will occur on the concrete test pad, minimal dirt/dust particles are expected in the vicinity so most of the signal is expected to come from chlorine aerosols. The WDL will not be calibrated for chlorine aerosol particle sizes, but size estimates may be possible if the WDL is able to interrogate an area adjacent to a particle sizer. **NOTE**: The safety distance for the WDL scan is 3300 m (10,827 ft).

j. Off-Post Monitoring. DPG will provide monitoring of chlorine at specific locations with ToxiRAE Pro sensors on DPG boundaries at appropriate times during test execution. The collected data will be reported to the Utah Division of Air Quality (DAQ, Salt Lake City, Utah) within timelines established by the approval order (AO, Reference 15). The ToxiRAE Pro sensors will be deployed at the following locations:

(1) Southern DPG boundary near Fish Springs Wildlife Reserve.

(2) Western DPG boundary near Bureau of Land Management (BLM) land.

(3) Northern DPG boundary near the Utah Test and Training Range (UTTR).

(4) I-80. **NOTE**: Before testing, DPG will collect background data at I-80 locations during timeframes that are similar to the planned release schedule. Background data will be collected for a minimum of 4 hours on 3 different days to capture weather-induced variability.

NOTE: UTG – Urban Test Grid; SL – Surface Layer.

Figure 27. Location of West Desert Light Detection and Ranging (LIDAR) (WDL) System; JRII.

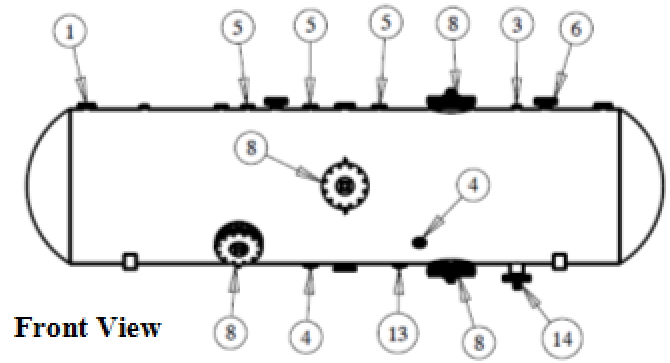
2.1.3.5 Tank and Specialized Disseminator

a. Disseminator Setup

(1) The dissemination system consists of a custom-built chlorine tank and a support system designed to include load cells for continuous mass measurement (Figure 28).

(2) The support system (Figure 29) consists of a structure built out of I-beam pillars instrumented with seven load cell assemblies for dynamic mass measurement. The pillars will be attached using concrete anchors sealed with a chlorine-resistant epoxy. The tank is bolted onto the horizontal crossbeam and, for redundancy, is also strapped to the cross beam using pre-tensioned steel cables. Four load cell assemblies are used for vertical measurements while the other three are used for horizontal force components measurement. The load cell assemblies will be wrapped in a chlorine-resistant material to avoid any damage from corrosion. The support system is designed to ensure that the down-facing dissemination port is located 1 m (3.28 ft) AGL.

Item Location	Description	Quantity
1	Vent Port Flange Assembly	1
2	Thermocouple Well Port	1
3	Guided Wave Radar (GWR) Port	1
4	Absolute Pressure Flange Assembly	5
5	Differential Pressure, Low Flange Assembly	3
6	Thermocouple Flange Assembly	2
7	Pressure Relief Valve Flange Assembly	1
8	Dispersion / Release Port Assembly	4
9	Fill Port Flange Assembly	1
10	Drain Flange Assembly	1
11	Differential Pressure, High Flange Assembly-1	1
12	Differential Pressure, High Flange Assembly-2	1
13	Differential Pressure, Hi Flange Assembly-3	1
14	GWR Extension Flange Assembly	1
15	Chlorine Vessel	1



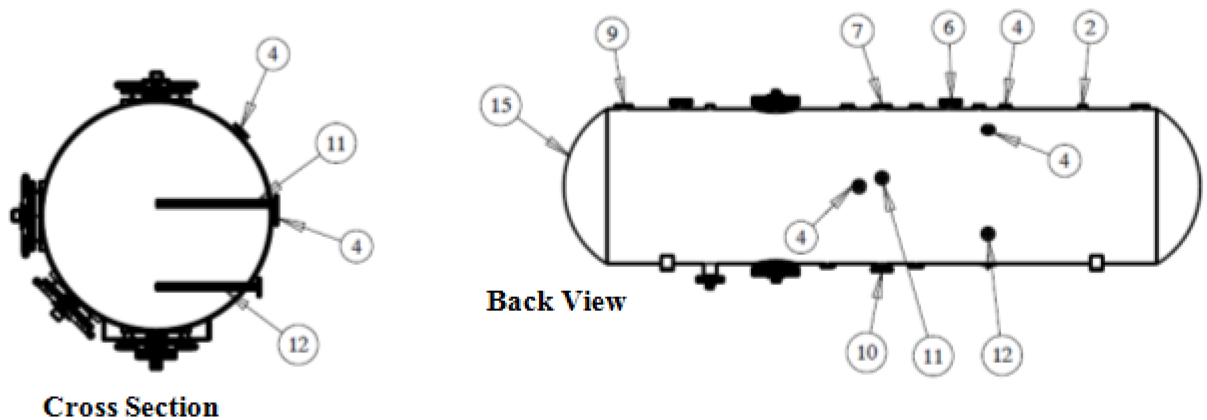


Figure 28. Illustration of Specialized Dissemination Tank; JRII.

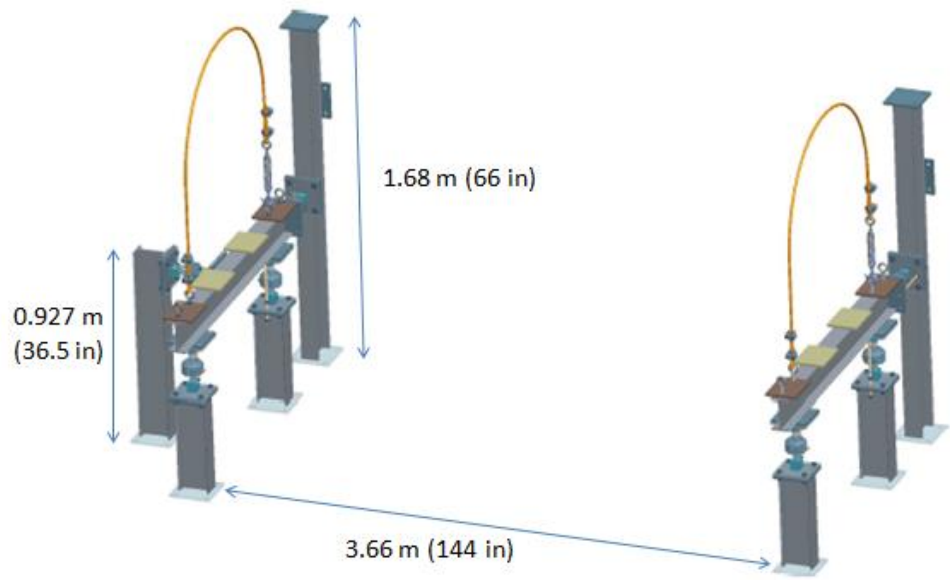


Figure 29. Illustration of Support System for Specialized Dissemination Tank; JRII.

(3) The support system can accommodate one 7571-L (2000-gal) size tank for releasing 4536 or 9072 kg (5 or 10 tons) of chlorine (Figure 29). The tank will be 5.64 m (222 in) long and 1.37 m (54 in) in diameter. The tank is provided with four dissemination ports each oriented differently as follows: 90 degrees upwards, horizontal, 45 degrees downwards, and 90 degrees downwards (Figure 30). Each dissemination port can be used for disseminating chlorine via a 15.2-cm (6-in) diameter penetration or a 6.4-cm (2.5-in) diameter penetration using an insert (Figure 31). **NOTE**: During 2015 trials, only the 15.2-cm (6-in) diameter penetration will be used.

(4) Explosive bolts will be used to create penetrations in the tank for dissemination. In order to provide a safe environment for the installation of the explosive bolts, a plug (Figure 31) will be used to seal the dissemination port and control any minor chlorine leaks. The plug will be tightened and capped during preparation for the chlorine fill/refill process. The respective volume will be constantly purged with nitrogen during the bolt replacement process or pressurized with nitrogen to a pressure above the pressure of the tank. **NOTE**: The plug is the maximum allowable width to provide a seal and still accommodate the nitrogen purge.

(5) Instrumentation ports are provided across the entire body of the tank. These are designed using standard flanges and penetration holes so that instruments can be easily replaced.

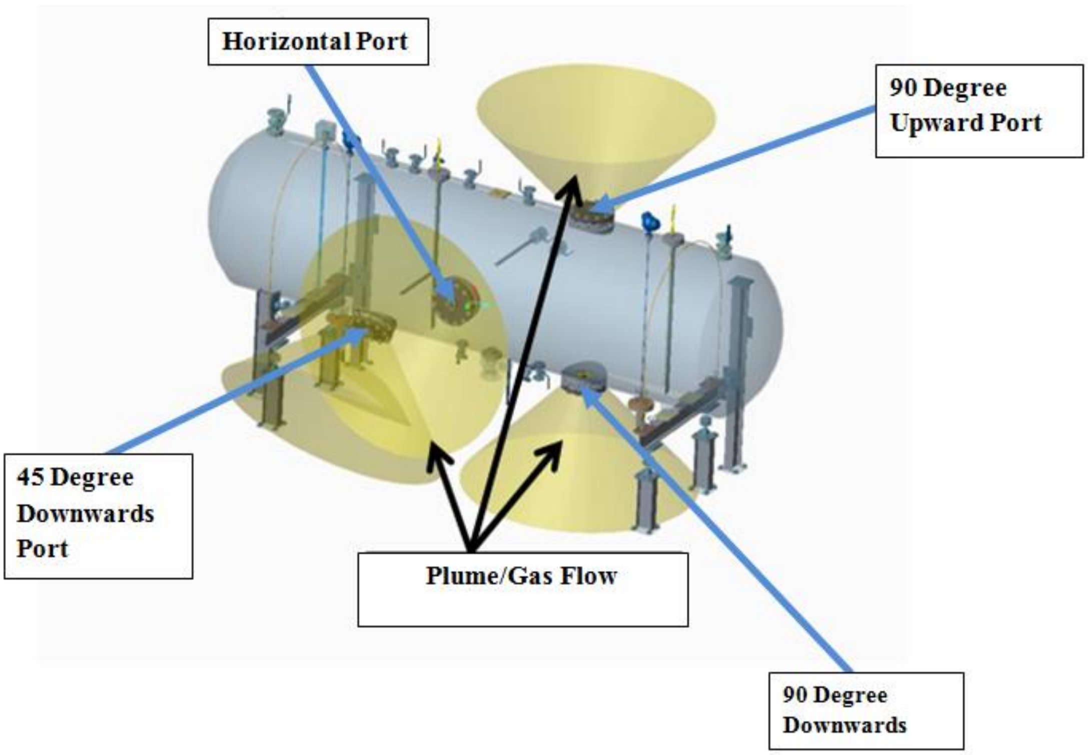


Figure 30. Illustration of Plume From Specialized Dissemination Tank; JRII.

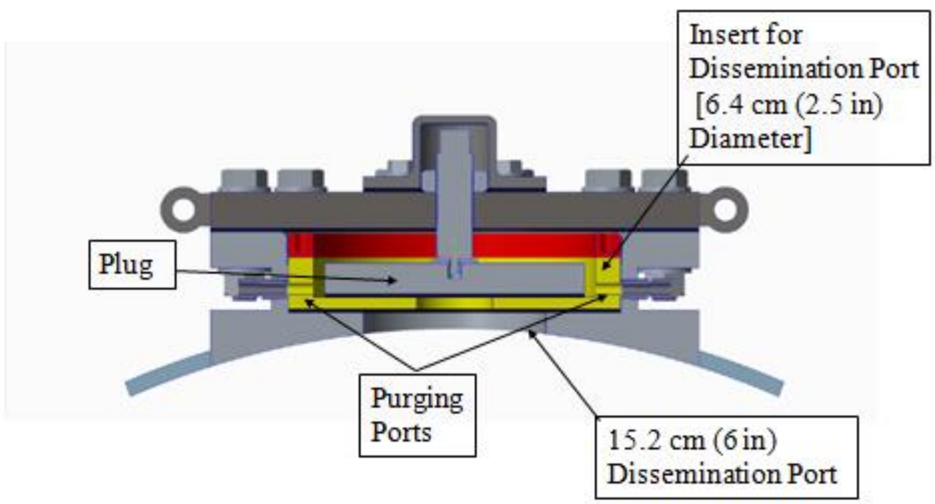
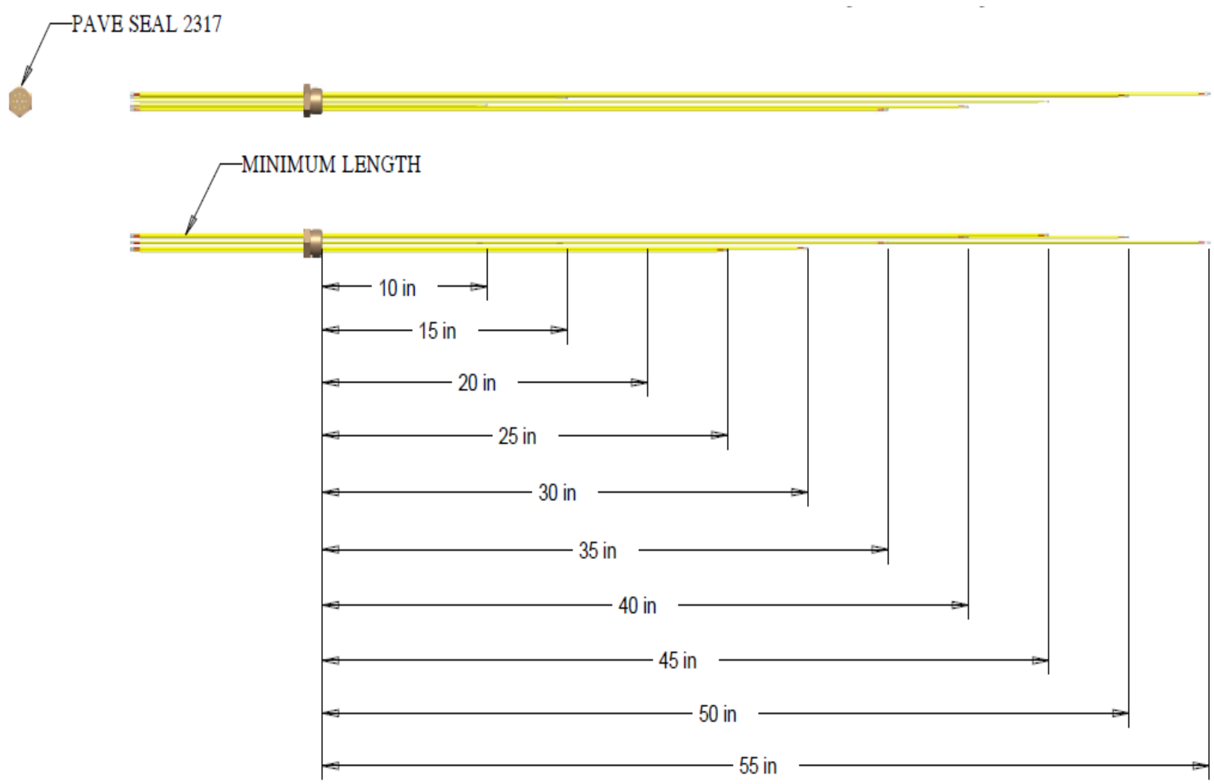


Figure 31. Illustration of Ports and Plug; JRII.

b. Tank Instrumentation

(1) Bare-Wire Thermocouples. Temperature profiles will be measured vertically at increments of 10 percent of the tank diameter at two axial locations in the tank. Two clusters of thermocouples will be immersed in the tank to take temperatures. The thermocouples will be located on opposite sides of the tank. Sensors will be located at varying distances along the length of the thermocouples and will have a pave seal connector as shown in Figures 32. An additional view of the thermocouple is in Figure 33.

(2) Load Cells. Seven load cells and 14 flexors will be placed on the support system to measure the exiting mass of chlorine from the tank and will account for the forces generated by the tank as the pressure is being released. A photograph of the load cell is in Figure 34. An illustration of the low profile load cell locations is in Figure 35.



NOTES: 1. Pave seal 2317 connector: 2.54 cm (1 in) pipe size and 11.5 threads per inch [National Pipe Thread (NPT)], 250 psi, chlorine-resistant.
2. Ten Type K thermocouples: 12.7 cm (5 in) apart.
3. Quantity required: three.

Figure 32. Thermocouple With Pave Seal and Minimum Length; JRII.

Figure 33. Illustration of Thermocouple; JRII.

Figure 34. Representative Photograph of Ultra-Precision Low-Profile Load Cell; JRII.

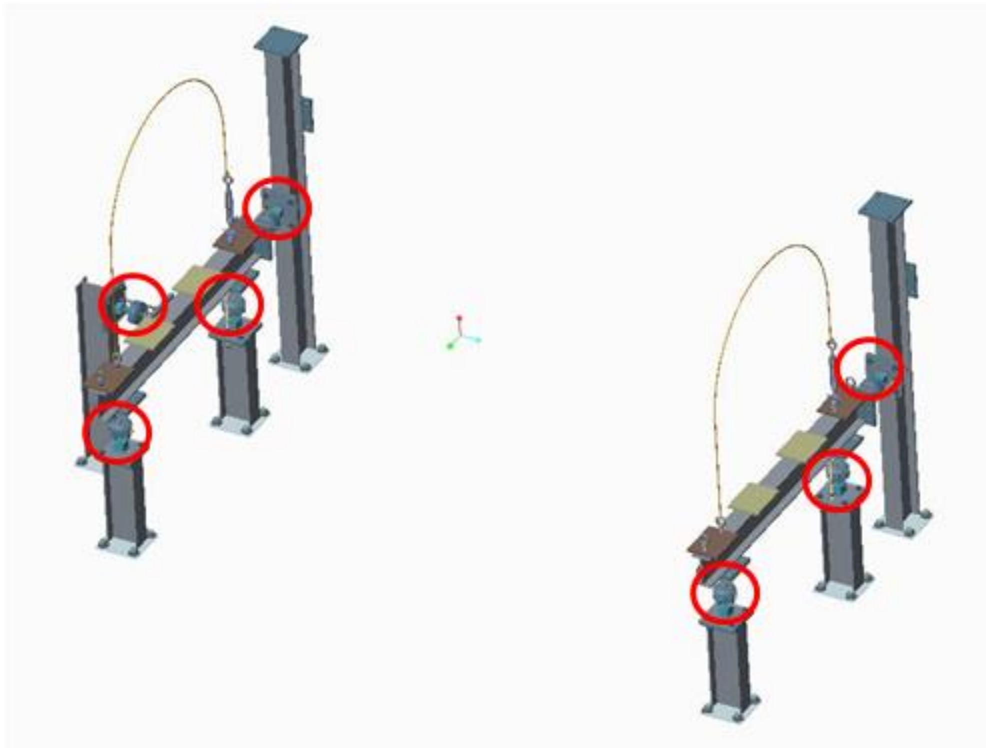


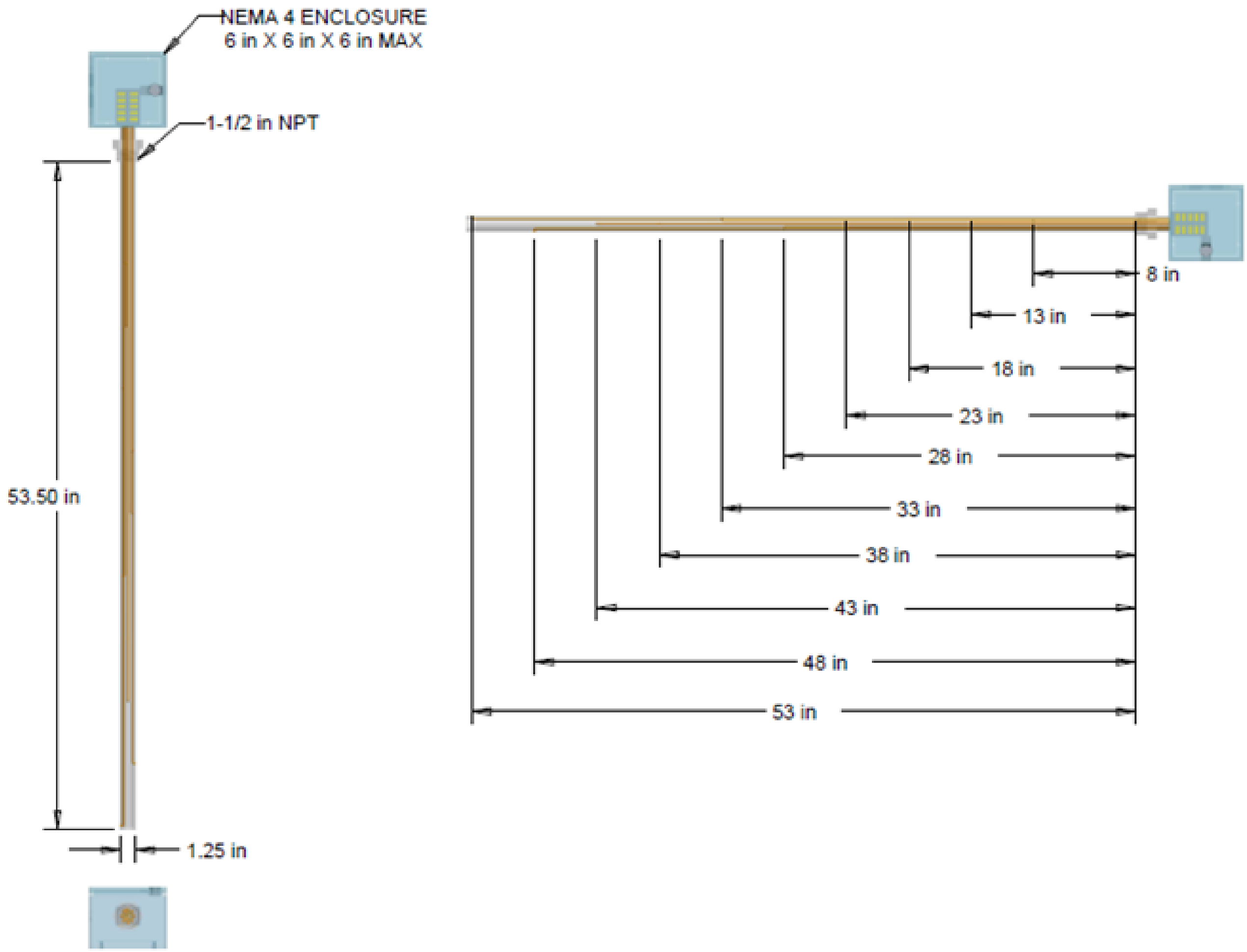
Figure 35. Illustration of Low-Profile Load Cell Locations; JRII.

(3) Thermowell Thermocouple. Temperature profiles will be measured vertically at increments of 10 percent of the tank diameter within the well. There will be one thermowell thermocouple in the tank (Figure 36). Sensors will be located at varying distances along the length of the thermowell thermocouple as shown in Figure 36.

(a) Absolute Pressure. Absolute pressure will be measured at four locations on the tank. The absolute pressure will be measured at the top, aligned with the 90 degree dissemination port, 45 degree dissemination port, and the bottom of the tank.

(b) Differential Pressure. Differential pressure will be measured vertically between the top of the tank and at elevations that correspond to the top of the tank (at the horizontal, 45 degree downward, and 90 degree downward dissemination ports, Figure 30). The differential pressure ports are outfitted with a well-line to enable measurement of the pressure in the center of the tank.

(4) Guided-Wave Radar (GWR). One GWR will be located on the tank to measure the change in the depth of liquid chlorine as the chlorine leaves the tank.



NOTE: NEMA – National Electrical Manufacturers Association; MAX – maximum; NPT – national pipe thread. Ten Type K thermocouples with 12.7 cm (5 in) spacing.

Figure 36. Illustration of Thermowell Thermocouple; JRII.

c. Pad Instrumentation and Setup

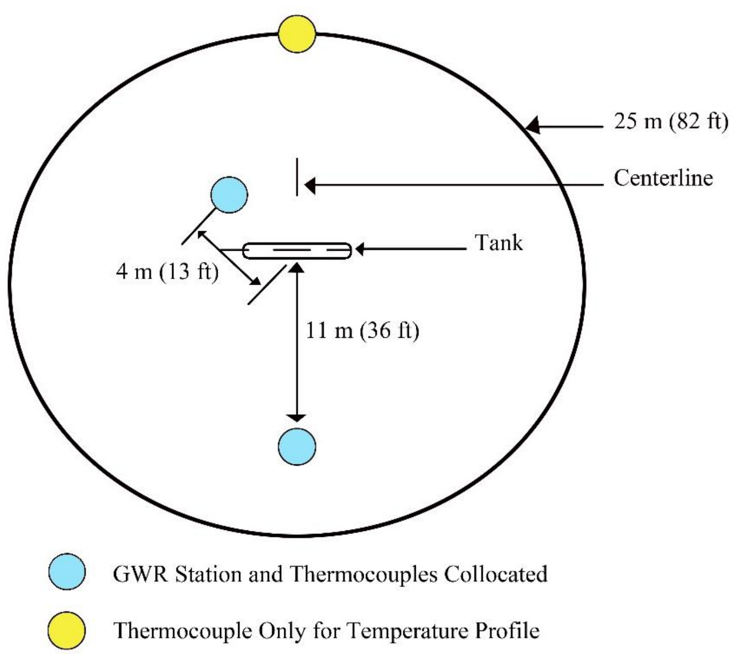
(1) Thermocouple. Vertical temperature profiles above and below grade will provide additional information important for understanding the relevant phenomenon in the near source region (Figure 37). Vertical temperature profiles below grade will provide estimates of the heat flux at the top surface of the concrete pad, which will allow determination of whether a significant quantity of rainout is present (heat transfer rates to boiling liquids are significantly greater than heat transfer rates to vapors). Vertical temperature profiles AGL will provide information about the chlorine cloud temperature. The vertical temperature profile can be made by attaching thermocouples to a simple vertical support such as a polyvinyl chloride (PVC) pipe. Thermocouples will be Type K 24 AWG to allow close placement starting at the concrete pad surface. Measurements below grade will be made by placing the thermocouples in predrilled holes that will be backfilled with concrete.

(2) The pad within the UTG will have two locations that each contain 14 thermocouples and two GWRs (Figure 37). The thermocouples will be located at the following elevations with respect to grade level:

(a) At 3, 6, 9, 15, and 22 mm (0.12, 0.24, 0.35, 0.59, and 0.87 in) below grade.

(b) At 0.5, 1, 2.5, 10, 40, 100, 200, and 300 cm (0.2, 0.39, 0.98, 3.9, 15.8, 39.4, 78.7, and 118.1 in) AGL.

(c) At grade level.



NOTE: Centerline is in the prevailing wind direction. The 4536-kg (5-ton) disseminator tank is shown at the center of the ring. This figure was adapted from a figure provided by the University of Arkansas (Fayetteville, Arkansas).

Figure 37. Instrumentation Locations on Concrete Pad; JRII.

(3) A specialized tank support system will be anchored to the concrete pad to prevent auto-rotation.

(4) The pad will have the means for grounding the tank and other instrumentation.

d. Explosive Bolt Setup

(1) Explosive bolt functionality and flange seal integrity were demonstrated in a methodology investigation (Reference 16).

(2) Personnel will maintain the appropriate PPE [as designated by the incident management team (IMT) and approved by command].

(3) After the specialized dissemination tank is filled with chlorine, the grid will be cleared except for explosives personnel. A decontamination team and back-up for the explosives operators will be located on the intersection of Goodyear Road and the newly constructed road leading towards the UTG. The decontamination team will be located 823 m (2700 ft) upwind of the grid when test conditions are met.

(4) Six standard bolts will be removed from the 12-bolt flange on the tank and replaced (one at a time) with exploding bridge wire (EBW) explosive bolts from Teledyne (Tracy, California, Figure 38). The explosive bolts will be placed in alternating bolt holes (Figure 39).

(5) High expansion bolts will be used and will be fabricated (made to order by Teledyne RISI, Inc., Tracy, California) from high-strength alloy steel with a tensile strength of 9525.44 kg (21,000 lb) according to the following specifications:

(a) The bolts will have a minimum diameter of 2.22 cm [0.88 in (7/8 in)] and will require standard RP-2 firing parameters as described in Reference 17. The RP-2 firing initiation requires 220 amps of electric current.

Figure 38. Image of the High-Expansion Exploding Bridge Wire (EBW) Explosive Bolt; JRII.

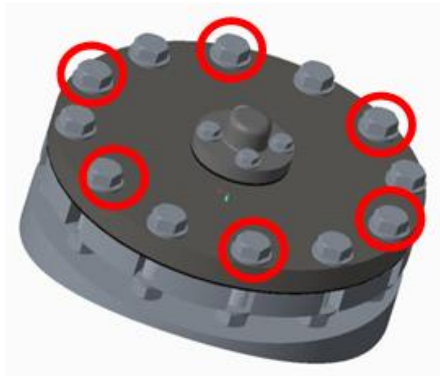


Figure 39. Illustration of Explosive Bolt Locations in Flange; JRII.

(b) The bolts will contain 86 mg (0.00303 oz) pentaerythritol tetranitrate (PETN), 123 mg (0.00433 oz) polymer bonded explosive 94 percent (PBX9407), which contains cyclotrimethylenetrinitramine (RDX) as the explosive ingredient, plus an RP-81 output pellet [454 mg (0.0160 oz) PBX9407]. The net explosive weight for each bolt will be about 660 mg or 0.660 g (0.0233 oz). The safety standoff distance from the bolts will be 11.28 m (37 ft), but the probability of an accidental detonation is very slim. The main hazard will be the possibility of a bolt head coming off prematurely.

(6) The remaining six standard bolts will be removed in a star pattern to maintain pressure and prevent leakage of chlorine. A nitrogen purge valve will allow nitrogen to flow between the flange and the plug to carry any chlorine gas that leaks beyond the plug to a scrubber. Alternatively, the space between the plug and flange could be pressurized with nitrogen to prevent any leaks. The installation procedures will be conducted IAW the findings from the methodology testing (Reference 16).

(7) The EBW fireset will be set up and fired IAW with DPG Standing Operating Procedure (SOP) DP-0000-G-139 (Reference 18) and with the operating manual for the FS-43 fireset (Reference 19). The documents (References 18 and 19) will be located on site in the CP.

2.1.3.6 Indoor/Outdoor Transport of a Dense Gas

a. Structure Specifications

(1) Indoor chlorine measurements will be collected in three types of structures. The modular trailers will provide empirical field-scale observations of cloud infiltration and aerosol interactions with indoor surfaces.

(2) A number of conex container structures will be modified to allow for a controlled intake of outside air with a specific flow rate through a specific opening. The modified conex container structures will include single-story and multistory structures. The multistory structure will be two conex containers wide by three conex containers high (2 × 3 conex stack).

b. Modified Trailers

(1) Two modular trailers will be furnished to represent two different indoor spaces: office and home (Figure 40). Dimensions of the modular trailers are approximately 6.1 × 3 × 2.4 m (20 × 10 × 8 ft). Each will be fitted with a heating, ventilating, and air conditioning (HVAC) system, furniture, and other materials (Reference 20). The target total surface area-to-volume ratios will be between 2.5 and 4.5 m^2 (8.2 and 14.8 ft^2) per 1 m^3 (3.3 ft^3) of room volume. The types of surfaces will include common material categories: impermeable surfaces (e.g., glass), permeable hard surfaces (e.g., painted wood, plastic), permeable wall/ceiling surfaces (painted wallboard), plush surfaces (e.g., fabric, foam, carpet), and other surfaces (e.g., paper). Used furniture and materials are preferred because weathered surfaces are more representative of occupied buildings.

(2) Exposure to chlorine might damage some materials, so replacements may be necessary during testing. It is assumed that furniture and other materials in the trailers will be replaced no more than once (if at all) during the six release trials. The exception is the HVAC air filter, which will be replaced after each release trial. Windows, doors, and ceiling light fixtures are assumed to be resistant to chlorine and will not be replaced.

(3) The modular trailers will remain on wheels during testing and each will be fitted with skirt made of chlorine-resistant material to prevent the chlorine cloud from flowing underneath the structure.

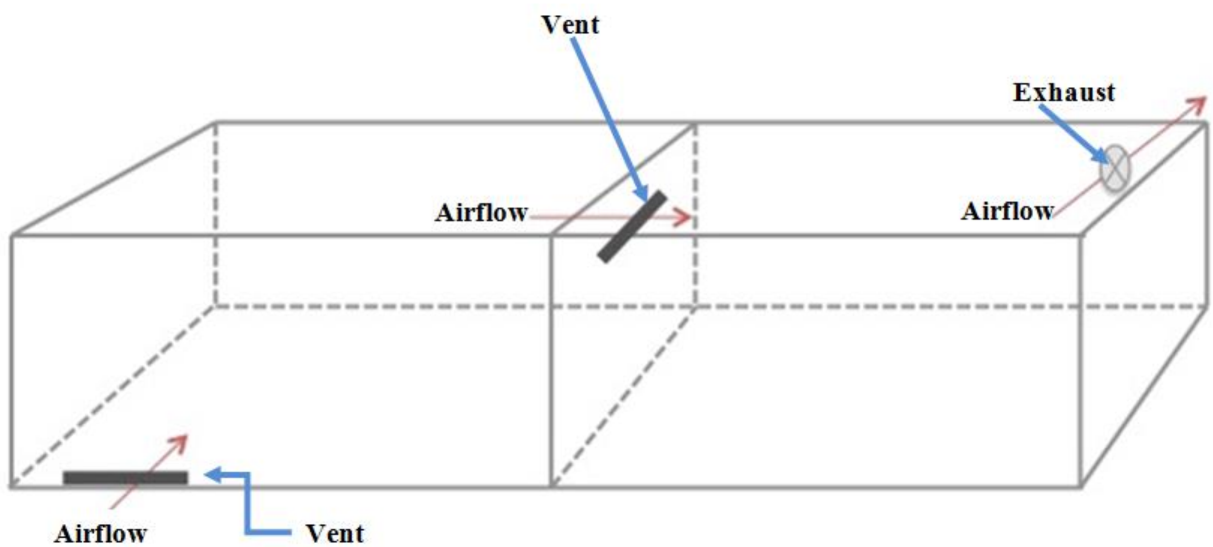
c. Modified Single-Story Conex Container

(1) One 12.2-m (40-ft) conex container with dimensions of 12.2 × 2.7 × 3 m (40 × 9 × 10 ft) will be configured for controlled experiments of airflow and transport in a single-floor structure. The container will be modified to include insulation. The transfer of pollutant across the building envelope (i.e., from outside to inside) will be monitored via a controlled artificial leak and an exhaust fan. The insulation, air sealing, and leakage pathway of the conex containers is described in Reference 20.

(2) Interior Partitioning. The conex container structure will be subdivided into two equal-volume compartments to provide data for modeling the transport of chlorine in a two-zone building (Figure 41).

NOTE: This figure was provided by Lawrence Berkeley National Laboratory (Berkeley, California).

Figure 40. Illustrative Example of a Modular Trailer Unit; JRII.



NOTE: This figure was provided by Lawrence Berkeley National Laboratory (Berkeley, California).

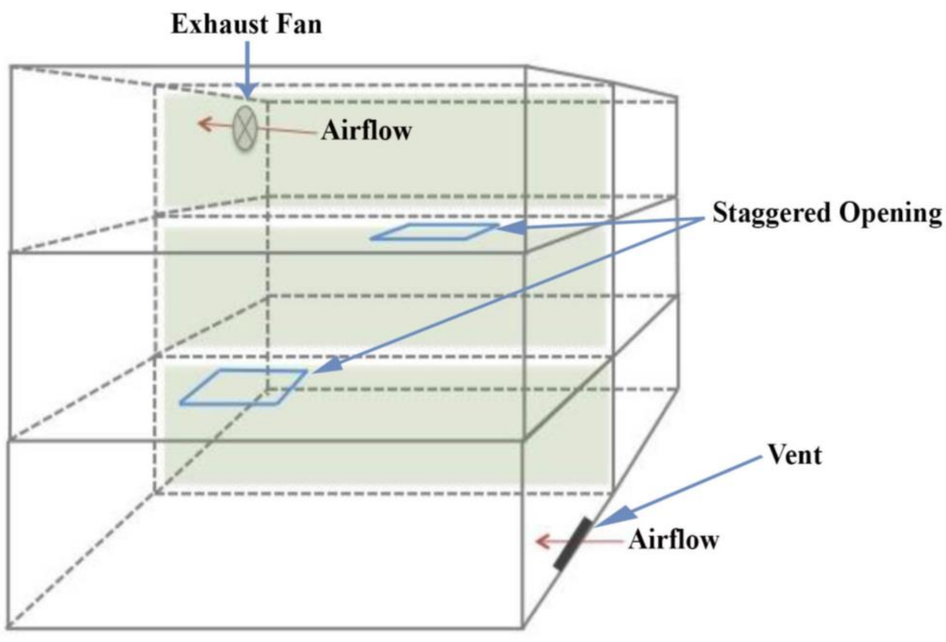
Figure 41. Illustration of the Prevailing Flow Pathway for the Trailers; JRII.

d. Modified Multistory Conex Container

(1) Six 6.1-m (20-ft) conex containers will be stacked two conex containers wide by three conex containers high (in a 2 × 3 conex stack) to create a multistory structure (Figure 42). The insulation requirements are the same as described for the single-story conex container (Paragraph 2.1.3.6.c). Exhaust fans need to generate 15.3 to 25.5 cubic meters per minute (CMM) [540 to 900 cubic feet per minute (CFM)] of airflow to result in an outside air intake rate of 3 to 5 per hour. It is recommend that the fans and flow controllers used in the single-story conex container also be used in the modified multistory conex container. The exhaust fan will be installed as shown in Figure 42.

(2) The adjacent conex container will be connected by cutting out parts of the envelope, as indicated by the areas shaded in green in Figure 42. The three floors will be kept mostly separated, as in the case of most multistory buildings, but the floors will be connected by an opening [of approximately 1.5 ×1.5 m (5 × 5 ft)] and the openings will be staggered (Figure 42). A staircase ladder is required to allow field team access to the upper floors. Other safety measures (e.g., railings) may be required for fall protection.

e. The leakage pathway will be identical to the opening made for the single-story container (Paragraph 2.1.3.6.c).



NOTE: This figure was provided by Lawrence Berkeley National Laboratory (Berkeley, California).

Figure 42. Illustration of the Prevailing Flow Pathway of the Multistory Structure; JRII.

f. Characterization Tests

(1) The four test structures (two modular trailers, one single-story conex container, and one multistory conex container) will require measurement of air leakage and airflow rates before the release experiments.

(2) In addition, the HVAC will be evaluated to make sure that performance adequately maintains indoor temperature and relative humidity within a specific range.

g. Blower Door Test

(1) A blower door test will be performed for the two modular trailers. This test will determine the building envelope air leakage by measuring the airflow rate needed to depressurize the structure at various pressure differentials. This test requires a blower door system, including a blower door, a calibrated fan, a pressure gauge, a computer controller and other accessories. The goal of the test is to determine if the building envelope of the modular trailer has the appropriate level of airtightness. If the building envelope is too leaky, caulking might be necessary. If the building envelope is too airtight, leakage pathways may need to be created to more accurately represent a typical structure. Thus, an iterative process will be followed to perform adjustments and retesting to obtain a desirable building envelope air leakage.

(2) This test will not be performed on the two conex container structures because the blower door cannot be easily mounted. The intention is to seal the conex container structures so that they are as airtight as possible.

h. SF_6 Tracer Decay Test

(1) This test will be performed in all modular trailers and conex container structures. SF_6 will be injected inside the structure to a uniform concentration of about 1 ppm. SF_6 concentrations will be measured by Gasmet™ instruments over a period of 3 to 6 hours. This test will be repeated 2 or 3 times because the air infiltration rates of the modular trailers can be impacted by the outdoor temperature and wind speed.

(2) The SF_6 test will require one gas analyzer in each of the modular trailers. The single-story conex container structures will require two gas analyzers each during the SF_6 decay test. The multistory conex container structure will require at least four gas analyzers to ensure that the air remains well-mixed during the test. One or more small recirculating fans will be needed to provide mixing. During the test, the indoor temperature will be roughly the same as the test condition [i.e., 18° through 25°C (64° through 77°F)].

(3) The total amount of SF_6 required is estimated to be about 50 g (0.1 lb). A small quantity of SF_6 can be transferred from a gas cylinder to a sampling bag and used as the release source for these characterization experiments.

i. Airflow Rate Measurements

(1) The recirculation airflow rate supplied by the modular trailer HVAC systems will be measured using a powered flow hood. For the modified conex containers, the exhaust fan airflow rates can also be measured using the powered flow hood.

(2) For the modular trailers, the outside air intake rate cannot be easily isolated from the recirculating air for taking measurement. Instead, the outdoor air intake rate will be estimated by repeating the SF_6 decay rate with the HVAC system running at a constant fan speed, and comparing the results with measurements when HVAC system is off.

j. Indoor Conditions Monitoring. Indoor air temperature and relative humidity will be monitored for 1 week (1 to 10-minute time intervals) before characterization testing to provide baseline data. These data will help identify what changes may be needed to ensure that the indoor conditions are met during the release experiments. In addition, the interior wall surface temperature, as well as the ceiling and floor, will be monitored to help determine whether insulation is adequate.

k. Instrumentation

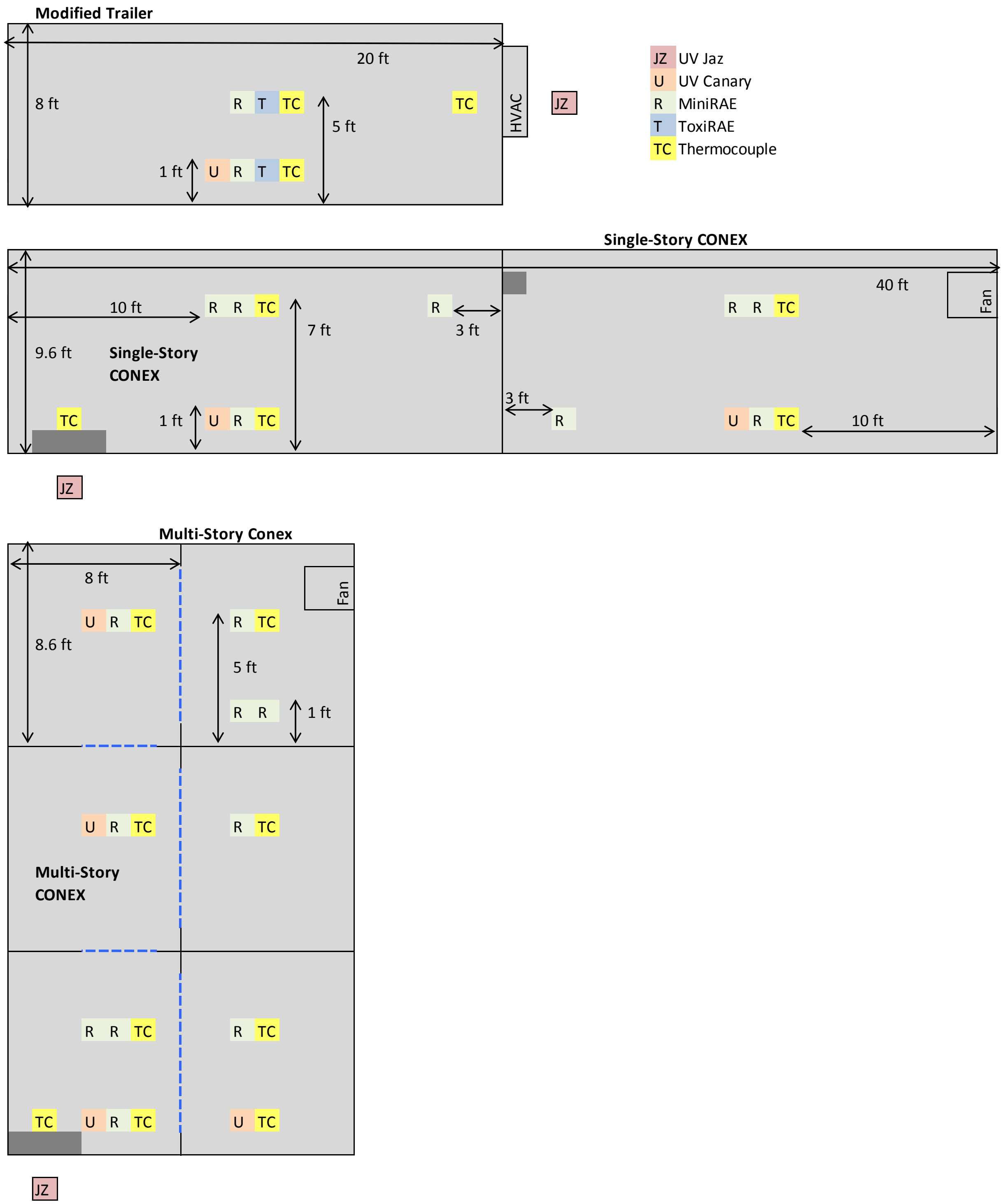
(1) The total number of instruments necessary for the indoor experiments are provided in Table 4.

(2) The layout of the different instruments is illustrated in Figure 43. In addition, up to 20 thermocouples are expected to be available for the indoor structures. The placements for these thermocouples are shown in Figure 43.

Table 4. Instrumentation for Indoor Experiments; JRII.

Structures	Type and Quantity of Instruments			
	Jaz™	UV Canary	MiniRAE	ToxiRAE
Modified trailer (office)	0	1	2	2
Modified trailer (home)	0	1	2	2
Single-story conex container	0	2	8	0
Multistory conex container	0	4	10	0
Outside indoor test structures	4	0	0	0
Total needed for indoor study	4	8	22	4

NOTE: UV – ultraviolet.



NOTE: UV – ultraviolet. This figure was provided by Lawrence Berkeley National Laboratory (Berkeley, California) and units were provided in feet.

Figure 43. Illustration of Instrumentation Placements; JRII.

l. Modified Trailers

(1) Indoor concentrations will be measured at a central location at two heights inside each of the modified trailers. The UV Canary will measure chlorine concentrations at a height of 0.3 m (1 ft). One MiniRAE and one ToxiRAE will be collocated and will sample at a height of 0.3 m (1 ft). Another set of a MiniRAE and a ToxiRAE will sample at a height of 1.5 m (5 ft) (near breathing-zone height) to determine the vertical distribution of chlorine concentrations. Both MiniRAE and ToxiRAE are required for the modified trailers because it is expected that the chlorine concentration will be reduced when exposed to indoor surfaces; therefore, use of both instruments will allow for measurement of indoor concentrations over a broad range from 1 to 2000 ppm. **NOTE**: Wire framed shelves with painted finish may be used for mounting sensors.

(2) After the release, the modified trailers will be aired out by running the HVAC at 100 percent power in outside air mode for about 1 hour. Indoor concentrations will be measured again using impingers for up to 2 hours at three averaging times: 0.5, 1, and 2 hours. Chlorine deposition on various indoor surfaces will also be measured using x-ray florescence.

m. Modified Single-Story Conex Container

(1) The indoor concentrations in the conex containers are likely to be somewhat higher than in the modified trailers because the conex container has fewer indoor surfaces where loss of chlorine is expected. The UV Canary and MiniRAE will be used to measure chlorine inside the conex container assuming that the expected indoor concentrations are within the range of these instruments. Indoor concentrations will be measured at two heights [0.3 and 2.1 m (1 and 7 ft)] and at three longitudinal distances along the 12.2-m (40-ft) conex container [3.0, 6.1, and 9.1 m (10, 20, and 30 ft)].

(2) Two of the six sampling locations will be monitored by a second MiniRAE to provide duplicate measurements that will aid data analysis. One UV Canary will be placed in each of the two zones of the conex container.

n. Modified Multistory Conex Container. The indoor concentrations in four of the six conex containers that make up the multistory structure will be measured by a UV Canary. In addition, each conex container will be measured by a MiniRAE placed at a sampling height of 1.5 m (5 ft). The conex container located closest to the chlorine intake and exhaust will also have an additional MiniRAE. In addition, two of the six sampling locations will be monitored by a second MiniRAE to provide duplicate measurements.

o. Post-Release Residual Chlorine Experiment

Impinger Sampling. Chlorine may deposit or react with indoor surfaces and materials present inside the modified trailers. Once the outdoor chlorine cloud has passed, interior surfaces and materials may offgas chlorine into the indoor air. This reintroduction of chlorine to the indoor air will be measured after the indoor test structures have been ventilated at 100 percent outdoor air for 1 hour. This will be accomplished by running the HVAC with the outdoor air damper fully open. Indoor concentrations of chlorine are expected to decrease rapidly during this period. Two pairs of collocated MiniRAEs and ToxiRAEs (1 to 2000 ppm range), located at heights of 0.3 and 1.5 m (1 and 5 ft) as previously set up during the release trial, will monitor changes in indoor concentrations. Additional details on this monitoring method are in Reference 20.

p. X-Ray Fluorescence (XRF) Analysis. A handheld XRF analyzer (Olympus Delta, Center Valley, Pennsylvania) will be used to analyze the chlorine content of indoor surfaces and materials after the impinger sampling has been completed. Operation of the XRF will follow the same procedure as described in the chemical reactivity and deposition experiments procedures (Reference 20).

2.1.3.7 Chlorine Reactivity and Deposition Experiments

a. Pilot studies of the following experiments will be performed during the 2015 trials. The experiment and purpose is as follows:

(1) Experiment 1. Determine relative amounts of chlorine deposited for substrate orientations.

(2) Experiment 2. Determine integrated amount of chlorine deposited, qualitative comparison of resistance to capture (Rc) (if not limited by transport) from vegetation.

(3) Experiment 3. Determine integrated amount of chlorine deposited, qualitative comparison of Rc (if not limited by transport) from soil.

b. The pilot studies will be used to familiarize technicians with the procedures, techniques, and instruments that may be used during 2016 trials. **NOTE**: There will be no agar appliances, vegetation, or soil sites in the urban environment, and the only samples prepared will be those needed to complete example analyses. The locations will be provided in the final test report.

c. The intent is to experimentally investigate, analyze and scientifically evaluate the potential efficacy of chlorine and TIH mitigation strategies, including uptake by soil, water, vegetation, and man-made materials and structures. Consequently, the chlorine reactivity and deposition experiments propose to characterize and quantitatively measure chlorine cloud removal by deposition on vertical and horizontal surfaces, hydrolysis, photolysis, reaction with organic and inorganic constituents of soil, and reaction with vegetation. A discussion of the deposition parameters may be found in *Following Accidental Releases of Chlorine from Railcars* (Reference 21).

d. The project must distinguish between naturally occurring chloride-contaminated particulates carried and deposited by the wind and chlorine deposited during the release. As an ancient dried seabed, the concentration of chloride in the playa soil is 27254±359 ppm (Reference 22). This can be accomplished by deploying samples of each type upwind of the release, analyzing them after the test in the same manner as the samples collected from the downwind environment, and comparing the results. All locations used for data collection will be documented and surveyed before the test.

NOTE: DHS personnel will collect reactivity samples. Civil Support Teams (CSTs) and/or Chemical, Biological, Radiological, and Nuclear (CBRN) units will participate in sample collection based upon availability. DPG is responsible for acquiring the required supplies and equipment, plus an auxiliary work trailer with a cleaning station for glassware, and a waste material disposal system that the technicians and student volunteers from Utah Valley University (Orem, Utah) may use to complete the analyses and store equipment.

e. Experiment 1: Determine Relative Amounts Deposited for Substrate Orientations

(1) The amounts of chlorine deposited for various substrate orientations will be determined from the post-release analysis of 25 agar substrate sampling appliances per test release. That is, four sample orientations (facing toward and away from the release; and facing up toward the sky and down toward the ground) at six stations along rows, plus a blank at a location upwind of the release to account for chlorine contaminating windblown dust from the playa. The intent is that chlorine gas and aerosol will impact on the agar surface, react with the substantial percentage of water in the matrix and the agar itself, and penetrate to some depth indicated by a color change of the universal pH indicator added during the appliance preparation. **NOTE**: This technique has not been tested or proven.

(2) The samples will be analyzed in place using the XRF protocol described in Reference 23.

f. Experiment 2: Determine the Integrated Amount of Chlorine Deposited; Conduct a Qualitative Comparison of Rc (If Not Limited by Transport) From Vegetation

(1) Two types of vegetation in flats will be acquired for each test: a deciduous broadleafed plant and clover used for groundcover. A sufficient number of plants and flats of each type will be purchased for each test so that they may be placed at six stations beside a chlorine point monitor (thus, near agar appliance stands and in two rows of three sites each, and progressively downwind from the release. Vegetation will remain in the planters in which they were purchased and placed at ground level with a min-max thermometer. The plants may have to be secured so that they remain upright during the release.

(2) Additional details of the analysis are in Reference 23.

g. Experiment 3: Determine Integrated Amount of Chlorine Deposited and Perform Qualitative Comparison of Rc (If Not Limited by Transport) From Soil

(1) During the test, 1.2- × 0.6-m (4- × 2-ft) sites will be created by hammering site-length pieces of steel to the grade. The steel will be 10.2 cm (4 in) wide and 0.32 cm [0.13 in (1/8 in)] thick. Rock and soil will be removed from within the box prescribed by the steel pieces, and the box will be filled with soil of varying composition. The size of the site will reduce edge effects and provide the flat surface ideal for determining deposition parameters.

(2) The soil sites will prepared at six stations beside a chlorine point monitor (thus, near agar appliance stands and vegetation sites), and in two rows of three sites each, and progressively downwind from the release. A Min-Max thermometer (separate from the vegetation thermometer) will be placed on each soil site. Surface chlorine will be measured by XRF before and after the test and marked so a subsequent analysis may be completed at the same location after the

test. A minimum of two measurements will be made for each sample site. After the test, two soil cores [10.2 cm (4 in) deep] will be taken from each sample site where coring may be done with a split-core sampler. Additional details on the analysis and the types of soil to be used are in Reference 23.

2.1.3.8 Test Execution/Dissemination

a. Chlorine Setup

(1) The procedures for filling the chlorine tank trailer from the mule trailer and filling the specialized dissemination tank are described in the Health, Safety, and Work Plan (HSWP, Reference 24). The mule tanker and specialized dissemination device are acceptable containers for holding and transporting chlorine.

(2) Before operations the fill team will conduct a safety meeting, review the site safety plan, and observe specific environmental conditions, and outline the primary and secondary evacuation routes. They will also review operations with the IMT and Emergency response teams. Fill operations will not start unless the IMT team is on site.

b. Filling. The specialized dissemination tank will be filled with liquid chlorine before all releases and will be conducted by Chlorine Institute (CI) personnel with DPG Fire Department (FD) providing emergency response. The area will be cleared of all non-essential personnel before any hazardous operations. All personnel that are not emergency responders will be located at a minimum distance of 1000 m (3281 ft) from hazardous operations. Personnel filling the tank will maintain the appropriate PPE (as designated by the IMT and approved by Command).

(1) The fill operation will be monitored from the JRII operations CP by the site TCO. The TCO will review real time meteorological (MET) modeling and update the fill team of any changes in the primary and secondary evacuation routes. The TCO will also notify DPG Range Control of the filling operation and will establish contact with the emergency response representative. **NOTE**: The TCO has overall safety and operations control, but the test officer (TO) has a higher authority when making decisions.

(2) The filling operation will continue in accordance with the HSWP (Reference 24).

c. Release. Planned chlorine releases will be conducted on a daily basis only after all safety and environmental requirements have been met. The releases will be controlled by the TCO from the JRII Operations CP located at the SL test site. The grid will be cleared of all personnel and the SL test site will be cleared of all non-essential personnel. **NOTE**: The TCO will use the Go/Hold Checklist for Test Execution to verify readiness. If any requirements are not met, the TCO will hold the countdown and address unmet requirements. Once all requirements are met, the TCO will resume countdown until dissemination. The Go/Hold checklist is described in the OPLAN (Reference 5).

d. Emergency Draining. Emergency draining is a last option that will only be conducted in the event that test personnel cannot safely drain the tank in a controlled manner. Before emergency draining, the test grid will be cleared of all nonessential personnel and the TCO will notify DPG Range Control and the emergency response team, who will be informed of the most up to date meteorological release model. The emergency drain will be controlled from the CP at the SL Test site using a remote activation device. Emergency drains will be conducted under meteorological conditions least likely to affect personnel or equipment, if at all possible, preferably within normal test conditions. In the event the model predicts the plume will flow toward the SL Test CP, all personnel will evacuate the site once the emergency drain is initiated. Following an emergency drain, the emergency response team will follow established procedures for reentering the test grid. The conditions that will lead to an emergency drain are as follows:

(1) Low order detonation of the explosive bolts during a planned dissemination, which prevents the flange from fully releasing from the tank.

(2) Failure of the pressure relief device to function properly if the tank exceeds the desired pressure limit, which will cause an uncontrolled leak or tank rupture.

(3) An unplanned rise in tank pressure that cannot be corrected and mitigated to normal pressure limits.

e. Re-Entry

(1) After the trials, the concrete pad will be monitored using the HD video cameras. At the point in time when no visible liquid is detected as determined by TCO using video camera images, the trial will be considered complete and the reentry team will reenter the test area to re-attach the flange and seal the tank. The reentry team will consist of DPG explosive personnel and CI personnel who will enter the grid in two phases.

(a) Phase I. DPG explosives personnel will make the initial entry from the upwind direction into the area in Level C with full face respirators and monitor the gas level with ToxiRAEs. If at any time during the approach, gas level is detected above 5 ppm the explosive personnel will egress the site, change into level A with SCBA and reenter the site. Explosive personnel will inspect the area, and notify the TCO that the area is cleared of any explosive hazard. Re-entry teams will maintain the appropriate PPE (as designated by the IMT and approved by command).

(b) Phase II. The TCO will initiate the second phase of the reentry after authorizing the CI team to enter the test area and replace the flange on the tank.

(2) The re-entry operation will continue as follows:

(a) The chlorine gas recovery scrubber will be operated to reduce chlorine concentrations during the flange replacement operation.

(b) A new rubber plug will be installed in flange opening.

(c) The blind flange will be replaced with non-explosive standard secure nuts and bolts.

(d) Any damaged instrumentation will be removed and replaced.

(e) The disseminator will be prepared for next test.

f. Retrograde

(1) Any residual chlorine in the mule will be returned to a commercial vendor for use.

(2) Bleach generated by scrubbing process will be delivered to a commercial vendor for use.

(3) The specialized dissemination tank will be pressurized with nitrogen before storage.

(4) The test site will be cleared of any unnecessary equipment, including conexes. Final retrograde will occur in 2016 at completion of testing.

2.1.4 Urban Configuration Test Data Required

The urban configuration test data required are listed in Table 5.

2.1.5 Urban Configuration Test Data Analysis/Procedures

Test data will be collected and reviewed by WDTC before release to the customer as level 2 data (data that have been reviewed, but not manipulated in any way) or level 3 data (data that have been converted to another format or assembled into a tabular form, such as a spreadsheet). All data will be provided to the customer in the final test report and in data packages. The data format to be provided for all test instrumentation measurements will be approved by the customer before testing begins.

Table 5. Urban Configuration Test Data Required; JRII.

Item Number	Data Required
1	MiniRAE 2000 data.
2	MiniRAE 3000 data.
3	ToxiRAE Pro data.
4	Gasmet™ Data
5	Ultraviolet (UV) Canary data (Hz) collected at the end of each trial.
6	Jaz™ data.
7	UV Sentry data.
8	UV LIDAR data.
9	Optical Data [high definition (HD), high speed (HS), infrared (IR), unmanned aerial system (UAS), and photographs].
10	Meteorology Data: Portable Weather Instrumentation Data System (PWIDS), Ultrasonic Anemometer, 32-m (105 ft) Meteorological Tower, Energy Balance Station (EBS), MiniSODAR™, and modeling.

Table 5. Urban Configuration Test Data Required; JRII (Cont'd).

Item Number	Data Required
11	Thermocouple data (Hz) collected from six heights (real time).
12	GRIMM data.
13	West Desert Light Detection and Ranging (LIDAR) (WDL) data.
14	Disseminator data (pressure, temperature, valve status, valve inlet pressure, and valve outlet pressure).
15	Guided Wave Radar (GWR) data.
16	Test Control Officer (TCO) Log.

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SECTION 3. APPENDICES

APPENDIX A. TEST CRITERIA

None.

APPENDIX B. TEST SCHEDULE

Event	Start Date	End Date
Test planning	1 March 2014	1 April 2015
Provisioning	14 October 2014	20 August 2015
Final command review (FCR)	13 August 2015	13 August 2015
Preoperational safety survey (POSS)	18 August 2015	18 August 2015
Test execution	21 August 2015	12 September 2015
Test report preparation	2 September 2015	18 November 2015

APPENDIX C. TEST SUPPORT ORDER

2015-DT-DPG-SNIMT-F9735 (Methodology (DT)) Jack Rabbit II Planning	
System	Methodology (DT)
Test Title	Jack Rabbit II Planning
Test Support Order	Activation in ADSS constitutes authority to begin planning IAW Project: 2014-DT-DPG-SNIMT-F9735. Upon receipt of this directive, immediately review the test milestone schedule in light of known other workload and projected available resources. If rescheduling is necessary and the sponsor non-concurs, forward a memorandum citing particulars, together with recommendations, to ATEC G9 - Test Business Management Division (Mr. Michael K. Joiner), within 15 days after receipt of this directive. Reschedules concurred in by the sponsor can be entered directly by the Test Center.Test Execution is authorized after approval of Test Plan (TP)/Detailed Test Plan (DTP) and conduct of Test Readiness Review (TRR).
Scope of Work	The Jack Rabbit test program is a study to improve the understanding of rapid large-scale releases of pressurized, liquefied toxic inhalation hazard (TIH) gases from a railcar or other toxic industrial chemical / toxic industrial material (TIC/TIM) transports. The program supports a Department of Homeland Security / Transportation Security Administration (DHS/TSA) initiative aimed at deterring terrorist attacks on TIH railcars or attacks against U.S. rail yards. Along with the counter-terrorism aspect, knowledge gained from the program has proven to be a valuable asset to the TIC/TIM and scientific communities and more importantly, to first responders of large chemical incidents. The first Jack Rabbit test program was funded by DHS/TSA and conducted at Dugway Proving Ground (DPG) during April/May 2010. Currently, the DHS Science and Technology (S&T) Directorate, is proposing a follow-on test to Jack Rabbit (Jack Rabbit II), to be conducted at DPG. This phase of Jack Rabbit will be a multi-year program with field testing to be executed in July-September 2015 and July-September 2016. Jack Rabbit II addresses many issues not examined in the original Jack Rabbit test, such as the long-range dispersion of the chemical. Another component of this new program is an urban element to see how much of the chemical infiltrates buildings and automobiles. Lastly, reactivity with soil and vegetation will be studied, along with the solar decay of the cloud. Current stakeholders in the Jack Rabbit II program include: the Defense Threat Reduction Agency (DTRA); Joint Program Executive Office (JPEO); Joint Program Project Manager for Protection (JPM P); Joint Program Project Manager for Contamination Avoidance (JPM CA); Edgewood Chemical Biological Center (ECBC); Naval Surface Warfare Center – Dahlgren (NSWC-Dahlgren); Air Force Research Laboratory (AFRL); Unmanned Aerial Systems (UAS) Rapid Integration and Acceptance Center (RIAC); and the National Guard.

2015-DT-DPG-SNIMT-F9735 (Methodology (DT)) Jack Rabbit II Planning	
Scope of Work (Cont'd)	The scope of this ADSS entry is to provide planning and limited provisioning for the Jack Rabbit II test program. The majority of provisioning and all of the test conduct will be accomplished as another ADSS entry/program.
Test Documentation	Plans and Reports will be IAW with the ADSS milestones and DTC Pam 73-1. Test plans are to be approved prior to the start of test. Maximum use of TOPS/ITOPS will be made during test planning.
Storage	Unclassified plans/reports/data will be uploaded to the VISION Digital Library per DTC PAM 73-1.
References	References to support creation of Detailed Test Plan/Test Plan, to include any Safety, Security and Environmental documents, as well as cost estimates, will be posted to the VISION Digital Library.
Security Considerations	Jack Rabbit II test program is UNCLASSIFIED. All unclassified data will be treated as FOUO at a minimum; test center will follow OPSEC procedures and take appropriate precautions for CLASSIFIED data.
Safety Considerations	As part of the planning phase of this test program, a safety risk assessment will be conducted at the local Command (DPG) level. Safety Assessment Report (SAR) will be provided by the sponsor. Local risk assessment will be performed prior to test commencement. If a Safety Assessment Report (SAR) is not available, the test center will review scope of the test to identify, classify, mitigate, and accept all hazards associated with the test item and test conditions IAW local standard operating procedures; completion of this review will be documented as the actual date for the 2270 milestone.
Environmental Considerations	An environmental assessment (EA) will be conducted at the local level Command (DPG) level and be available for public comment. Title-V air quality permits and Migratory Bird Treaty Act (MBTA) agreements will also be managed at the local Command (DPG) level. Environmental documentation should be requested, in writing, from the test sponsor. Site-specific environmental documentation should be prepared and concurrence obtained from the Test Center Environmental Office. Immediately contact the Safety and Environmental Risk Management Point of Contact if lack of sponsor-developed documentation results in significant data gaps which preclude the preparation of such documentation.

APPENDIX D. RECORD OF ENVIRONMENTAL CONSIDERATION

Signature Page

RECORD OF ENVIRONMENTAL CONSIDERATION (REC)

To: Michael M. Robinson
From: Ryan W. Harris

Project Title: Jack Rabbit II Gravel Pad for Command Posts at U.S. Army Dugway Proving Ground DPG), Utah.

Brief Description: The Director, West Desert Test Center (WDTC), U.S. Army Dugway Proving Ground (DPG), Dugway, Utah, and the Chief, Special Programs Division, are planning to expand the existing gravel parking pad at the SL Grid by adding a 100 foot by 100 foot gravel pad extension. The gravel would be obtained from the North Granite Peak Gravel Pit. This expansion would allow placement of three mobile trailer command posts and the WDTC Lidar trailer, which would support Jack Rabbit II test operations in FY15 and FY16. Upon completion of Jack Rabbit II testing, the trailers would be removed from the gravel parking pad. Grid coordinates for the gravel pad at SL Grid are 291200 Easting, 4445750 Northing.

Duration of Project: 18 through 28 May 2015

Reason for using record of environmental consideration:

a. Under the screening criteria in 32 Code of Federal Regulations (CFR) Part 651, Environmental Analysis of Army Actions; dated 29 March 2002, neither an environmental assessment (EA) nor an environmental impact statement (EIS) is required. The proposed action meets the requirements of 32 CFR §651 Appendix B Categorical Exclusion (CATEX) II(c)(1), which stipulates: "Construction of an addition to an existing structure or new construction on a previously undisturbed site if the area to be disturbed has no more than 5.0 cumulative acres of new surface disturbance. This does not include construction of facilities for the transportation, distribution, use, storage, treatment, and disposal of solid waste, medical waste, and hazardous waste (REC required)".

b. Additionally, under the provisions of § 651.12(2) the potential environmental impact issues of this construction at DPG are addressed in the existing documents entitled: *Environmental Assessment for Construction in Developed Areas of Dugway Proving Ground* (1982), *Summary Development Plan for U.S. Army Dugway Proving Ground, Utah* (2000), and *Final Environmental Impact Statement for Activities Associated with Future Programs at U.S. Army Dugway Proving Ground and Record of Decision* (2005), from which this REC is tiered and which are on file at WDTC.

Approvals:

Original Signed: ***14 May 2014***	***Original Signed:*** ***18 May 2014***
RYAN W. HARRIS Date	JASON N. RAFF Date
Director, West Desert Test Center	Environmental Programs Division
	U.S. Army Dugway Proving Ground

To: Michael M. Robinson

From: Ryan W. Harris

Project Title: Re-opening the North Granite Peak Gravel Pit and Construction of Gravel Road and Pad Off Goodyear Road at U.S. Army Dugway Proving Ground (DPG), Utah.

Brief Description: The Director, West Desert Test Center (WDTC), U.S. Army Dugway Proving Ground (DPG), Dugway, Utah, and the Chief, Meteorology Division, are planning to re-open the North Granite Peak Gravel Pit and construct a road and gravel pad off of Goodyear Road. Gravel obtained from the pit would be used in construction of the road and pad. Grid coordinates for the gravel pit are 305700 Easting, 4449463 Northing. Grid Coordinates for the road and gravel pad off Goodyear Road are 288070 Easting, 4444794 Northing.

Duration of Project: 16 September 2014 through 15 September 2015

Reason for using record of environmental consideration:

a. Under the screening criteria in 32 Code of Federal Regulations (CFR) Part 651, Environmental Analysis of Army Actions; dated 29 March 2002, neither an environmental assessment (EA) nor an environmental impact statement (EIS) is required. The proposed action meets the requirements of 32 CFR §651 Appendix B Categorical Exclusion (CATEX) II(c)(1), which stipulates: "Construction of an addition to an existing structure or new construction on a previously undisturbed site if the area to be disturbed has no more than 5.0 cumulative acres of new surface disturbance. This does not include construction of facilities for the transportation, distribution, use, storage, treatment, and disposal of solid waste, medical waste, and hazardous waste (REC required)".

b. Additionally, under the provisions of § 651.12(2) the potential environmental impact issues of this construction at DPG are addressed in the existing documents entitled: *Environmental Assessment for Construction in Developed Areas of Dugway Proving Ground* (1982), *Summary Development Plan for U.S. Army Dugway Proving Ground, Utah* (2000), and *Final Environmental Impact Statement for Activities Associated with Future Programs at U.S. Army Dugway Proving Ground and Record of Decision* (2005), from which this REC is tiered and which are on file at WDTC.

Approvals:

Original Signed: 15 September 2014
RYAN W. HARRIS — Date
Director, West Desert Test Center

Original Signed: 08 October 2014
JASON N. RAFF — Date
Environmental Programs Division
U.S. Army Dugway Proving Ground

ENVIRONMENTAL ASSESSMENT FOR
JACK RABBIT II TESTING AT
US ARMY DUGWAY PROVING GROUND, DUGWAY, UTAH

SIGNATURE PAGE

PREPARED BY:

Original Signed: 27 October 2014
MICHAEL M. ROBINSON Date
Lead Environmental Protection Specialist
Environmental Technology Office
Operations Division
West Desert Test Center

REVIEWED BY:

Original Signed: 27 October 2014
DONALD P. STORWOLD, JR Date
Physical Scientist
Modeling and Assessment Branch
Meteorology Division
West Desert Test Center

CONCUR

Original Signed: 27 October 2014
JOHN C. PACE Date
Chief
Meteorology Division
West Desert Test Center

SECURITY CHECK

Original Signed: 28 October 2014
JAMES W. NADEAU Date
Chief, Counterintelligence Office
US Army Dugway Proving Ground

PROPONENT

Original Signed: 28 October 2014
RYAN W. HARRIS Date
Director
West Desert Test Center

CONCUR

Original Signed: 30 October 2014
JASON N. RAFF Date
Environmental Programs Division
US Army Dugway Proving Ground

SPONSOR CONCUR

Original Signed: 30 October 2014
GEORGE R. FAMINI, Ph.D Date
Director
Chemical Security Analysis Center

CONCUR

Original Signed: 3 November 2014
AUDY SNODGRASS Date
Garrison Manager
US Army Dugway Proving Ground

APPROVAL

Original Signed: 4 November 2014
RONALD F. FIZER Date
Colonel, Chemical Corps
Commander
US Army Dugway Proving Ground

Finding of No Significant Impact (FNSI)
Jack Rabbit II, US Army Dugway Proving Ground, Dugway, Utah

CONCLUSION

Based on the Jack Rabbit II EA, I conclude that the environmental effects of the Proposed Action will not be individually or cumulatively significant and the preparation of an environmental impact statement is not warranted.

APPROVAL

Original Signed: ***4 November 2014***
RONALD F. FIZER Date
Colonel, Chemical Corps
Commanding
US Army Dugway Proving Ground

APPENDIX E. OPSEC SIGNATURE SHEET

1. Directorate/Division: West Desert Test Center, Special Programs Division
2. Test Officer: Damon Nicholson
3. Unclassified Program Title: Jack Rabbit II
4. Customer/Sponsor (if Unclassified):
5. ADSS Project Number: 2015-DT-DPG-SNIMT-F9735
6. Projected Test Start Date: 29 June 2015
7. Security Classification of Test:
   Classified: ☐ Top Secret (Notify Security Office Immediately)
   ☐ Secret
   ☐ Confidential
   Unclassified: ☒ Unclassified
   ☐ For Official Use Only
   ☐ Other Agency Marking – Specify: _____
   Please provide any additional special handling requirements (i.e., Proprietary, Competition Sensitive, FOUO): FOUO.

8. If the test is classified, has a current program security classification guide (SCG) been received from the Program Manager's Office? ☐Yes ☐No
   a. Title of SCG: _____
      Date of SCG: _____
      Declassification Date: _____
      Customer Security POC (Name/Phone Number): _____
   b. If "NO" what classification guidance has been received to lead you to believe there will be classified aspects to this program? _____

   When is customer/sponsor expected to provide SCG? NA.
   What action has been or will be taken to obtain the SCG prior to start of test (i.e., request in writing)? Customer will not provide a SCG and indicated that we can use the DPG WDTC OPSEC plan.
   Once SCG is received, please provide document information in Part a.

9. Has a current Program Protection Plan or OPSEC Plan been received from the customer?
   ☐Yes ☒No ☐Not a test/support effort only
   If "No" or "Not a test/support effort only," will OPSEC Guidance be used? ☒Yes ☐No
   If "No," has a program OPSEC Plan been requested in writing from the Program Manager's Office? ☒ Yes ☐ No If so, when? 17 February 2015 (Shannon Fox).
   (If not yet requested, test officer must do so immediately and a copy of the request should be sent to Test Center OPSEC Officer.)
   When is the customer/sponsor expected to provide the OPSEC Plan? NA.

10. Technical Information:

Has the customer/sponsor provided marking and handling instructions? ☐ Yes ☒ No

Has a distribution statement been provided in accordance with DOD Directive 5230.24? ☒ Yes ☐ No

11 Other Remarks: _____

NOTE: All information referenced above must be obtained prior to the start of test. If this is unable to be accomplished, you must notify the TC security and intelligence division.

Original Signed: 19 February2015	***Original Signed: 23 February2015***
Signature (Test Officer) Date	Signature (OPSEC Officer) Date
Damon Nicholson	James Nadeau

APPENDIX F. SAFETY PROCEDURES AND RISK MANAGEMENT

The safety procedures and deliberate risk assessment are in the DPG OPLAN (Reference 5) per authorization from DPG command.

APPENDIX G. TANK DRAWINGS

FIGURE LIST

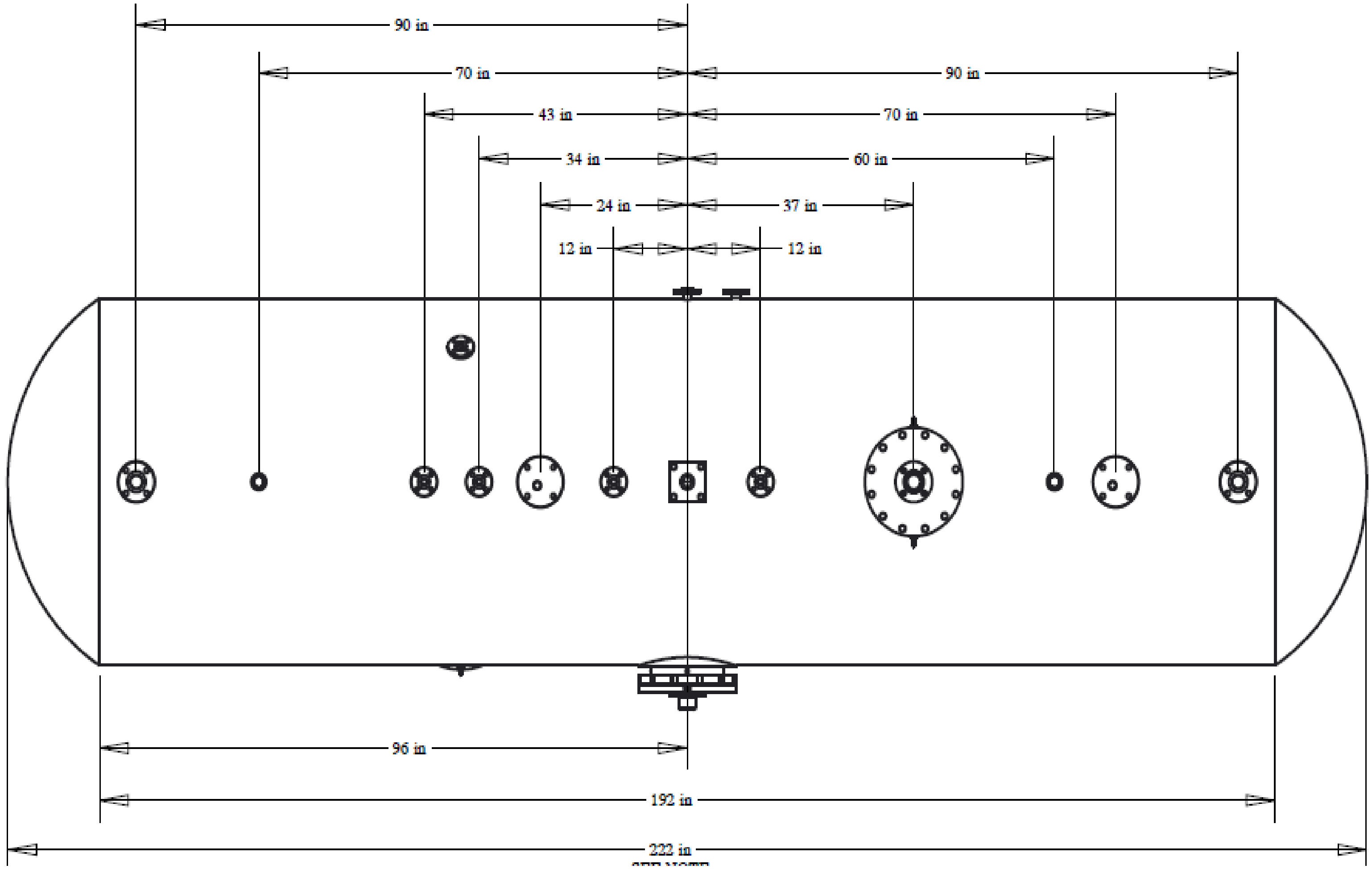

Figure G.1. Top View of Chlorine Tank Port Locations; JRII.

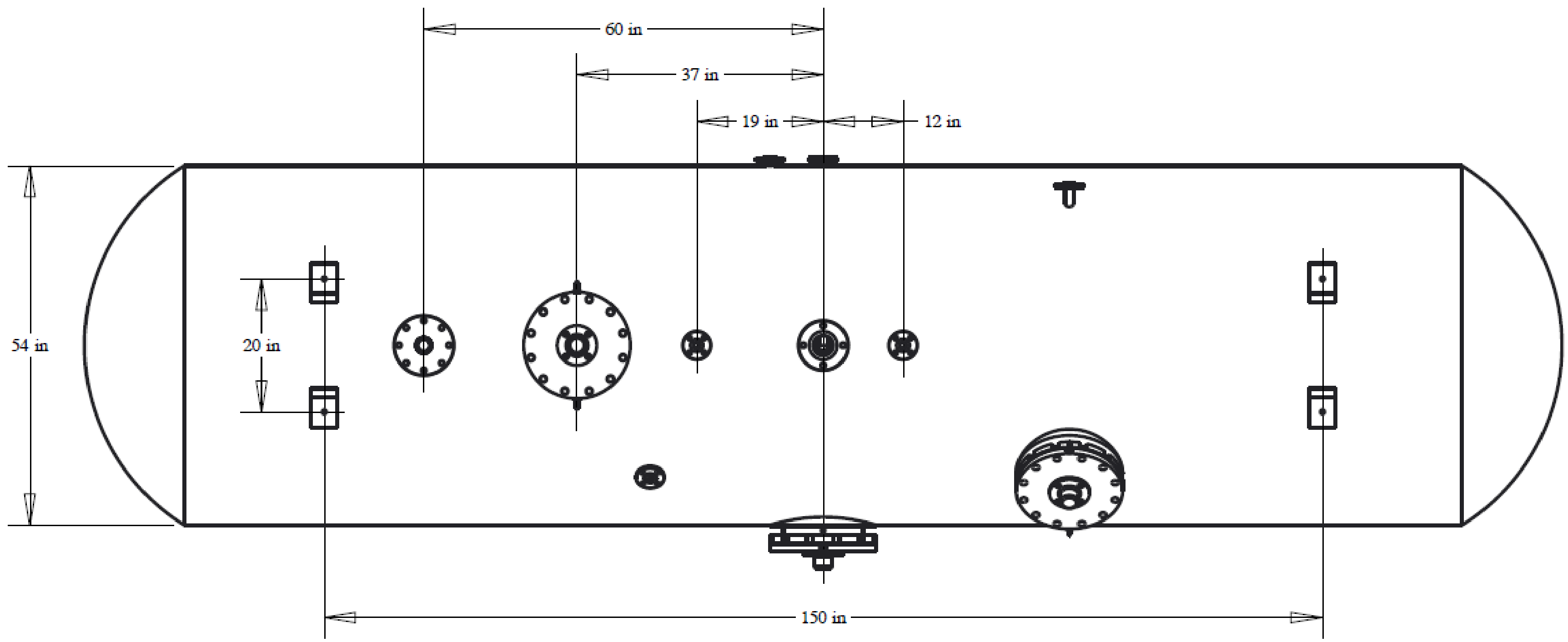

Figure G.2 Bottom View of Chlorine Tank Port Locations; JRII.

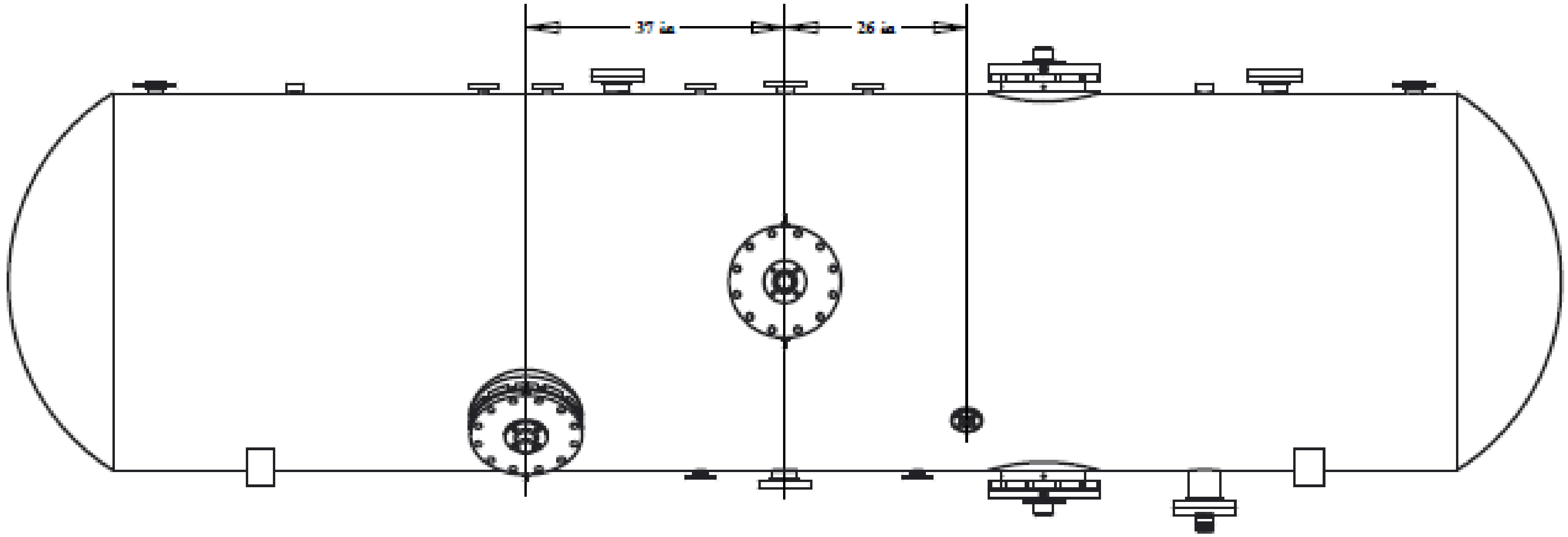

Figure G.3. Front View of Chlorine Tank Port Locations; JRII.

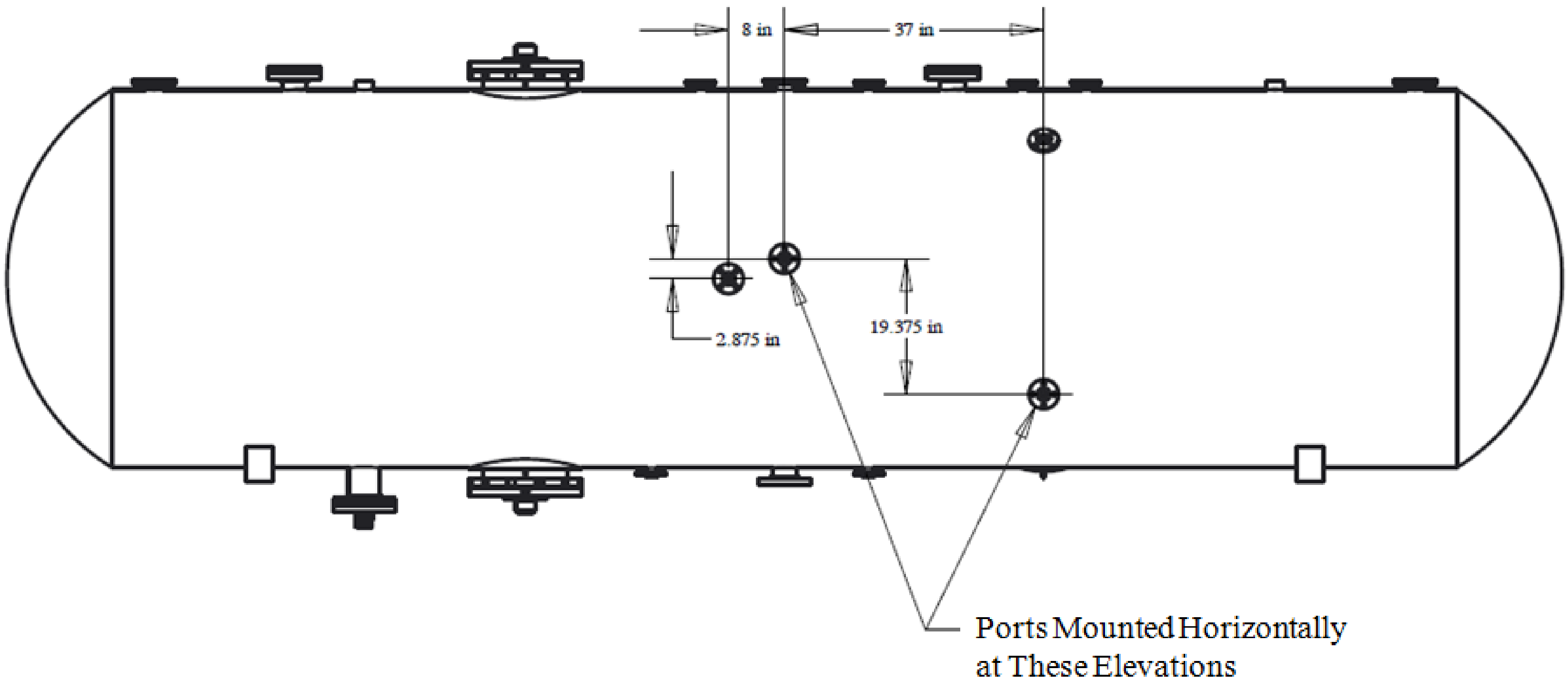

Figure G.4 Back View of Chlorine Tank; JRII.

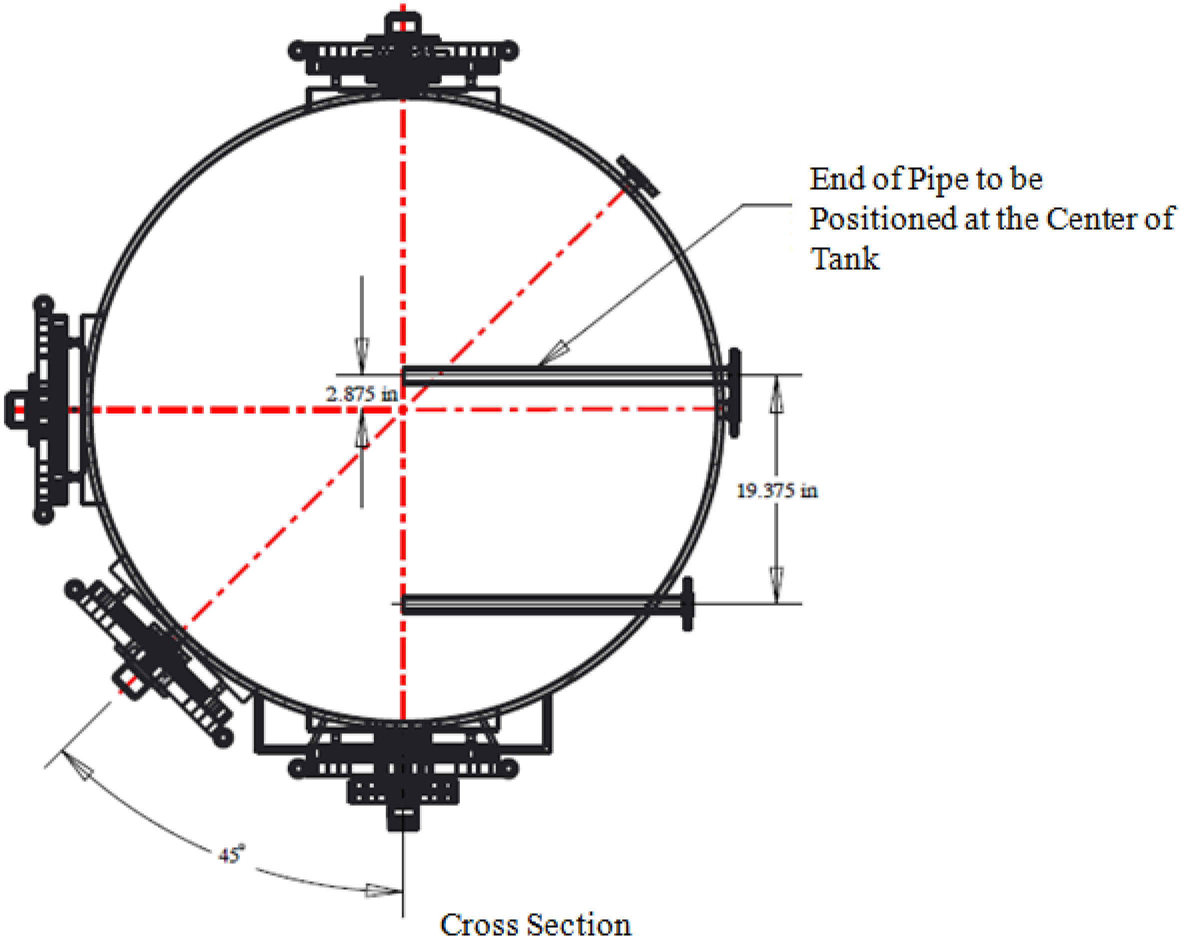

Figure G.5 End View of Chlorine Tank Port Locations; JRII.

APPENDIX H. REFERENCES

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APPENDIX I. ABBREVIATIONS

ADSS – ATEC Decision Support System

AFRL – Air Force Research Laboratory

AGL – above grade level

AO – approval order

APG – Aberdeen Proving Ground

AT&D – atmospheric transport and dispersion

ATEC – Army Test and Evaluation Command

ATV – all-terrain vehicle

AWG – American Wire Gauge

BLM – Bureau of Land Management

CAD – computer-aided design

CATEX – categorical exclusion

CBRN – chemical, biological, radiological, and nuclear

CFM – cubic feet per minute

CFR – Code of Federal Regulations

CI – Chlorine Institute

CMM – cubic meters per minute

CP – command post

CSAC – Chemical Security Analysis Center

CST – civil support team

DAQ – Division of Air Quality

DHS – Department of Homeland Security

DOD – Department of Defense

DPG – US Army Dugway Proving Ground

DSN – Defense Switched Network

DT – developmental testing

DTC – US Army Developmental Test Command

DTCC – Distributed Test Control Center

DTP – detailed test plan

DTRA – Defense Threat Reduction Agency

EA – environmental assessment

EBS – energy balance station

EBW – exploding bridge wire

ECBC – Edgewood Chemical Biological Center

EIS – environmental impact statement

eV – electron volt

FCR – final command review

FD – fire department

FNSI – finding of no significant impact

FOUO – for official use only

FOV – field of view

fps – frames per second

FTIR – Fourier-transform infrared spectrometer

FY15 – Fiscal Year 2015

GPS – Global Positioning System

GWR – guided-wave radar

HD – high-definition

hPa – hectopascal

HPAC – Hazard Prediction and Assessment Capability

HS – high speed

HSIN – Homeland Security Information Network

HSWP – health, safety, work plan

HVAC – heating, ventilating, and air conditioning

Hz – hertz

I – Interstate

IAW – in accordance with

IMT – incident management team

IR – infrared

ITOP – International TOP

JPEO – Joint Program Executive Office

JPM CA – Joint Program Project Manager for Contamination Avoidance

JPM P – Joint Manager for Protection

JR – Jack Rabbit

LIDAR – Light Detection and Ranging

MAX – maximum

MBTA – Migratory Bird Treaty Act

MET – meteorological

MHz – megahertz

MP4 – H.264

NA – not applicable

Nd:YAG – neodymium-doped yttrium aluminum garnet

NEMA – National Electrical Manufacturers Association

NPT – national pipe thread

NSWC – Naval Surface Warfare Center

OPLAN – operations plan

OPSEC – operations security

ORI – operational readiness inspection

PAM – pamphlet

PBX – polymer bonded explosive

PETN – pentaerythritol tetranitrate

POC – point of contact

POSS – preoperational safety survey

PPE – personal protective equipment

ppm – parts per million

ppm-m – ppm-meters

PVC – polyvinyl chloride

PWIDS – Portable Weather Instrumentation Data System

Rc – resistance to capture

RDX – cyclotrimethylenetrinitramine

REC – record of environmental consideration

RH – relative humidity

RIAC – Rapid Integration and Acceptance Center

RPT – rapid phase transition

S&T – Science and Technology Directorate

SAR – safety assessment report

SCBA – self-contained breathing apparatus

SCG – security classification guide

SF_6 – sulfur hexafluoride

SL – surface layer

SODAR – sonic detection and ranging

SOP – standing operating procedure

TAC – tactical

TC – test center

TCO – test control officer

TIC – toxic industrial material

TIH – toxic inhalation hazard

TIM – toxic industrial material

TO – test officer

TOP – test operations procedure

TP – test plan

TRR – test readiness review

TSA – Transportation Security Administration

UAS – unmanned aerial system

UTG – urban test grid

UTTR – Utah Test and Training Range

UV – ultraviolet

UV-DOAS – ultraviolet differential optical absorption spectroscopy

UVU – Utah Valley University

UXO – unexploded ordnance

v – volume

VIP – very important person

VISION – Versatile Information Systems Integrated ON-line

VOC – volatile organic compound

WDL – West Desert LIDAR

WDTC – West Desert Test Center

WMV – Windows Media Video

Xe – xenon

XRF – x-ray fluorescence

APPENDIX J. DISTRIBUTION LIST

All electronic distribution must be encrypted.

Addressee	Plans	Reports
Department of Homeland Security (DHS) Science & Technology (S&T) Chemical Security Analysis Center (CSAC) (Negron, A.) E3401 Ricketts Point Road, 2nd Floor Aberdeen Proving Ground – Edgewood Area, MD 21010-5424 adolfo.negron@st.dhs.gov	1	1
Department of Homeland Security (DHS) Science & Technology (S&T) Chemical Security Analysis Center (CSAC) (Fox, S.) E3401 Ricketts Point Road, 2nd Floor Aberdeen Proving Ground – Edgewood Area, MD 21010-5424 shannon.fox@st.dhs.gov shannon.fox@st.dhs.gov	1	1
US Army Test and Evaluation Command (ATEC) , G-9 Test Operations Division (CSTE-TM/M. Joiner) 2202 Aberdeen Boulevard - First Floor West Aberdeen Proving Ground, MD 21005-5055	1	1
Defense Technical Information Center (DTIC/OA) 8725 John J. Kingman Road, Suite 0944 Fort Belvoir, VA 22060-6218	1	1
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US Army Dugway Proving Ground		
(TEDT-DPW-DMA/West Desert Technical Information Center)	1	1
(-CTC/C. Nicholson)	1	1
(-CT/C. Johnson)	1	0
(-DP-SA/P. Krippner)	1	0
Dugway, UT 84022-5000		