

# **TECHNOLOGY DEMONSTRATION TEST PLAN**

## **PROJECT 4 TASK 2: D&D SUPPORT FOR TECHNOLOGY INNOVATION, DEVELOPMENT, EVALUATION AND DEPLOYMENT**

### **FX2 Advanced Fogging Technology**

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## 1.0 INTRODUCTION AND PROBLEM STATEMENT

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In discussions with representatives from the Savannah River National Lab (SRNL), the requirement for an advanced fogging technology that could better address potential airborne contaminants than existing products and technologies was identified. The deactivation and decommissioning challenges being faced by the SRS 235-F Project have precipitated a requirement for more advanced fogging technologies in the areas of capture coating fogging agents themselves, as well as the delivery mechanisms for their dispersion. In several of the older processing facilities, it is well known that contamination, in some cases substantial contamination, is evident throughout the exhaust ductwork due to the years of processing in glove boxes, etc. Large accumulations of radioactive dust and lint are present that have the potential to become airborne from disposal site exhumation, laundry facilities, exhaust ventilation ducting and exhaust stacks, all of which pose significant risk and critical concern.

There have been previous attempts at applying a coating to capture the high levels of airborne contamination with varying degrees of success in various facilities across the DOE enterprise. On occasion, these attempts have not been successful in penetrating and causing adherence of contaminated lint and dust to the ductwork and other surfaces. As a result, the contamination was not fixed and ultimately became airborne when it was disturbed. Also, traditional methods of capturing this contamination have been very labor intensive by placing a worker in the area to spray a coating and exposing personnel to the hazard. Likewise, spraying a coating in an area with penetrations, such as auxiliary piping and other equipment, usually does not fix contamination that is “shadowed” by such items. Further complicating the issue, some coatings, such as glycerin, leave a residue that is slippery and could cause a secondary potential hazard, while using excessive amounts of water to control dust presents a radiological waste issue. Thus, an improved capture coating and delivery mechanism was identified as a need to resolve these contamination issues. (1)

In response, FIU has focused its efforts on identifying, testing, evaluating, and enhancing innovative fogging technologies in support of the SRS 235-F project. The SRS 235-F facility was constructed in the 1950’s as part of the weapons complex materials production and fabrication. The building is approximately 24,000 ft<sup>2</sup> per floor totaling 48,000 ft<sup>2</sup>. The blast resistant, two-level, windowless structure was built to meet NPH PC-3 seismic and wind design criteria. The facility was built on a reinforced concrete slab foundation with 14-inch thick exterior walls constructed of double-reinforced concrete. The 235-F building has three separate ancillary facilities: 291-2F (stack), 292-2F (sand filter fan house), and 294-2F (sand filter) plus an underground concrete tunnel connecting 235-F to the sand filter. Major modifications to the facility began in the mid-

1970s to support the new Pu-238 fuel mission for NASA. The most significant quantities of residual contamination remaining in 235-F building are found in the Plutonium Fuel Form (PuFF), Plutonium Experimental Facility (PEF), Old Metallography Lab (OML), and Actinide Billet Line (ABL) facilities.

A research initiative started and further developed at Idaho National Laboratory (INL) on a new contamination capture coating and fogging agent, currently dubbed FX2, has been highlighted as having tremendous potential in addressing the airborne contaminant problem at SRS 235-F and throughout the DOE enterprise. This fogging fixative contains a sticky base and surfactant that behaves similar to a gas upon dispersion and can be introduced into targeted spaces at low pressure and low velocity to increase its penetration into hard-to-reach areas. It then captures and fixes radioactive materials, metals and other contamination in place. Furthermore, recent tests conducted at INL demonstrated that the FX2 agent could be adequately dispersed via commercial-off-the-shelf (COTS) fogging delivery systems, thereby potentially diminishing the requirement for specially designed equipment that in turn reduces costs. The technology improves safety during nuclear facility decommissioning by assuring that contamination does not spread or expose workers during decontamination operations. Through extensive coordination via phone, email, and site visits, FIU is overseeing a collaborative testing and evaluation effort with SRNL and INL to advance the development, and eventual field deployment, of the FX2 Advanced Fogging Technology in a radioactive contaminated environment. It is an integrated approach designed to reduce technical risks, improve safety, and limit uncertainty within D&D operations.

The majority of the FX2 technology demonstration will occur at the FIU Testing Facilities in Miami, Florida, starting on or about 30 Mar – 3 Apr 2015, or until the test objectives outlined in this document have been satisfactorily achieved. The purpose and intent of this FIU technology evaluation is to subject the FX2 fogging agent to the next phase of testing, consistent with ASTM universally accepted standards where applicable, in order to more completely characterize the agent in the areas of flash / ignition point, burn rate, and ability to provide for the control of airborne particulate contamination to levels appropriate for accomplishing contamination-sensitive activities. If the necessary site-specific geometry data is provided with sufficient lead time and deemed feasible, FIU will conduct the tests in a mockup that duplicates the desired SRNL dimensions and geometries where the agent is most likely to be deployed in a hot technology demonstration to address real-world, radioactive decontamination scenarios. All findings from the demonstration will be published as an ARC technical report and a technology fact sheet will also be developed. FIU will provide these reports to DOE EM as a project deliverable and for further dissemination.

## 2.0 TECHNOLOGY DESCRIPTION

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Potential fogging technologies were researched via: (1) FIU D&D technology databases (D&D KM-IT), (2) Internet search, (3) subject matter experts, and (4) professional conferences and forums. Based on that research, the FX2 Advanced Fogging agent and COTS delivery system employed by INL appeared to be a very viable, cost effective method to mitigate airborne contamination hazards that would potentially be encountered at the SRS 235-F Project. Additionally, it provides a unique opportunity to demonstrate and further the development of an effort that has shown some strong, initial promise. The description of the technologies outlined below is extracted from an INL Advanced Fogging Technologies report drafted in 2014.

**Fogging Agent:** The FX2 fogging agent is a proprietary mixture of water, latex paint (LTX), glycerin (GLY) and sodium lauryl sulfate (SLS) optimized to penetrate dusty contaminants and bind them into a film. Initial development of an acceptable fogging agent began in 2006, when a DOE Small Business Innovative Research (SBIR) grant resulted in the development of a conceptual advanced capture coating fog system. This coating was shown to be superior at reducing airborne contamination and “fixing” it in place compared to the few other commercial fogging agents.

During FY-2014, the INL built upon those initial findings and further refined the fogging agent mixture, resulting in a solution that optimized effectiveness in addressing potential airborne contaminants and produced superior results to the 2006 effort. The initial objective of the solution development was to achieve a fogged capture coating which would allow for easy application, unmanned operation and flow through facilities and equipment. The solution had to “knock down” and fix existing airborne particulates, as well as penetrate through the surface layer of dust and “freeze” the dusty contaminants, fixing them to the substrate. This new coating demonstrated better penetration of the lint and dust, and an ability to stabilize potentially respiratory particles. All of the additives are common materials, found in paint and shampoo for example, and none are considered harmful (beyond being irritants in higher concentrations). The solutions are aqueous and generally clean up with soap and water. Based on the laboratory tests that compared wetness, stickiness, dustiness and penetration, several coatings showed improved performance over the conventional glycerin fogging technique.

**Stationary Fogging Delivery System:** The set of experiments conducted by the INL also validated the approach of using an inexpensive, unsophisticated fogger and a portable blower to control the buildup of fog. Previously it was thought that testing the FX2 Fogging Agent would require more sophisticated equipment. However, a fogger that produced the proper droplet size was commercially available at an inexpensive price.

Though different configurations and techniques of employment will be tested, FIU will employ the Cyclone Fogger by Curtis Dyna-Fog (see Figure 1). The fogger contains an ultra-low volume (ULV) nozzle that can subject the FX2 Fogging Agent to fewer than 20 microns and produces a flow rate of .07 liters per minute. The capacity of the tank is one gallon (3.8 liters). The Cyclone Ultra-Flex weighs approximately 10 lbs. and approximately 16 lbs. with a full tank.

Input Power:	110/120 V AC, 8.5 amps, 50/60 Hz (models 3000, 3000-1), 210/250 V AC, 4.2 amps, 50/60 Hz (models 3004, 3004-1).
Adjustable flow rate:	0-5 gal/h. (0-19 L/h.)
Particle Size:	5-30 microns.
Tank capacity:	1 gal. (3.8 L).
Length:	54 in. (137 cm).
Width:	8 in. (20.2 cm).
Height:	14.5 in. (36.5cm).
Weight empty:	10.5 lbs. (4.8 kg.)
Shipping data:	L x W x H: 27 in. x 12 in. x 17 in. (68cm x 30 cm x 43 cm)
Weight:	16 lbs. (7.26 kg.),
Volume:	3.2 cubic feet. (0.09 cubic meter).
Option:	36 inch (91 cm) flex hose.



**Figure 1. Cyclone Fogger by Curtis Dyna-Fog**

## **3.0 TEST OBJECTIVES AND METHODOLOGY**

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There are four (4) primary test objectives associated with this Test Plan: 1) Test and evaluate the FX2 fogging agent's capacity to "knock down" and fix airborne particulates, as well as coat and fix loose surrogate contamination with the potential to go airborne, both within and outside the direct line-of-sight of the dispersion nozzle and using various surface types (eg: metal, plastic, wood, etc) in differing geometries; 2) Determine the ignitability of the FX2 Fogging Agent during stationary application; 3) Determine the shielding abilities of the FX2 Fogging Agent against an alpha emitter source; and 4) Determine the ignition / flash point and burn rate characteristics of the FX2 Fogging Agent.

### **3.1: Evaluate FX2 Fogging Agent in Controlling (ie: Knocking Down and Fixing) Potential Airborne Particulates, Both Line of Sight and Non-Line of Sight, on Various Surfaces in Varied Geometries**

1) This represents the primary objective for the Test Plan, and is intended to: 1) Confirm previous findings related to FX2's capacity to satisfactorily fix contaminants on various surfaces in varying geometries; 2) Evaluate FX2's capacity to knock down and fix suspended airborne particulates in varying geometries; and 3) Evaluate FX2's overall fogging ability to satisfactorily coat both line of sight and non-line of sight contaminants in varying geometries. FIU will utilize their hot cell mockup facility and create three (3) separate dimensions / geometries as outlined in the below figures. These dimensions / geometries will be created in sequential order, starting with the smallest configuration (Figure 2) and progressing to the larger ones (Figures 3-4). Dividers constructed from plywood and/or fire retardant canvas will be used to create the desired dimensions, with careful attention paid to making the best use of the existing structure (ie: window, entry portholes, etc). This will ensure optimization of the existing structure and facilitate attaching the fogger and ventilation systems for remote application of the FX2 agent, while also allowing for easier visibility during the conduct of the respective tests. Appropriate measures will be taken to ensure the designs are adequately sealed for maximum effectiveness of the experiments. INL tested the FX2 agent using the Dyna Fogger depicted above in a small make shift tent that was approximately 2.5m x 2.5m x 2m (~8'x8'x6') with adequate results, and assessed that the Dyna Fogger delivery system may be able to uniformly disperse the FX2 agent in a room as large as 6m x 6m x 3m (~18'x18'x10'). The dimensions to be tested by FIU are all larger than the test dimensions used by INL during their experiment, but generally fall within the range of the assessed effective area size. The three scenarios that FIU will implement (FIU mockup) are as follow:

- Scenario 1 is 10'x10'x10'(show in Figure 2)

- Scenario 2 is 10'x15'x10' (shown in Figure 3)
- Scenario 3 is 10'x20'x10' (shown in Figure 4)

\*\*NOTE: As previously stated, if provided by SRNL on or about 16 January 2015, FIU could replicate the desired dimensions and geometries associated with any potentially planned “hot demo” of the FX2 fogging agent in a radioactive environment. This will allow for a rehearsal of the hot demo in a cold environment before the actual event.

- 2) Petri dishes and coupons will be placed in the designated locations as outlined in the below figures for each of the three dimensions / geometries tested. The petri dishes will contain talcum powder / lint to simulate contaminants with the potential to become airborne, and the coupons will consist of polypropylene cloth/batting coupons cut into 10 cm squares. Additionally, a 3-shelved utility shelf will be placed in each of the three configurations, with talcum powder placed on small platforms / plates made of various materials (ie: glass, metal, brick, wood, stainless steel, and concrete). The intent is to evaluate how well the FX2 agent fixes contaminants to different material surfaces. Finally, no less than two of these samples will be placed in non-line of sight configurations in order to evaluate the fogging agent’s ability to sufficiently coat the entire surface area (Figure 5).
- 3) The FX2 fogging agent will be prepared according to INL’s technical specifications and application instructions. It is anticipated that INL will have 1-2 representatives present and assisting with the execution of certain components of the Test Plan.
- 4) The Dyna Fogger and associated equipment will be configured outside the test tent in the mockup in order to simulate dispersing the FX2 agent remotely through the designated portholes and/or windows for each of the three test diagrams. As each diagram / design offers a few alternatives, some latitude will be granted in experimenting with different set-ups to determine which configurations afford the greatest uniform coverage.
- 5) Prior to the application of the FX2 agent via the Dyna Fogger, FIU will conduct some baseline testing of airborne particulates in the hot cell mock up during the testing of geometry / dimension scenario #1. Utilizing either the HandiLaz Mini Particle Counter or Lasair III Portable Counter manufactured by Particle Measuring Sytems, an airborne particulate measurement will be conducted with the environment “as is”, and then another measurement taken after dispersing an aerosol. This will be done a few times using the same pattern to get an approximate baseline, with and the results captured and documented in accordance with Appendix 3.
- 6) Once there is general consensus that a workable airborne particulate baseline has been established, progression to the next phase will commence. The aerosol will be dispersed into the environment, the particulates counted, and then the FX2 agent will be remotely applied to the hot cell mockup by the Dyna Fogger for a designated time



period. Time duration for running the fogger for the initial test will be 15 minutes based on feedback received during the INL tests, but since FIU will be using different / larger dimensions, necessary latitude will be provided to determine optimum duration times for uniformly dispersing the FX2 agent given the respective dimensions.

- 7) Upon completion of the remote application of the FX2 agent by the Dyna Fogger, an airborne particulate measurement will be taken approximately five (5) minutes after there is no visible fog and the results captured and documented, once again, in accordance with Appendix 3 (As noted previously, some latitude will be required in order to determine the optimal “waiting period” to achieve the best results for the airborne particulate measurement).
- 8) To measure effectiveness in terms of area covered, reduction of dustiness, coverage over the surface and penetration of the fog into the surface of the batting coupon, the petri dishes and coupons will be removed, allowed to sufficiently dry, and examined. Based on previous tests conducted by INL this drying process ranged from 1-3 days. Dustiness will be qualitatively evaluated by the ability of the talcum powder to be “fixed” (encapsulated) after fogging and remain immobile when being rubbed and inverted. Penetration of the fog will be judged by the relative depth the fog penetrated into the central portion of the batting coupon. The evaluation of this portion of the test will be performed by microscopic analysis. The results for each dish, material, coupon, line of sight and non-line of sight apparatus, etc will be documented and recorded.
- 9) This general sequence will be applied during all three test scenarios associated with the various dimensions / geometries (Note, the airborne particulate test will only be conducted during scenario #1). It is currently planned to run each scenario a total of three (3) times.

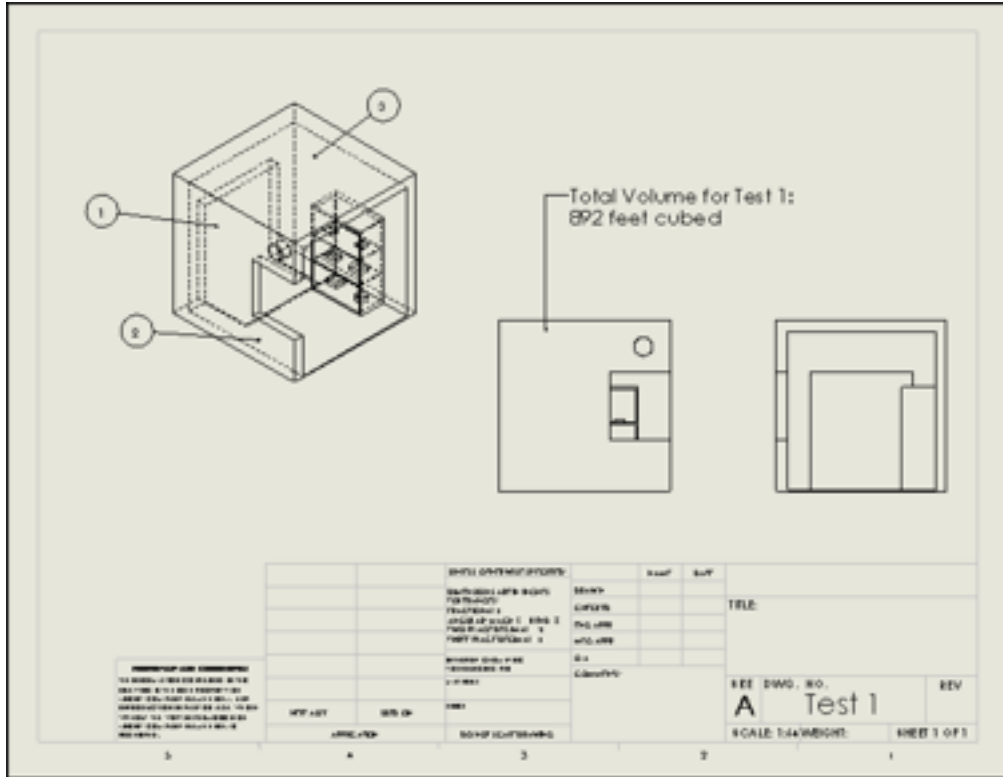


Figure 2. Dimensions / Geometries for Scenario 1

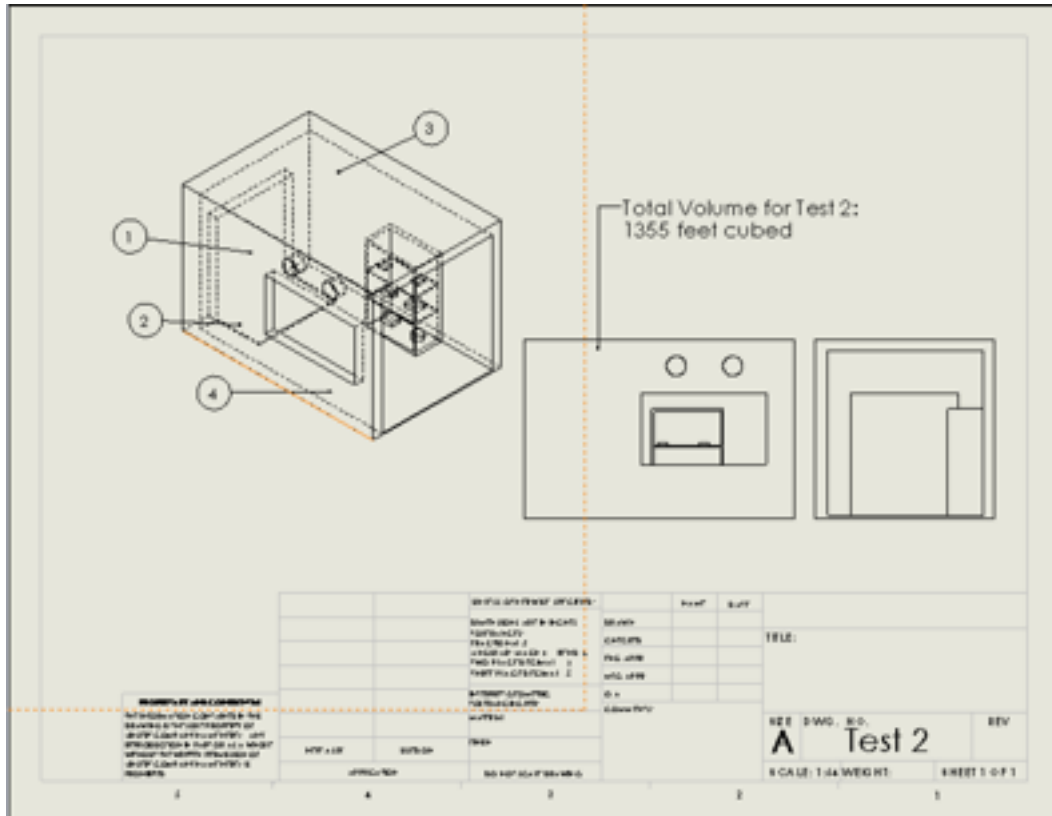


Figure 3. Dimensions / Geometries for Scenario 2

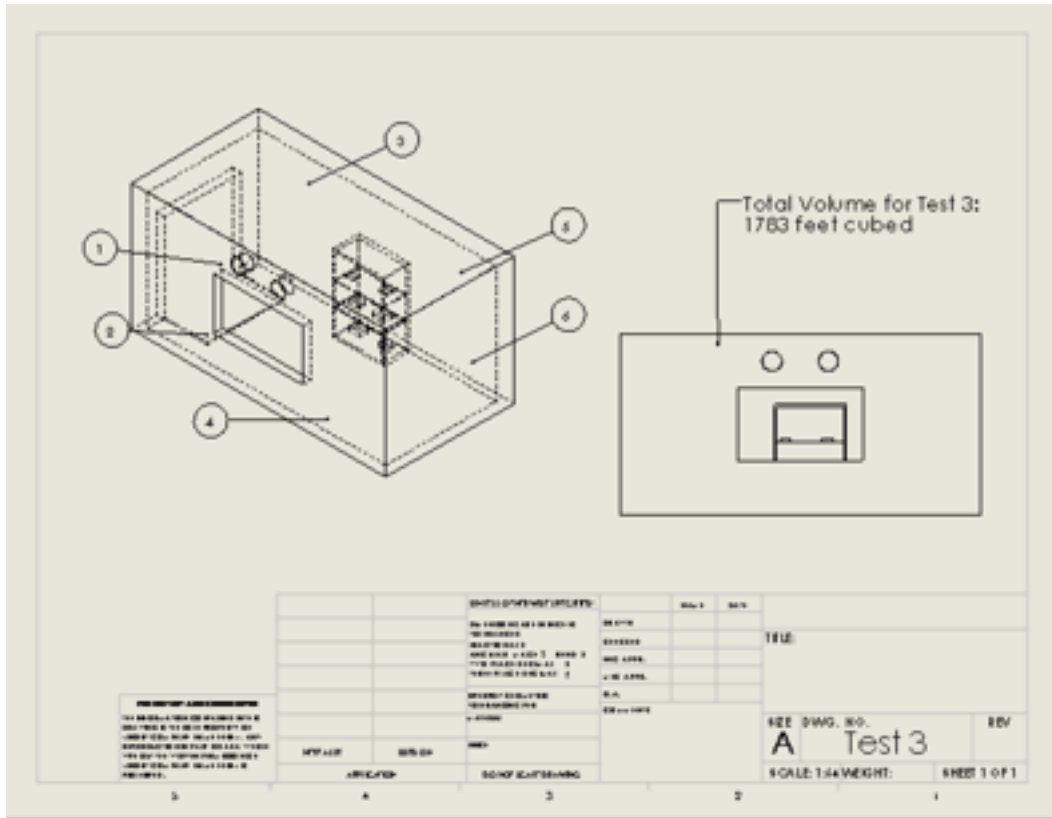


Figure 4. Dimensions / Geometries for Scenario 3

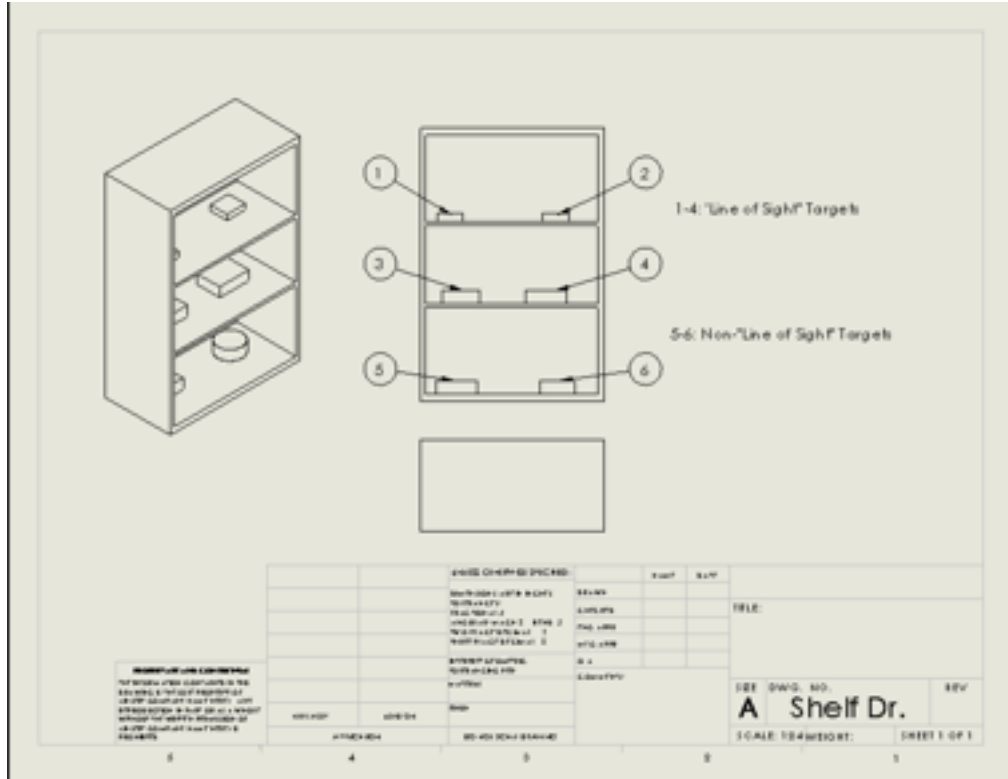


Figure 5. Utility Shelf Configuration

**3.2: Determine the Ignitability of the FX2 Fogging Agent**

In discussions with INL representatives, it was highlighted that significant costs were incurred during the recent testing of the FX2 agent in order to ensure fire compliance standards of the facility were met. Despite literature searches indicating private manufacturing regularly conducted similar application activities with airborne particulate suppressants with as low as 30% water, there was a lack of empirical data supporting the fire resistant qualities of the FX2 agent (approximately 70% water content). The next series of tests are designed to better characterize FX2’s qualities in the areas of ignitability, flash point, and burn rate per ASTM D93, ASTM E84, and ASTM 1354 standards where applicable.

- 1) A small amount of the FX2 Fogging Agent will be placed in a mist bottle and sprayed in the vicinity of several types of flame / heat sources. Observations will be recorded and documented.

- 2) Pending the results of step 1 above, various types of flame / heat sources will be placed in the hot cell mockup while the FX2 fogging agent is being dispersed during the application process.
- 3) All testing will be video recorded, and observations documented.

### **3.3: Determine Shielding Properties of FX2 Fogging Agent Against Alpha Sources**

Though widely recognized and accepted that the FX2 agent was not designed to provide shielding against radiation, there was general concurrence among the various stake holders that it would be of value to test its shielding ability against an alpha source. Therefore, this component has been incorporated into the Test Plan as such. However, it is dependent on approval by the FIU Radiation Safety Officer (RSO) and final approval by the FIU Radiation Control Committee (RCC).

Two options for this component are being considered. Option 1 is to conduct a small scale test as outlined below in the approved FIU labs for handling radioactive materials. Option 2 would be to transition and incorporate the experiment outside in the hot cell mock up during test scenario #1.

- 1) An alpha emitter / point source will be measured using a calibrated Geiger-Muller Counter, Pancake-type, Model 2241-3 from Ludlum Measurements. The radioactive source will be Polonium-210 with a disk diameter of 25mm, disk thickness of 4.45mm, and radioactive source diameter of 2-3mm (Note, these sources will need to be approved for purchase by the RSO, or alternative sources selected based on the RSO's input).
- 2) The FX2 agent will then be applied to the point source, be allowed to sufficiently dry, and then measured again by the Geiger counter. Recordings and observations will be documented and changes, if any, noted.
- 3) This process will be repeated three (3) times in order to assess the impact increased coverage and thickness of the FX2 agent may have on the point source. Recordings and observations will be documented and changes, if any, noted.
- 4) If the results in the laboratory prove promising, and if approved by the RCC, then FIU will deploy one (1) alpha emitter point source during test scenario #2 in the FIU hot cell mockup. The same procedures will be followed and all recordings and observations will be documented.
- 5) In all instances, radioactive sealed sources will be disposed of in strict accordance with FIU's Radiation Waste Disposal policy, specified in the Radiation Safety Manual for the Department of Environmental Health & Safety & Risk Management Services. This department is located in room CSC 162, contact info: (305) 348-2621, [ehs@fiu.edu](mailto:ehs@fiu.edu) [www.fiu.edu/~ehs](http://www.fiu.edu/~ehs).

**3.4: Determine the Ignition Point and Burn Rate of the FX2 Fogging Agent**

- 1) FIU will prepare the FX2 fogging agent in accordance with established procedures by the testing facility and as outlined in Appendix 1, and send to the designated private sector laboratory certified to conduct ignition point testing to ASTM D93 standards.
- 2) If the requisite equipment is available within the FIU laboratory infrastructure, independent ignition point testing will be conducted internally in accordance with established protocols and the results documented, compared, and reported.
- 3) FIU will prepare the FX2 fogging agent in accordance with established procedures outlined in Appendix 2 and send to the designated private sector laboratory certified to conduct burn rate testing to ASTM 1354 standards.
- 4) If the requisite equipment is available within the FIU laboratory infrastructure, independent flash point and burn rate testing will be conducted internally in accordance with established protocols and the results documented, compared, and reported as outlined in the Appendices.

## 4.0 PERFORMANCE MEASUREMENT AND DATA COLLECTION

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The majority of the field data collection tables are outlined in the designated appendices and manufacturer manuals for the various types of equipment outlined within this Test Plan. They will be modified to support the specific tests here within to include the airborne particulate test and shielding from an alpha emitter test. In the instance of the flash point and burn rate series of tests, the contracted company will submit universally accepted ASTM standard reports to support their findings, and will be included in the final overall report.

The performance of the fog in all other areas not already addressed will be assessed relative to the following characteristics; (i) ability to fix the dust / lint on the various materials, (ii) penetration into / encapsulation of the substance (eg: lint, coupon, talcum powder, etc) and (iii) coverage.

Fixing / dust retention will be assessed by measuring the amount of the given substance that is re-suspended after spraying the surface with a commercial air duster for a period of 3 – 5 seconds. Dust re-suspension will be measured using a commercially available portable dust counter (MET ONE HHPC 6+ or similarly capable apparatus), following the manufacturer's operating manual.

Fog penetration will be measured as maximum, and minimum distance to which the fog penetrates into a permeable object (e.g. felt coupon, sponge) using a microscope. Surface coverage will be assessed by the ability of a permeable object to repel water after treatment.

Fog coverage will be measured by two methods, area covered as well as thickness/volume of material deposited. The area covered will be determined by taking a photograph of the sample coupon and using the ImageJ<sup>®</sup> software to measure the total area of the coupon covered by the FX2 agent. This technique has demonstrated superb potential with other projects where measuring area covered by an adhesive was necessary. Investigating its application in this particular series of tests shows tremendous promise. The thickness/volume of the agent deposited will be determined by weighing the coupon both before and after applying the fog. The difference in the weight will be the mass of the FX2 agent deposited and from which the volume will be calculated.



## 5.0 ROLES AND RESPONSIBILITIES

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The Applied Research Center (ARC) at FIU uses its state-of-the-art facilities to conduct research and development, testing, evaluation, and validation for new and innovative technologies to support DOE and industry. ARC's headquarters, laboratories, and technology demonstration facilities are part of FIU's Engineering Center, a 243,000-square-foot building that occupies 38 acres in Miami, FL. ARC facilities include numerous specialized laboratories and facilities, including the outdoor technology assessment site that will be the location of this technology demonstration. The majority of the technology demonstration will be conducted under standard non-nuclear conditions. However, if approved by the RCC, there will be a radioactive component integrated into the Test Plan as outlined above.

The hot cell mock-up at the outdoor technology assessment facility for this technology demonstration represents a typical DOE site facility hot cell in size, construction materials, and points of access. It is approximately 10-ft wide x 20-ft long x 10-ft high and has an entry point at one end as well as a window in the side. The construction of the wall is poured concrete with plexiglass installed over the window. The three test scenarios will be built within the current hot cell facility to accommodate the 3 dimension sets mentioned in previous sections of the test plan.

ARC evaluators will be present at all times for the duration of the technology demonstrations to record performance data and take photographs and videos during the technology's operation. During the demonstration, ARC evaluators will gather data concerning the technology's operation, performance, maintenance, health and safety, cost, benefits, and limitations.

The following outlines FIU's role and responsibilities:

- 1) ARC will provide all utilities and services, such as water, power, phone, and sanitation at the work location.
- 2) Proper trash and hazardous waste disposal of items generated during the demonstration.
- 3) Receiving and storage of FX2 fogging agent, Dyna-Fogger(s), and associated equipment from INL.
- 4) Hot cell mockup and configuration and tent construction as needed for the demonstrations. This includes all material support.
- 5) Supply the alpha point sources / emitters.
- 6) Coordinate and fund flash point and burn rate ASTM standard testing of FX2 fogging agent with a designated vendor.

- 7) Supply all equipment outlined in this Test Plan necessary to successfully conduct the requisite experiments other than those highlighted in the INL section below.
- 8) Documenting and publishing all standard, requisite reports associated with technology demonstrations within the DOE enterprise.
- 9) Provide all equipment needed to support data collection. All data collection equipment will be calibrated as per vendor's standards and guidance.

The following outlines INL's roles and responsibilities:

- 1) Review and approve the FX2 Demonstration Test Plan.
- 2) Prepare and ship to FIU sufficient quantities of the FX2 fogging agent to conduct a minimum of 3 x test runs per scenario given the specific dimensions and area volumes (~25 gallons).
- 3) Ship to FIU the Dyna Fogger(s) and associated equipment necessary to disperse the FX2 agent within the mockups.
- 4) Provide previous data / data collection forms from earlier tests at INL in order to assist in confirming a baseline in scenario #1 and for reference in drafting the final report.
- 5) If at all feasible, provide a representative to participate in the actual test execution from 30 Mar – 3 Apr 2015.
- 6) Review draft and final versions of the technology report document.
- 7) Review and approve the technology demonstration fact sheet.

The following outlines SRNL's roles and responsibilities:

- 1) Review and approve the FX2 Demonstration Test Plan.
- 2) If at all feasible, provide a representative to participate in the actual test execution from 30 Mar – 3 Apr 2015.
- 3) Review draft and final versions of the technology report document.
- 4) Review and approve the technology demonstration fact sheet.

## 6.0 DEMONSTRATION SCHEDULE

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This test plan will be conducted on or about 30 Mar – 3 Apr 2015. Results will be reported in a draft report by April 20, 2015. The final results will be documented in a Technology Demonstration Evaluation Report by May 13, 2015.

Major events associated with the Program of Action and Milestones (POAM) are contained below:

- 09 Jan:** Draft Test Plan completed and distributed to stakeholders (INL, SRNL, DOE EM-13)
- 16 Jan:** Obtain comments and revision from stakeholders (INL, SRNL, DOE EM-13)
- 21 Jan:** FIU issues final test plan
- 22 Jan:** Final decision on airborne particle counter and/or dust counter made and equipment ordered
- 23 Jan:** Alpha emitter point sources ordered
- 23 Jan:** Coordination to secure support from other FIU Departments with measuring coverage tests (eg: photo color differentiation software and weighing of coupons)
- 23 Jan:** Formal quotes for outsourcing flash point and burn rate tests received, decision made, and contract initiated
- 23 Jan:** Designs for 3 x test tents completed and approved
- 30 Jan:** Power requirements at hot cell mockup test site confirmed
- 6 Feb:** Materials for constructing test tents inside hot cell mockup purchased (eg: PVC pipe, plywood, fire retardant canvass, tape, ventilation materials (filters, hoses, etc), plastic coverings, clean up supplies, etc)
- 6 Feb:** Tools secured for modifying hot cell mockup
- 13 Feb:** INL representative(s) complete flight, hotel, and rental car reservations to Miami (if intent remains to participate)
- 13 Feb:** SRNL representative(s) complete flight, hotel, and rental car reservations to Miami (if intent remains to participate)
- 13 Feb:** INL ships determined quantities of FX2 agent (~25 gallons) and Dyna Fogger(s) plus associated components to FIU
- 20 Feb:** Hot cell mockup prepared and ready for test site modifications
- 20 Feb:** All other materials required for Test Plan execution secured / purchased (ie: Petri dishes, utility shelf, talcum powder, etc)

**27 Feb:** Coupon preparation for flash point and burn rate tests completed IAW company's established protocols and sent to company for tests, analysis, and test results

**6 Mar:** Hot cell modifications with tent constructed for Scenario 1 (baselining) completed

**13 Mar:** Frames for tents to support Scenarios 2 and 3 constructed

**13 Mar:** All training on instrumentation completed

**13 Mar:** ARC internal dress rehearsal / walk thru completed, issues identified (ie: identification of missing equipment, final approvals and paperwork, etc)

**30 Mar:** INL and SRNL representative(s) arrive Miami

**31 Mar:** ARC, INL, and SRNL dress rehearsal completed and issues identified and resolved

**1 Apr:** Day 1 of Testing – Objectives for Day 1 are completion of Test Objective 3.2 (Ignitability of FX2 Agent); Test Objective 3.4 (Shielding Against Alpha Emitter); and the first series (ie: Testing of FX2 in Geometry #1) of Test Objective 3.0.1

**2 Apr:** Day 2 of Testing – Objectives for Day 2 are completion of second series (ie: Testing of FX2 in Geometry #2) of Test Objective 3.1

**3 Apr:** Day 3 of Testing – Objectives for Day 3 are completion of third series (ie: Testing of FX2 in Geometry #3) of Test Objective 3.1

**4 Apr:** INL and SRNL participant(s) return

**6 Apr:** Test results and official reports on FX2 flash point and burn rate tests received

**20 Apr:** Draft report submitted for review

**13 May:** Final report submitted

## **7.0 DOCUMENTATION**

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The data generated by the demonstration as well as the information on the planning and conducting of the tests will be assembled and documented in a Technology Demonstration Evaluation Report. The report will summarize the tests, test results, and lessons learned and provide recommendations for further development. In addition, any changes to the test plan will require approval from the project manager and will be clearly documented and included in the Technology Demonstration Evaluation Report. Also FIU-ARC will develop a Technology Demonstration Fact Sheet.

All documents and technology information will be posted in the D&D Knowledge Management Information Tool (KM-IT).

## 8.0 HEALTH AND SAFETY

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All activities will be subject to general health and safety procedures established by FIU and ARC. Operators will perform all tasks in compliance with OSHA guidelines, obeying all personal protective equipment requirements. Potential hazards include exposure to the FX2 fogging agent and aerosol product, exposure to heat/flame during ignitability testing, slips on wet flooring, trip hazards, injuries due to broken glass or plastic parts, pinches or punctures while dealing with equipment, and possible back injury while moving heavy objects or equipment. Appropriate precautions will be taken to protect the health and safety of everyone involved in the demonstration. Any safety concerns that arise will be corrected in a timely manner. Access to the test area will be administratively controlled and briefings will be conducted with all site visitors to ensure that health and safety issues are understood and that safe practices will be followed during the course of the demonstration. Finally, if the RSO recommends and the RCC approves integration of the alpha emitter point sources, then all activities involving those sources will be conducted in strict accordance with the Radiation Safety Manual for the Department of Environmental Health & Safety & Risk Management Services. This department is located in room CSC 162, contact info: (305) 348-2621, [ehs@fiu.edu](mailto:ehs@fiu.edu)[www.fiu.edu/~ehs](http://www.fiu.edu/~ehs).

## 9.0 WASTE DISPOSITION

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Based on the project test plan, the only anticipated waste streams from the technology demonstration activities are non-regulated, non-hazardous solid wastes. The test site is a non-radiological area and therefore, any generated waste would not be classified as a radiological low-level waste. All solid waste generated in conjunction with this demonstration shall be disposed of in a manner that complies with local ordinances and environmental law. The management of any unanticipated solid waste will be in accordance with FIU waste management procedures.

That said, if the FIU RSO concurs with, and the FIU RCC approves, then the alpha point source emitter component will be integrated into the Test Plan as outlined in Section 3.4 above. In all instances, radioactive sealed sources will be disposed of in strict accordance with FIU's Radiation Waste Disposal policy, specified in the Radiation Safety Manual for the Department of Environmental Health & Safety & Risk Management Services. This department is located in room CSC 162, contact info: (305) 348-2621, [ehs@fiu.edu](mailto:ehs@fiu.edu) [www.fiu.edu/~ehs](http://www.fiu.edu/~ehs).

## 10.0 REFERENCES

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<http://www.inl.gov>
2. “Pilot Scale Advanced Fogging Demonstration Advanced Fogging Technologies – EM-13, INL/NNL Collaboration”, Rick Demmer, Don Fox, Kip Archibald, Idaho National Laboratory, Idaho Falls, Idaho
3. “National Labs Integrate Technologies to Trap Contaminants, Protect Workers”, Idaho National Laboratory News Release, November 15, 2012, Idaho Falls, Idaho
4. Radiation Safety Manual, Florida International University, April 2005, Miami, FL
5. Radiation Safety Manual for the Department of Environmental Health & Safety & Risk Management Services