A SPECIAL PURPOSE VEHICLE FOR RADIOLOGICAL EMERGENCY RESPONSE

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ABSTRACT

The scope of this paper encompasses the design and application of a Contamination Control Station (CCS) Response Vehicle. The vehicle is part of emergency response assets at the Department of Energy Pantex Plant, the nation's final assembly and disassembly point for nuclear weapons. The CCS Response Vehicle was designed to satisfy the need for a rapid deployment of equipment for the setup of a Contamination Control Station. This deployment may be either on the Pantex Plant site, or, if directed by the DOE Albuquerque Operations Office, to any location in the U.S. or worldwide to a site having radioactive contamination and needing response assets of this type. Based on the specialized nature of the vehicle and its mission, certain design criteria must be considered. The vehicle must be air transportable. This criteria alone poses size, weight, and material restrictions due to the transporting aircraft and temperature/pressure variations. This paper first focuses on the overall mission of the vehicle, then highlights some of the design considerations.

SCOPE

The scope of this paper encompasses the design and application of a Contamination Control Station (CCS) Response Vehicle. The vehicle was designed to support the Radiological Assistance Team at the Department of Energy Pantex Plant, the nation's final assembly and disassembly point for nuclear weapons.

BACKGROUND

Pantex Plant

The Pantex Plant, located about 18 miles northeast of downtown Amarillo, Texas, is managed and operated by Mason & Hanger- Silas Mason Co., Inc. The U.S. Department of Energy directs the operations of the facility and the approximately 3,100 workers employed at the site. The primary mission of Pantex is the assembly and disassembly of nuclear weapons. Secondary missions include the processing of high-explosives and mock-explosive components, interim storage of plutonium "pits", and the assembly of weapon-like devices for testing and training programs.[1]

Radiological Assistance Team (RAT)

The Pantex Radiological Assistance Team (RAT), consisting of approximately 70 responders, maintains capabilities to perform offsite and onsite monitoring and assessment as directed by the DOE Regional Coordinating Office in Albuquerque, NM. In addition, the RAT is responsive to the Department of Defense, Department of Energy, and Federal Emergency Management Agency (FEMA) tripartite agreement to support each other for world-wide response to nuclear weapons accidents. These capabilities must be flexible enough to support response throughout the full range of peacetime nuclear accidents offsite, to include those involving nuclear weapons, nuclear power reactors, transportation of radioactive materials, and nuclear medicine.[2]

In support of the above mentioned potential accidents, the RAT is trained to conduct several response activities. Among these activities include contamination control. A team consisting of approximately 15 RAT responders are trained in the setup and operation of a Contamination Control Station (CCS).

Contamination Control Station (CCS)

The Contamination Control Station (CCS) is the transition area between the contaminated zone and the clean zone of a radiological incident scene. The CCS is designed to control ingress and egress around the contaminated area, and to employ anti-contamination procedures to eliminate or reduce to an acceptable level (a) contamination of personnel and equipment operating in the controlled area, and (b) the spread of contamination to surrounding areas.[3] Operational procedures for the CCS must remain flexible to allow for variations in both terrain and the myriad of potential accident scenarios. A typical layout is shown in Figure 1.[4]

DESIGN CONSIDERATIONS

Purpose

The CCS Response Vehicle was designed to satisfy the need for a rapid deployment of equipment for the setup of a Contamination Control Station. This deployment may be either on the Pantex Plant site, or, if directed by the DOE Albuquerque Operations Office, to any location in the U.S. or worldwide to a site having radioactive contamination and needing response assets of this type. The external layout and interior plan of the CCS Response Vehicle is shown in Figure 2.

Application Overview

The CCS Response Vehicle remains in a stand-by mode, fully loaded and ready to respond at all times. When deployed to an accident involving radioactive contamination, the vehicle will proceed to a predetermined "safe" distance, upwind of the contamination source(s). This distance may vary, depending on the scenario and hazards involved. Equipment handlers, or "loadmasters", issue items directly from the Vehicle to CCS team members, who set up the contamination control station according to RAT CCS procedures. The CCS Response Vehicle must be able to transport equipment and materials to potentially anywhere on the globe. Thus, the vehicle must necessarily be designed as air transportable. Pursuant to DOE agreements with the Department of Defense, C-5A or C-141 aircraft would be provided for transport when requested for an exercise or actual deployment. The design specifications call for overall dimensions and gross weight commensurate with cargo capacity of the smaller C-141.

Equipment Requirements

In accordance with the typical setup shown in Figure 1, the following equipment is required and must be carried by the CCS Response Vehicle:

- 6 Ludlum Model 12 radiation monitors
- 6 Ludlum Model 2000 swipe counters
- 2 high volume air samplers
- 2 portable gas generators
- 2 10ft. x 20ft. portable awnings w/poles for CCS protection from sun and weather
- 4 rolls herculite ground covering; 54"W x 100 yds. each
- 50 complete sets of "Level C" anti-contamination suits
- 50 pocket ionization chambers and/or thermoluminescent dosimeters
- 6-12 folding 8 ft. tables
- 10 folding chairs
- 6 portable collapsible repositories for the doffing of personal protective equipment

Functional Description

Size & Loadability. In determining overall external dimensions of the vehicle, equipment requirements had to be evaluated against size and gross weight tonnage constraints of the transport aircraft. Typical projection limits and loading configuration are shown in Figure 3. Maximum vehicle overhand was determined empirically, using the load angle of standard ramp shoring for a C-141B. Because the highest point of the vehicle is behind the first wheel going up the ramp, the overall vehicle height can be no more than 102 inches.[5] The optimum overall dimensions were determined to be 280"L x 102"H x 94"W. This called for a vehicle similar in construction and appearance to a commercial ambulance. In order to manufacture a vehicle with this configuration, a specially designed box would have to be fabricated and joined to a standard vehicle chassis.

Chassis/Body. The chassis selected is a Chevy C3500 High Output with 4x2 drive and 6.5 liter turbo-diesel engine. With 180 horsepower at 3400 rpm, and 360 ft-lbs of peak torque at 1700 rpm, this model was determined to offer adequate power and capacity based on possible highway and unimproved road conditions, and a gross vehicle weight of 15,000 lbs.

Figure 1
CCS Layout

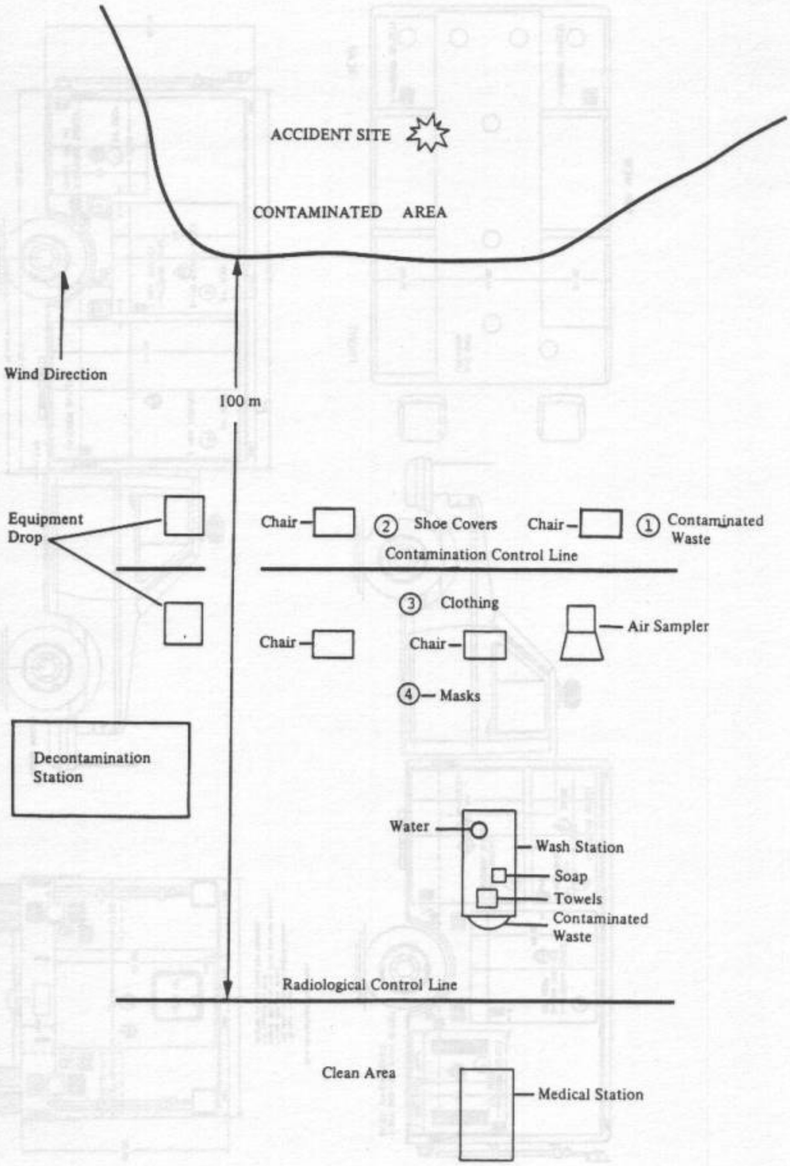

Figure 2
VEHICLE LAYOUT

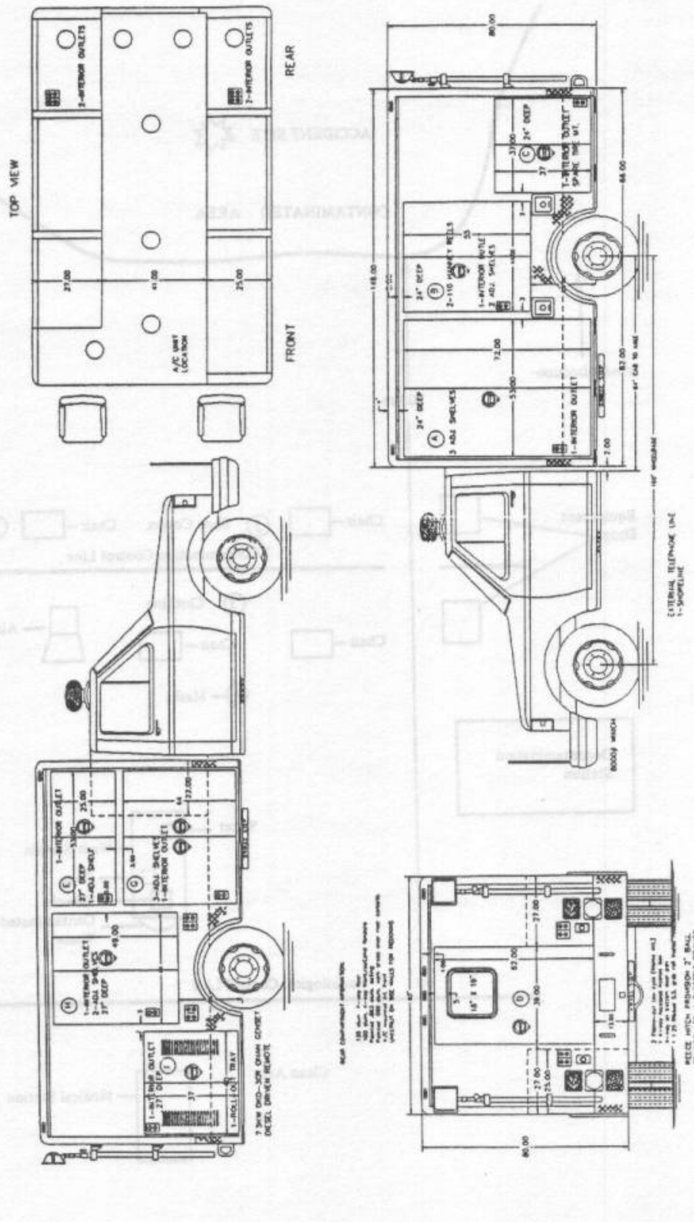

Figure 3

Projection Limits

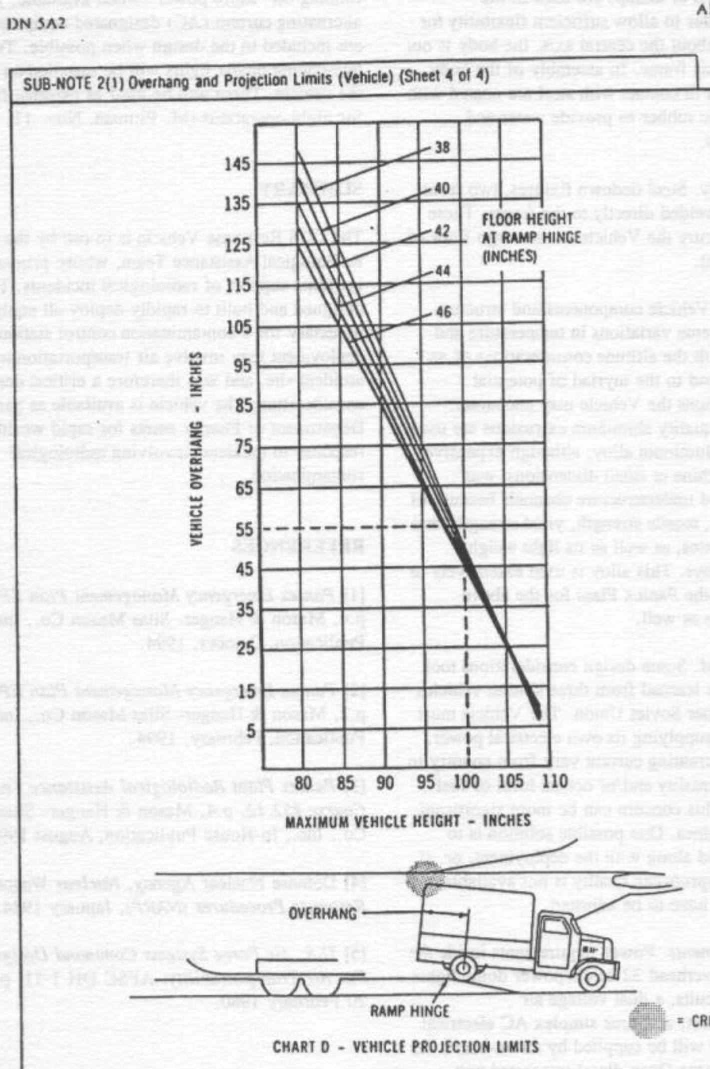

CHART D - VEHICLE PROJECTION LIMITS

Substructure. Structurally, the body is of bolted and welded construction. All parts of the body and attachments are fastened using rust-resistant fasteners in a manner precluding the loosening of any bolts or screws, and the cracking of welded joints. For this reason, no "U"-bolts or clamps are used in the construction. In order to allow sufficient flexibility for bending moments about the central axis, the body is not welded to the chassis frame. In assembly of the body, areas where steel is in contact with steel are coated with a modified synthetic rubber to provide water and corrosion resistance.

Transportability. Steel tiedown fixtures, two front and two rear, are welded directly to the frame. These are necessary to secure the Vehicle to the cargo floor of the transport aircraft.

Metallurgical. Vehicle components and structure must allow for extreme variations in temperature and pressure, due to both the altitude considerations of an airlift deployment and to the myriad of potential climates and conditions the Vehicle may encounter. Prime commercial quality aluminum extrusions are used throughout. 6061 aluminum alloy, although expensive and difficult to machine at small dimensions, was chosen for body and understructure channels because of its superior rigidity, tensile strength, yield strength, and ductility characteristics, as well as its light weight relative to other alloys. This alloy is used extensively in weapons tooling at the Pantex Plant for the above mentioned attributes as well.

Lessons Learned. Some design considerations took into account lessons learned from three similar vehicles supplied to the former Soviet Union. The Vehicle must have provision for supplying its own electrical power, as standards for alternating current vary from country to country. Also, the quality and/or octane level of fuel can vary as well. This concern can be more significant for turbo diesel engines. One possible solution is to have fuel transported along with the deployment, or, if diesel fuel of the appropriate quality is not available, vehicle timing may have to be adjusted.

Power Requirements. Power requirements inside the box include eight overhead 32 candlepower dome lights on two separate circuits, a dual voltage air conditioner/heater unit, and four simplex AC electrical outlet plugs. Power will be supplied by an on-board 7.5 KW, 60 Hz, one-phase Onan diesel integrated unit generator. The generator must be capable of supplying all required electrical power with the vehicle engine turned off. The unit is mounted on roll-out glides for access to maintenance points and to reduce noise inside the vehicle. Additionally, an external 110/120v receptacle is placed at the rear of the vehicle to enable running on "shore power" when available. Therefore, alternating current (AC) designated equipment and lights are included in the design when possible. Two telescoping quartz lights will be installed on the rear of the vehicle. These will be used as external floodlights for night operations (M. Pittman, Nov. 11, 1994).

SUMMARY

The CCS Response Vehicle is in use by the Pantex Radiological Assistance Team, whose primary mission is offsite support of radiological incidents. The unit was designed and built to rapidly deploy all equipment necessary for a contamination control station. This deployment may involve air transportation to the accident site, and was therefore a critical design consideration. The vehicle is available as part of Department of Energy assets for rapid worldwide response to incidents involving radiological contamination.

REFERENCES

[1] *Pantex Emergency Management Plan EPP-1000*, p.4, Mason & Hanger- Silas Mason Co., Inc., In-House Publication, October, 1994.

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[4] Defense Nuclear Agency, *Nuclear Weapon Accident Response Procedures (NARP)*, January 1984.

[5] *U.S. Air Force Systems Command Design Handbook For Air Transportability*: AFSC DH 1-11, p. DN5A2-6, 20 February 1980.