NRC FORM 313
(10-87)
10 CFR 30, 32, 33, 34, 35 and 40

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED BY OMB 3150-0120
Expires: 6-30-89

APPLICATION FOR MATERIAL LICENSE

030-30885

INSTRUCTIONS: SEE THE APPROPRIATE LICENSE APPLICATION GUIDE FOR DETAILED INSTRUCTIONS FOR COMPLETING APPLICATION. SEND TWO COPIES OF THE ENTIRE COMPLETED APPLICATION TO THE NRC OFFICE SPECIFIED BELOW.

APPLICATIONS FOR DISTRIBUTION OF EXEMPT PRODUCTS FILE APPLICATIONS WITH:

U.S. NUCLEAR REGULATORY COMMISSION
DIVISION OF FUEL CYCLE AND MATERIAL SAFETY, NMSS
WASHINGTON, DC 20555

ALL OTHER PERSONS FILE APPLICATIONS AS FOLLOWS. IF YOU ARE LOCATED IN:

CONNECTICUT, DELAWARE, DISTRICT OF COLUMBIA, MAINE, MARYLAND, MASSACHUSETTS, NEW HAMPSHIRE, NEW JERSEY, NEW YORK, PENNSYLVANIA, RHODE ISLAND, OR VERMONT, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION I
NUCLEAR MATERIALS SAFETY SECTION B
475 ALLENDALE ROAD
KING OF PRUSSIA, PA 19406

ALABAMA, FLORIDA, GEORGIA, KENTUCKY, MISSISSIPPI, NORTH CAROLINA, PUERTO RICO, SOUTH CAROLINA, TENNESSEE, VIRGINIA, VIRGIN ISLANDS, OR WEST VIRGINIA, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION II
NUCEAR MATERIALS SAFETY SECTION
101 MARIETTA STREET, SUITE 2900
ATLANTA, GA 30323

IF YOU ARE LOCATED IN:

ILLINOIS, INDIANA, IOWA, MICHIGAN, MINNESOTA, MISSOURI, OHIO, OR WISCONSIN, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION III
MATERIALS LICENSING SECTION
799 ROOSEVELT ROAD
GLEN ELLYN, IL 60137

ARKANSAS, COLORADO, IDAHO, KANSAS, LOUISIANA, MONTANA, NEBRASKA, NEW MEXICO, NORTH DAKOTA, OKLAHOMA, SOUTH DAKOTA, TEXAS, UTAH, OR WYOMING, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION IV
MATERIAL RADIATION PROTECTION SECTION
611 RYAN PLAZA DRIVE, SUITE 1000
ARLINGTON, TX 76011

ALASKA, ARIZONA, CALIFORNIA, HAWAII, NEVADA, OREGON, WASHINGTON, AND U.S. TERRITORIES AND POSSESSIONS IN THE PACIFIC, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION V
NUCLEAR MATERIALS SAFETY SECTION
1450 MARIA LANE, SUITE 210
WALNUT CREEK, CA 94596

PERSONS LOCATED IN AGREEMENT STATES SEND APPLICATIONS TO THE U.S. NUCLEAR REGULATORY COMMISSION ONLY IF THEY WISH TO POSSESS AND USE LICENSED MATERIAL IN STATES SUBJECT TO U.S. NUCLEAR REGULATORY COMMISSION JURISDICTION.

1. THIS IS AN APPLICATION FOR *(Check appropriate item)*

- [ ] A. NEW LICENSE
- [X] B. AMENDMENT TO LICENSE NUMBER 29-13141-05
- [ ] C. RENEWAL OF LICENSE NUMBER ____

2. NAME AND MAILING ADDRESS OF APPLICANT *(Include Zip Code)*

Department of Transportation
Federal Aviation Administration
Technical Center, ACT-360, Bldg. 210
Atlantic City, NJ 08405

3. ADDRESS(ES) WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED.

In baggage or cargo handling ramp areas at airports.

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION: P. Ryge/C. Seher

TELEPHONE NUMBER: 408-727-0607/ 609-484-6787

SUBMIT ITEMS 5 THROUGH 11 ON 8½ x 11" PAPER. THE TYPE AND SCOPE OF INFORMATION TO BE PROVIDED IS DESCRIBED IN THE LICENSE APPLICATION GUIDE.

5. RADIOACTIVE MATERIAL
a. Element and mass number, b. chemical and/or physical form, and c. maximum amount which will be possessed at any one time.

6. PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED.

7. INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING AND EXPERIENCE.

8. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS.

9. FACILITIES AND EQUIPMENT.

10. RADIATION SAFETY PROGRAM.

11. WASTE MANAGEMENT.

12. LICENSEE FEES *(See 10 CFR 170 and Section 170.31)*
FEE CATEGORY | AMOUNT ENCLOSED $

13. CERTIFICATION. *(Must be completed by applicant)* THE APPLICANT UNDERSTANDS THAT ALL STATEMENTS AND REPRESENTATIONS MADE IN THIS APPLICATION ARE BINDING UPON THE APPLICANT.

THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATION ON BEHALF OF THE APPLICANT, NAMED IN ITEM 2, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PARTS 30, 32, 33, 34, 35, AND 40 AND THAT ALL INFORMATION CONTAINED HEREIN, IS TRUE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF.

WARNING: 18 U.S.C. SECTION 1001 ACT OF JUNE 25, 1948, 62 STAT. 749 MAKES IT A CRIMINAL OFFENSE TO MAKE A WILLFULLY FALSE STATEMENT OR REPRESENTATION TO ANY DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANY MATTER WITHIN ITS JURISDICTION.

SIGNATURE—CERTIFYING OFFICER	TYPED/PRINTED NAME	TITLE	DATE
[signature]	Chris Seher	Contracting Officer – Technical Representative	4/19/89

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29-13141-05 PDR

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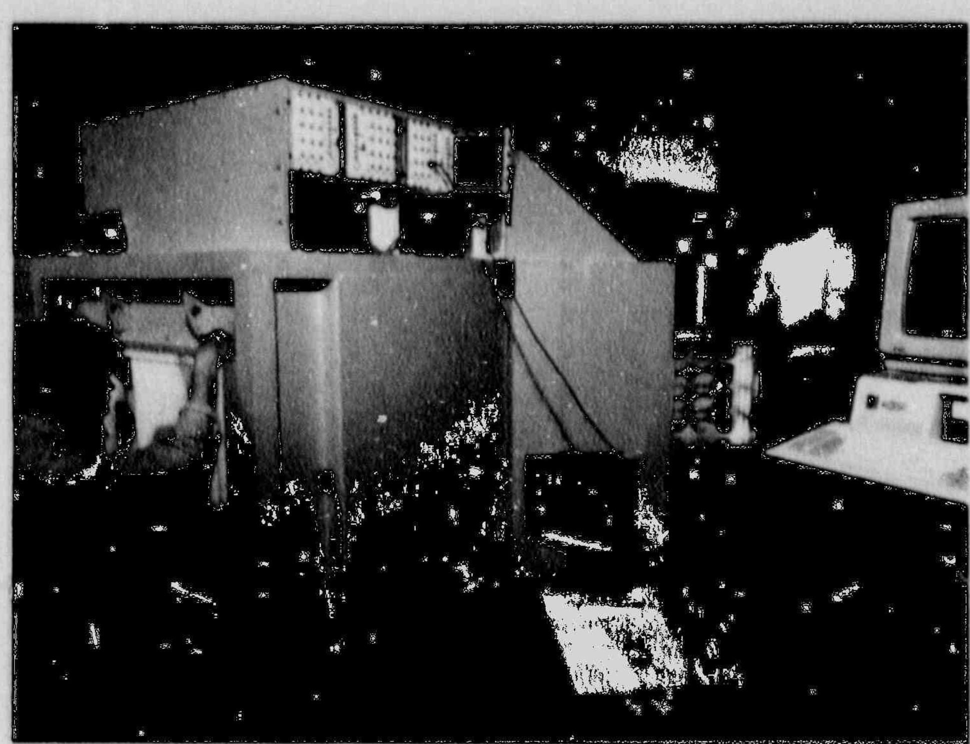
APR 20 1989

Science Applications International Corporation

SAIC Special Report

March 1989

Pan Am explosion focuses national attention on SAIC's Explosive Detection System



The latest SAIC SNOOPE system in production. *When prototype explosive detection systems were tested at both San Francisco and Los Angeles International Airports, they scanned approximately 40,000 pieces of luggage with 95 percent accuracy. The new systems currently under construction (above) will be considerably streamlined yet will offer even higher accuracy.*

In the wake of the December 21 bombing of Pan Am Flight 103 over Scotland, SAIC has been besieged by phone calls asking for information on the company's explosive detection system. The highly accurate system can detect all known explosives including the kind of plastic explosive that investigators believe blew apart the Pan Am Boeing 747 at 31,000 feet.

Among the callers were magazines such as *Science, Newsweek, Time,* and *Business Week*; newspapers such as *The New York Times,* the *Los Angeles Times,* and *The Washington Post*; as well as newspapers in Canada and England. The four major U.S. television networks (ABC, CBS, NBC and KPBS) as well as a Dutch television station also interviewed SAIC personnel in the Santa Clara and San Diego offices.

Earlier last year, the Federal Aviation Administration had ordered five SAIC explosive detection systems

Los Angeles Times

December 31, 1988

Science Applications Agrees to Rush Production of Bomb Detector at FAA's Request

The FAA has funded research that could lead to other detection technologies, but "this is the one that really looks good," according to Tim Neale, a spokesman for the Airline Transport Assn. (ATA), a Washington, D.C.-based trade group. "They're far enough along in development that we can expect to see them in airports fairly soon."

SAIC's unit is "extremely effective in detecting all types of explosives in quantities large enough to severely damage an aircraft," Neale said. "We're encouraging the FAA to move them as quickly as possible into airports in Europe and the Middle East where the risk is higher."

The Washington Post

DECEMBER 24, 1988

Airlines Have Few Means To Find Plastic Explosives

Airlines have no reliable method of detecting plastic explosives in luggage, but the Federal Aviation Administration has done tests proving that a new device could do the job, experts said yesterday.

The new device represents the first large advance in practical detectors. It can reliably spot explosives because its beams of neutrons can pass through any material, including lead, almost as if it were not there.

Lee Grodzins, a professor of physics at the Massachusetts Institute of Technology and an FAA consultant on the detection of explosives, said the device is by far the best ever developed for airport detection and it is nearly ready to be put into practical use.

Reprinted with permission from
The Washington Post

under an $8.3-million contract. The contract also included a one-year operation and maintenance agreement for the systems which are called SNOOPE (System for Nuclear Observation of Possible Explosives).

Following the disaster of Pan Am Flight 103, the FAA directed SAIC to add a sixth unit to the contract and to speed up its delivery date by several months. The FAA also has an option for an additional four units (using a different neutron source).

According to Tsahi Gozani, who manages the Santa Clara operation, the Santa Clara facility is busy readjusting itself to the high production, testing, and operation entailed by the accelerated FAA order. Production manager Russell Cole added that further expansion of SNOOPE production is being studied to meet a possible increase in demands for the machines.

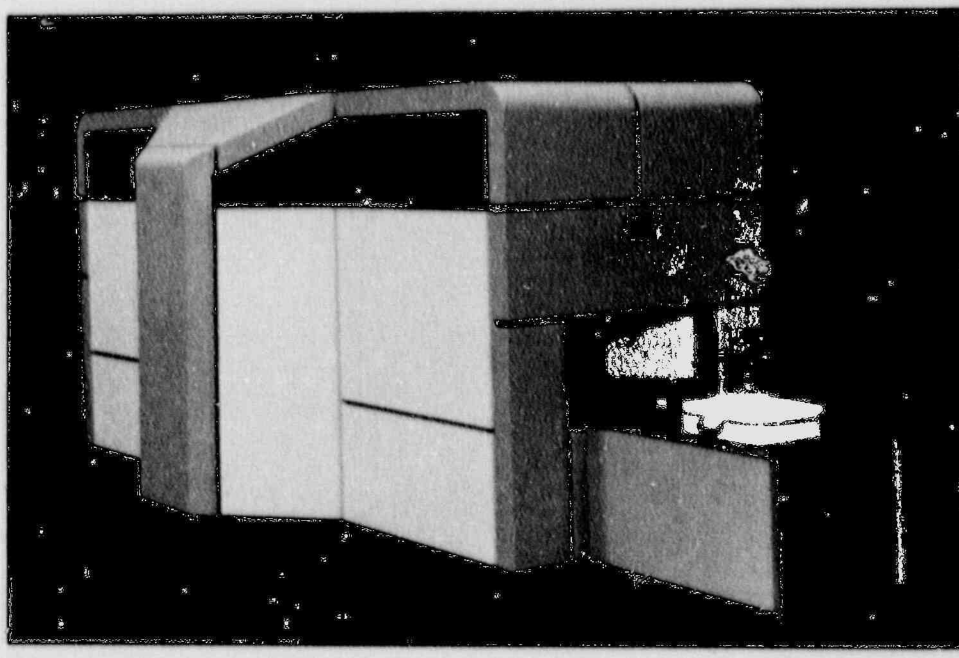
The FAA placed the original order following months of testing at San Francisco and Los Angeles International Airports. During the tests, approximately 40,000 pieces of luggage (containing a wide variety of simulated explosives) were scanned by two prototype systems which proved 95 percent effective, according to Gozani.

In Washington interviews, several FAA spokespersons confirmed that the performance of the SNOOPE system met all FAA requirements and that no other available device, including X-ray and vapor detection ("SNIFFER") systems, can detect all plastic explosives concealed in luggage.

Hadi Bozorgmanesh, who performs marketing for many SAIC high-technology products including the explosive detection system, explained why this was so. "The X-ray systems we have now were really designed to detect guns. At the time they installed those machines, that was the nature of the threat," he said. "The threat has changed to the plastic type of explosive, which can be modeled in any shape."

Bozorgmanesh said that North Korean terrorists downed a South Korean jetliner last year with explosives disguised in a portable radio and in bottles of liquor that passed both X-ray and visual inspections.

The explosives are called plastic not because they are made of that



The new production model of SNOOPE. *Fully-automated explosive detection systems can scan 600 pieces of luggage an hour (about the same rate as an X-ray machine). In other words, they can scan the luggage for an entire Boeing 747 in less than an hour.*

material but because they are soft and pliable like putty (allowing them to be shaped into innocuous appearing items.) Plastic explosives escape X-ray detection because they are composed of light elements such as nitrogen, carbon, hydrogen, and oxygen — the same elements that comprise clothes, water, and other organic substances found in luggage.

Virtually all modern military and commercial explosives contain unusually large amounts of nitrogen and SAIC's system takes advantage of that fact.

Virtually all modern military and commercial explosives contain unusually large amounts of nitrogen and SAIC's system takes advantage of that fact. The device, which uses thermal neutron activation technology, bombards the luggage with a beam of very low energy ("thermal") neutrons that pass easily through metals and other heavy materials. But some of these neutrons are absorbed by some light elements such as nitrogen and hydrogen. After absorbing the neutrons, the nitrogen and hydrogen nuclei emit gamma radiation in signatures that are unique to each element.

The amount of radiation used is small and the safety of the technology has been confirmed by both the Nuclear Regulatory Commission and the California Department of Health Services.

Like the prototypes that SAIC built, the new systems will also be fully automated and able to scan 600 pieces of luggage an hour (about the same rate as an X-ray machine). Like one of the original prototypes, the six new systems will use californium as a neutron source and will be shaped in a "straight through" configuration. However, their appearance will be very different from either of the original two prototypes.

The experience gained in the construction and tests of these prototypes led to a considerable reduction in the size of the SNOOPE to about 13 feet long, 6 feet high, and 7-1/2 feet at its widest point.

According to Gozani, the company began developing its proprietary system in 1984 as part of an FAA-sponsored competition aimed at developing a technology for detecting plastic explosives. In 1985, the FAA funded SAIC's concept, and the company began a 20-month crash program that delivered two prototype machines in 1987.

Along with the Advanced Products & Systems Group, three other SAIC groups participated in the early phases of the program. These were COMSYSTEMS, the National Security Studies & Systems Group, and the Energy Systems Group.

Two patents are currently pending on the SAIC systems.

Report on SAIC device presented to Senate Subcommittee

The best available technology for detecting compact, professionally-made plastic bombs is a security device called the Thermal Neutron Analyzer (TNA). So said Transportation Secretary Samuel Skinner at a March 14 Senate Subcommittee hearing.

The Federal Aviation Administration has asked SAIC to speed the delivery of the devices (called SNOOPE by the company). Skinner and the FAA hope the first one can be installed at John F. Kennedy Airport in New York by June.

The FAA has already ordered six of the TNA devices. However, Skinner acknowledged that to be truly effective TNA devices will have to be installed at every major U.S. and foreign airport.

The New York Times

December 25, 1988

New Devices May Stop More Bombs At the Gate

While investigators were still trying to determine what caused Pan American World Airways Flight 103 to explode over a Scottish village last week, killing at least 275 people, the suspicion of sabotage gave fresh impetus to the search for ways to keep terrorists from endangering the skies.

Metal detectors, X-ray machines and beefed up security have made airports less hospitable to hijackers in recent years. But passenger planes remain vulnerable to explosives, whether hidden inside suitcases or other cargo, or underneath a passenger's clothing. New technology aimed at detecting such threats is now being developed, however, and could be in routine use at airports within a few years, counterterrorism experts said.

The work being financed by the Federal Aviation Administration is taking a different approach. "We want the human being out of the loop," said Fred Farrar, an F.A.A. spokesman. "People get tired, people get distracted. Instead, we want to find a way to automatically set off an alarm any time a bomb is headed for a plane."

Two techniques show promise. The first is called thermal neutron activation, or TNA.

"We've tested TNA at two airports in San Francisco, and we're pleased with the results," said Mr. Farrar. Used on 40,000 pieces of luggage, the detection rate was 95 percent and the false alarm rate was 4 percent. Mr. Farrar said that the F.A.A. has issued a contract for five models that will be tested at five airports still to be picked. "We hope to improve TNA," he said, "and perhaps require airlines to buy it, possibly within the next five years."

The San Diego Union

December 30, 1988

S.D. Company to Provide 5 Machines For Use in Airports

Pat Cariseo, a spokesman for the FAA in Washington, D.C., said yesterday that the federal agency has not decided where the machines would be put into operation after Science Application International delivers them in July.

But a group that represents airport operators said it would make sense to install the first five devices at the U.S. airports that handle the most international flights. "That's where the threat is," said Tom Browne, director of technical services for the Airport Operators Council International.

Browne listed the airports in Los Angeles, San Francisco, Dallas, Washington, Chicago, Miami and New York as logical candidates.

"Certainly in the long run, all of those airports and maybe more need to have those devices," he said.

Written by R.B. Brenner, San Diego Union *Staff Writer.*
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The Christian Science Monitor

December 30, 1988

Experts See Future in New Bomb Detector

While X-ray machines are severely limited in keeping modern explosives off airliners, researchers say they have developed a device that can detect bombs inside luggage with uncanny regularity.

But no airline has ordered one of the devices, and with the exception of two prototype machines used in a yearlong test program in San Francisco and Los Angeles, no air[illegible]orts have put the machine into o[illegible]

The confir[illegible]nesday that a bomb deton[illegible]d a Pan Am jumbo jet last we[illegible] over Scotland is likely to spur interest in the new explosives detection device, industry officials say.

The machine is called Thermal Neutron Analysis device, or TNA, and is about twice the size of an airport X-ray machine. During the yearlong test under a contract from the Federal Aviation Administration it demonstrated a 95 percent detection rate with few false alarms, the agency says.

The FAA recently ordered five more TNAs at a cost of $8.4 million. The agency plans to put them into other United States airports beginning next summer.

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SAIC
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An Employee-Owned Company

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FAX: (408) 727-8748

EDS-3 DESCRIPTION AND FEATURES

DESCRIPTION

The attached figures show the EDS-3 explosive detection system. Fig. 1 shows the system assembled in perspective. The mechanical structure is made of aluminum channels and beams welded together, with a welded on outer shell of 3/16" aluminum. Aluminum is chosen because of its relatively low production of activation gamma rays compared to other practical choices such as steel. It is then filled with shielding which is cast in place. The structure is built in three modular sections to facilitate transportation; they are tied together at installation.

Fig. 2 shows the dimensions of the system, while Figs. 3 and 4 show the shielding configuration.

The Cf-252 source is located in a moderator assembly containing deuterium oxide (heavy water) and heavy metal for shielding against the direct gamma rays from the source. An outer skin, not shown on the section drawings, covers the entire system for cosmetic purposes. The space between the top of the end shielding and the top skin is occupied by electronics and cooling equipment.

The neutron shielding is paraffin loaded with boric acid. A proprietary process involving extremely fine crushing of the boric acid is used to reduce the tendency to settle during the casting process; tests have shown that settling does not occur. The blocks of detectors contain scintillator crystals with their photomultiplier tubes which are mostly void for shielding purposes. There is 16" minimum of shielding between the detectors and the outside.

The space above and below the ends of the baggage cavity contains detector electronics, the system computer, electronics cooling equipment, electric distribution components and conveyor belt motor and pulleys.

Three swinging panels of borated polyethylene and lead in each end of the system attenuate the radiation out the ends of the baggage passage. The end panels are 4" thick and swing about vertical axes with return springs, like Western saloon doors. The four inner panels hang from a horizontal pivot with a cam spring arrangement which allows them to be pushed up easily by the baggage. If the spring mechanism were to fail, it would most likely fail in the closed position because of the weight of the panels. Individual position sensors for each panel are coupled to a light indicating panel which shows that the doors are closing in the absence of baggage.

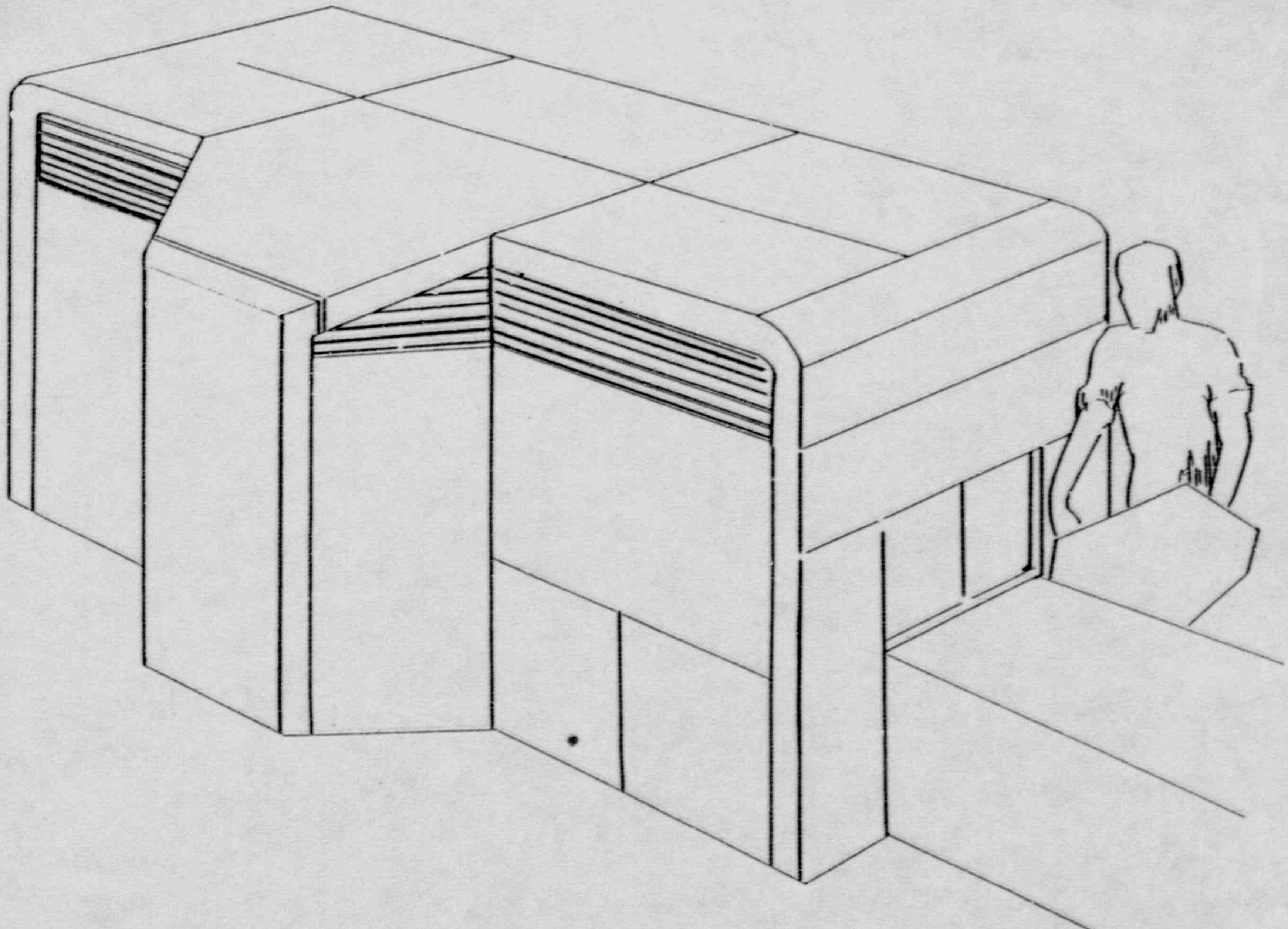


Figure 1. EDS-3 Perspective View

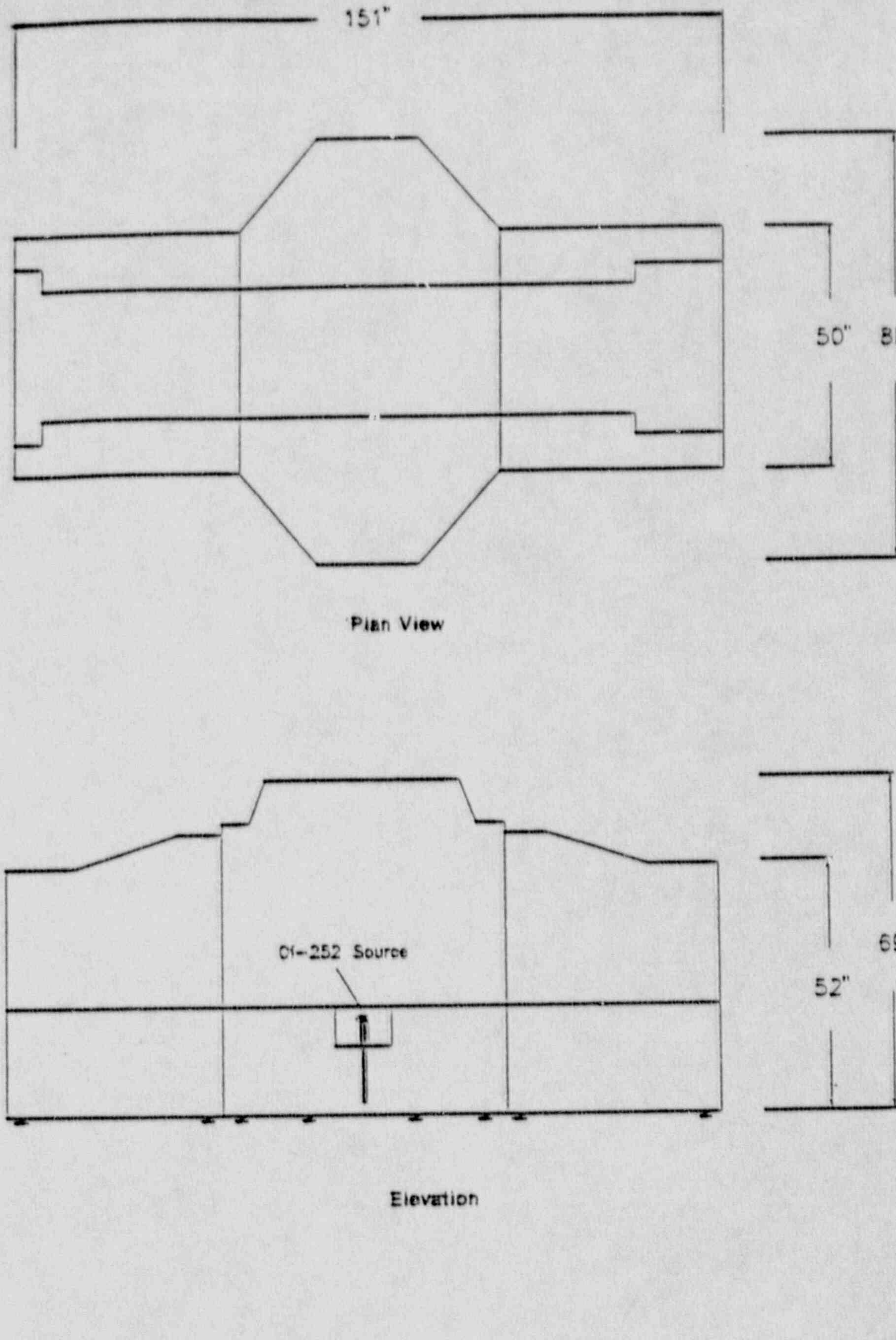
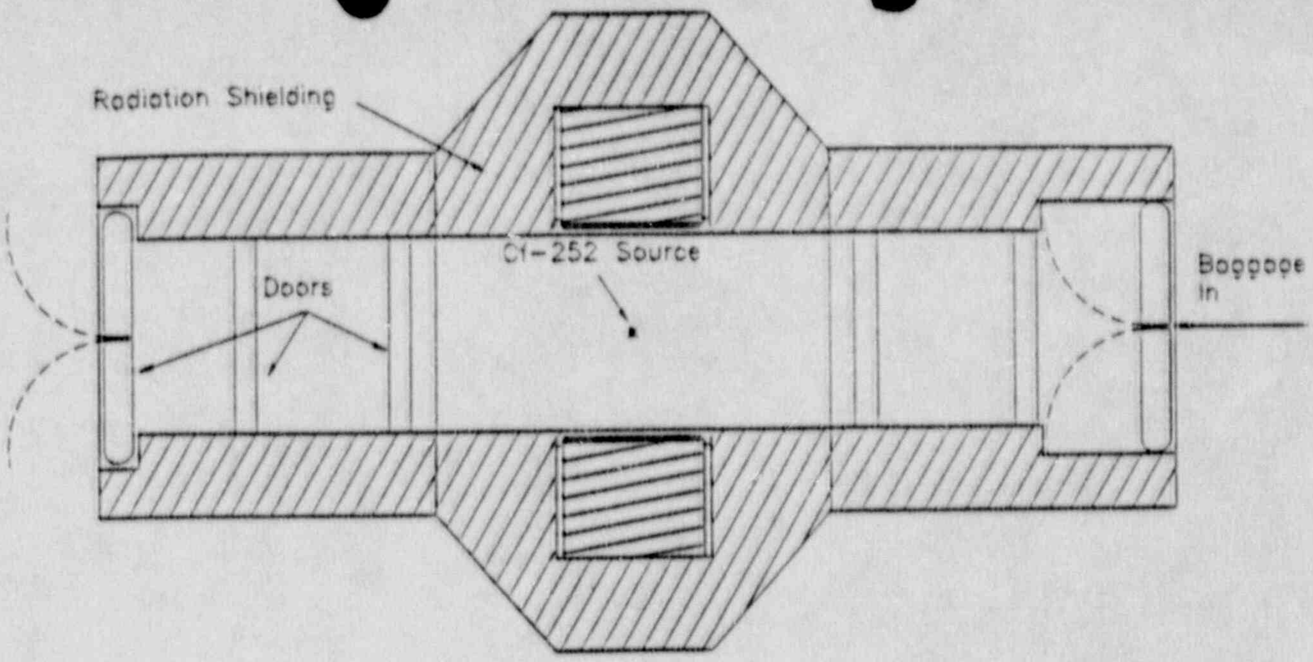
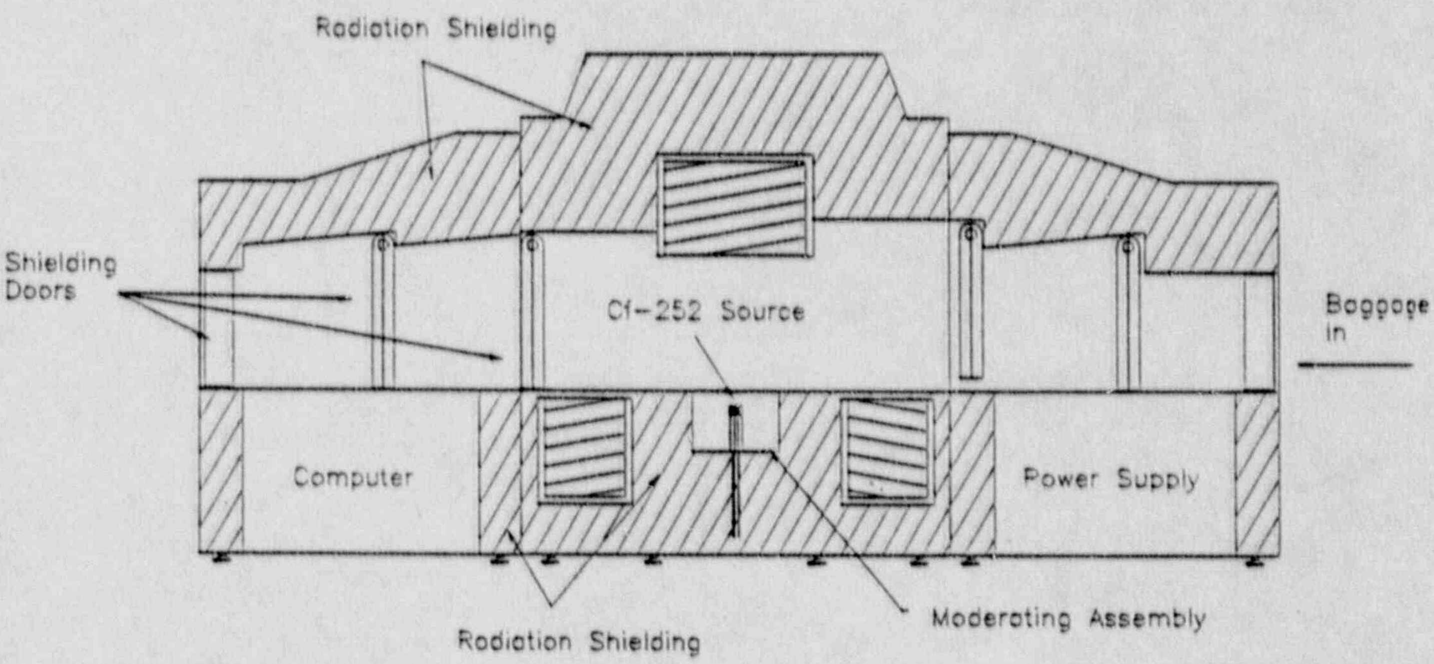


Figure 2. Dimensions of EDS-3

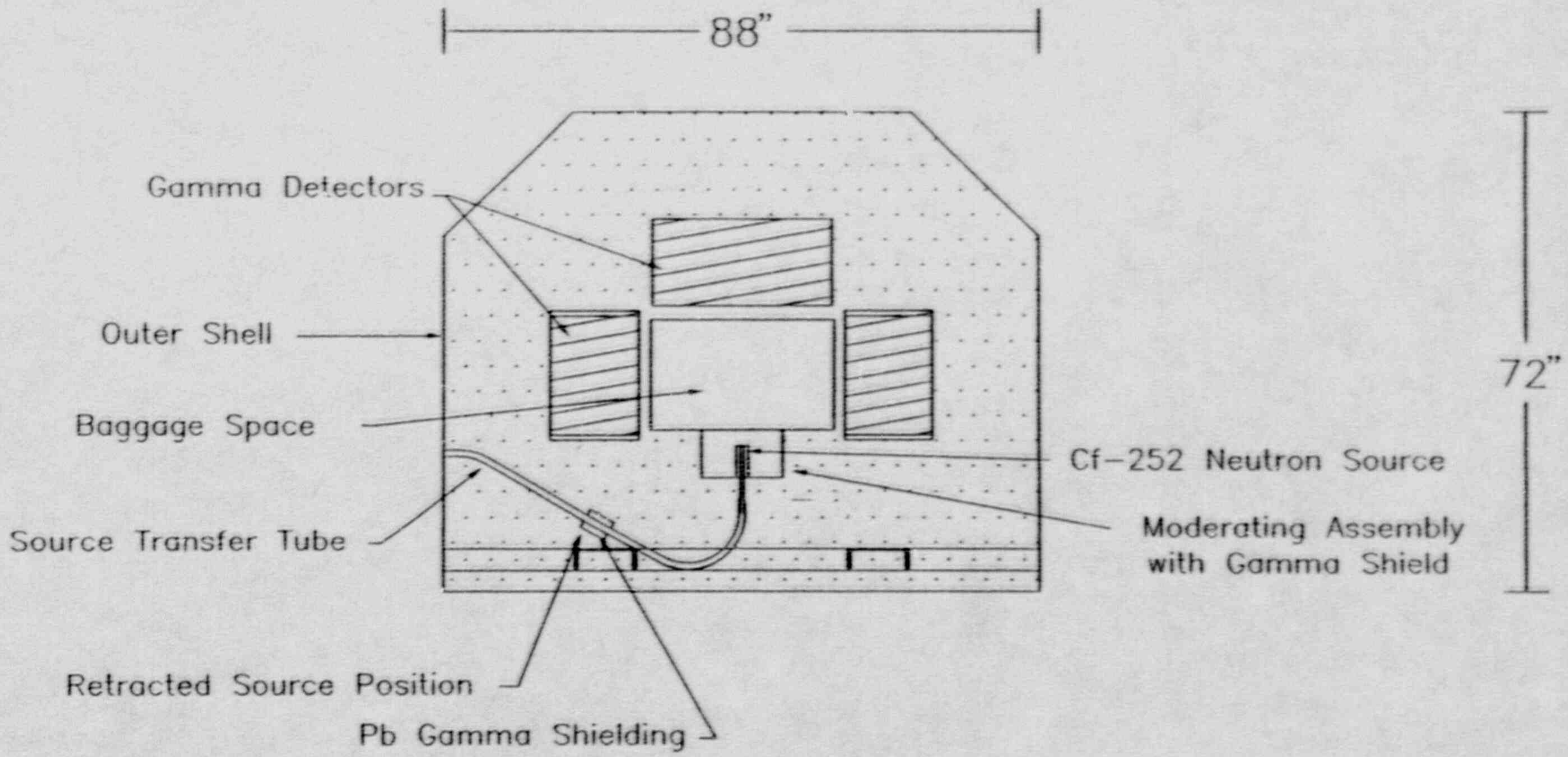


Plan View



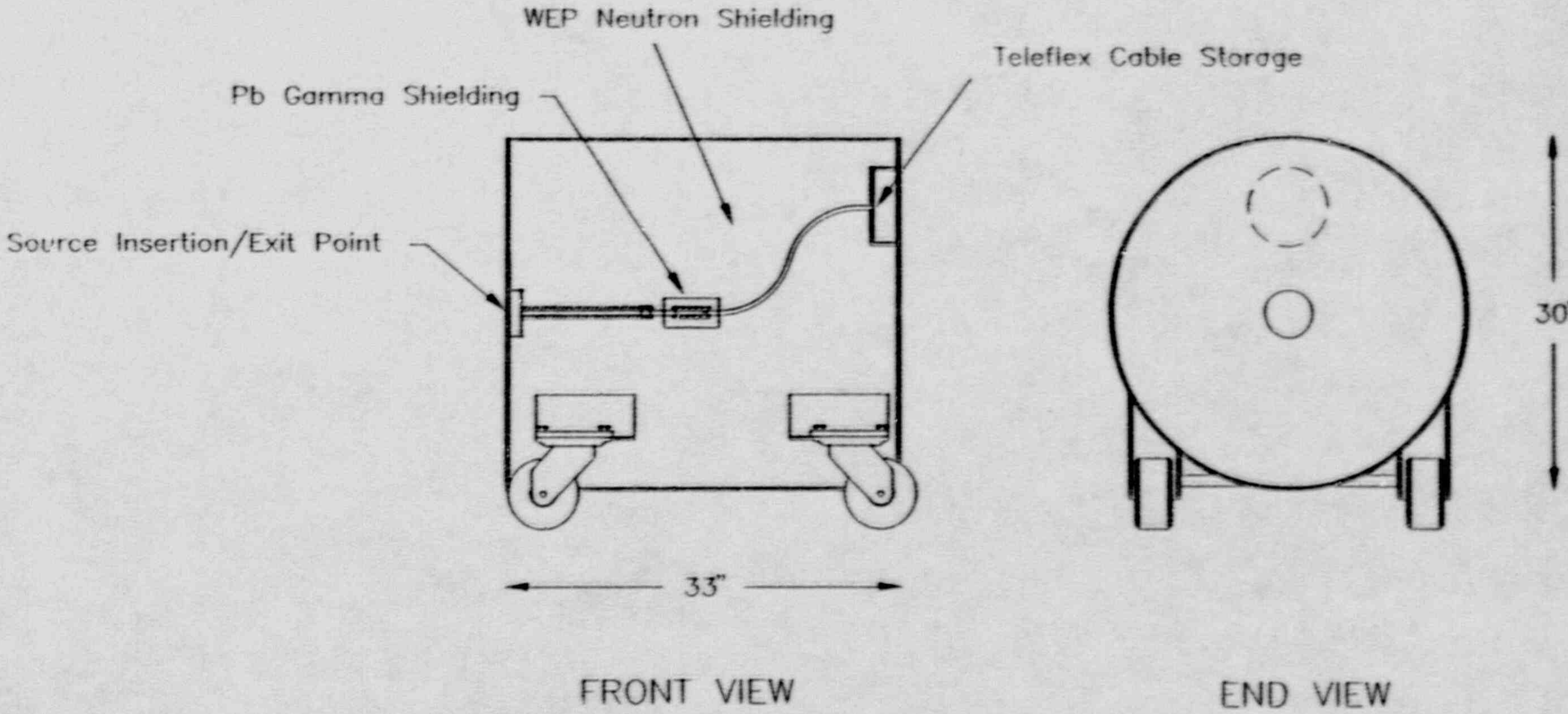
Elevation

Figure 3. Lengthwise Section of EDS-3



Cross Section of EDS-3 at Source

Figure 4



EDS-3 Source Transport Cask

Figure 5

The source is mounted on the end of a Teleflex cable, screwed on and held by thread locking compound. The cable is a little less than 0.2" in diameter and the source and mounting adapter about 0.37". The source can be withdrawn manually to a retracted position for lower radiation levels in the baggage cavity to be sued for in-cavity maintenance, baggage unjamming, etc.

SOURCE TRANSPORT AND INSTALLATION

The source transport cask, see Fig. 5, is constructed of steel, welded together and filled with a composite neutron/gamma ray shield based on water-extended polyester (WEP) with lead around the source position. It is 30 inches in diameter and 33 inches long. It is certified DOT-7A.

For source transfer between the cask and the system, a specially made platform with a ramp is attached by bolts to the side of the system. Its location is referenced to the outside end of the source transfer tube. A polyethylene adapter with a conical hole and which fits into a recess in the end of the cask is bolted on to the system for transfer. The cask is rolled onto the platform, and locked in position against the side of the system, engaging the adapter with the cask recess. The source is then transferred by pushing on the teleflex cable. After the source is in the system and the cask and transfer adapter removed, the flexible plastic tube is inserted over the cable and clamped in place. Its inner diameter is slighly more than the cable diameter but less than the source diameter. It is made to a length which just reaches the "retracted source position" and it thus serves as a stop to prevent the source from being retracted too far.

SAFETY FEATURES

o Security

The outer shield doors will be key locked in the closed position when the system is unattended. These doors are interlocked so that if the system operator removes his computer system key without first locking the shield doors, an audible alarm goes off as a reminder.

A locked panel covers the access to the Teleflex cable to which the source is mounted. Tamper indicating tape or paint will be used to identify attempted tampering.

o Baggage Activation Monitor

A baggage activation monitoring system checks for excessive gamma ray emissions from baggage which may have been activated by passing through the system. It uses a commercial "area monitor" electronics package with special long detectors with a lead collimator open toward the baggage. The exact detector position may vary from one installation to another depending on the details of the installation, e.g. whether the EDS-3 conveyor belt is coupled to another baggage conveyor, baggage divertor, or X-ray system.

The activation monitor has a radiation level threshold and is equipped with a visible and/or audible indicator. It will also be coupled to the means used to designate suspected explosive containing bags to ensure that the radiation level is checked with a survey meter before release for flight. In presently contemplated installations, a mechanical divertor will push explosive suspect and activation alarm bags off the conveyor to an inspection platform for clearance.

o Signs

A permanent "Radioactive Material" sign with isotope identification and dated strength information is located at the locked panel which must be opened to get access to the source cable so that anyone attempting to manipulate the source will see it. This sign will not be visible until the outer skin panel is removed.

"Radiation Area" signs at the entrance and exit warn anyone attempting to pass into the baggage passage.

SOURCE DISPOSAL

The useful life of the source is one to two years, after which time it will be replaced. The expended source will be reused in another application for which its strength is adequate or returned to the source supplier for recycling.

COMPARISON OF EDS-3 DEVICE WITH EDS-2

The SAIC EDS-3 explosive detection system is similar to the EDS-2 (which is a one-of-a-kind prototype) with respect to radiation safety, but there are significant differences. The following is to highlight some of these similarities and differences.

1. EDS-3 has one source (150 micrograms) compared with two in EDS-2 (total of 340 micrograms).

2. EDS-3 is substantially smaller, estimated at less than 1/4 the weight of EDS-2, and is made up of 3 rather than 14 structural modules.

3. Neutron activation of baggage: The moderator in EDS-3 is more efficient, yielding about 40% more thermal neutrons per source neutron than EDS-2, but about the same number of fast neutrons per source position. The conveyor belt moves slightly faster in EDS-3. The single source in EDS-3 is on the bottom, whereas EDS-2 has one on top and one on the bottom. The net effect is that baggage activation is less for EDS-3 by an estimated 30-40%.

4. EDS-3 has a single straight conveyor belt rather than the 180° turns. Based on experience, it will be _far_ less prone to baggage jamming. (In the straight through prototype test of about 20,000 bags, only one jam occurred and it was due to forced loading of a too-tall bag.) For this reason, source retraction is not automatic, but will be done manually when required. There is no foreseen condition or routine maintenance, except preventive maintenance of the panel operating mechanism, which will require personnel to enter the baggage passage. Manual source retraction or transfer to the shipping cask will be done in the event it is required.

5. EDS-3 has counter-sprung pivoting shielding panels to attenuate radiation through the baggage passage.

6. Registration is being requested for specific licensees, not for a custom user.

7. EDS-3 will have a baggage activation monitor system using two long detectors, one above and one below the baggage as it exits the system. EDS-2 had a one-detector system. EDS-3 will thus have more uniform detection sensitivity.

8. For EDS-3 source transfer between the shipping cask and the system, the cask will be brought into direct contact with the system so that the source is shielded at all times. In EDS-2 there was a one inch gap.

RESPONSES TO NRC LIST OF SAFETY ANALYSIS ITEMS
FOR EDS-3 SINGLE SOURCE EXPLOSIVE DETECTION SYSTEM

1. Fire Safety of EDS-3 Shielding

The neutron shielding in the EDS-3 is provided primarily by borated paraffin wax. It is contained in several welded aluminum modules. They are made of structural aluminum channel beams covered with 3/16" thick aluminum plate. The molten wax, blended with boron in the form of boric acid powder, is poured into the module through an opening which is subsequently closed by a welded aluminum cover. The wax is thus completely contained in heavy aluminum. The choice of aluminum is based on its relatively low production of gamma ray background.

The EDS-3 is made up of three shielding modules of various shapes weighing up to 8,000 lbs. each, allowing installation in pieces manageable by a forklift.

The wax used is Chevron Refined Wax 128. The "Material Safety Data Sheet," issued by the manufacturer in accordance with OSHA regulation 29CFR1910.1200, is the source of the following data:

Melting point:	129-131°F (53.9-55.0°C)
Flash point:	428°F (220°C)
Autoignition temperature:	644°F (340°C)

This means that if the wax is melted and heated to 428°F in air with a flame or other ignition source, it will burn. If heated to 644°F in air, it will ignite and burn on its own.

The EDS-3 does not contain heat sources capable of generating such temperatures. The detector heaters and electronics can reach at most 200°F. Thus any burning of the shielding paraffin would have to be due to external causes. It would require melting of the paraffin and rupturing of the heavy aluminum containment.

The californium source used in the EDS-3 is a registered sealed source, double-encapsulated in welded zirconium, and special form certified. As such, it has an 800°C fire rating and would be affected only by an exceptionally hot fire.

Airports are operated with great concern for fire protection, with a separate fire department for the airport. Airports are well equipped with sprinklers, alarms, fire extinguishers, and so on, so that small fires (cigarettes, etc.) do not develop into big fires. The case of a severe fire, such as due to an aircraft hitting the terminal, was analyzed in the SAIC

Environmental Report, pages 61-62; the consequences were included in the NRC Environmental Assessment.

2. The Teleflex cable which controls the position of the source is behind a screwed on access panel. The cable is held in place by a locking bracket which is retained in place by a keyed padlock. In case of tampering, the lock would have to be cut, readily revealing that tampering had taken place. The access panel is hidden behind large decorative panels which cover the back of the system except during source handling activities.

3. The heavy water in the moderator is contained in a welded polypropylene container with an O-ring gasketed Zircalloy cover which will be carefully checked against leaks and is well protected against damaging forces, being behind the main shielding. However, leakage and loss of heavy water could in principle take place.

Tests without the heavy water showed that the gamma ray spectra were considerably altered, in a way which would cause the system diagnostic software to show a fault. The external radiation levels would increase due to complete loss of the heavy water by approximately a factor of four, a significant increase but not acutely hazardous, less than about 2 mrem/hr at the surface in the highest locations.

4. Individuals working immediately around the Explosive Detection System (EDS) are the crew consisting of one highly qualified and trained SAIC operator who supervises operation, and usually two baggage handlers who load and unload baggage to be inspected. The supervisor is responsible for compliance with radiation safety procedures and is the only one to have access to the source. The system is expected to operate 16 hours per day, seven days a week and so will be staffed by three such crews over the course of a week.

The training of the supervising operators includes the following:

- Physics of radiation and interaction with matter
- Biological effects of radiation
- Use of radiation survey meters
- Radiation protection guides
- Radiation safety operating procedures for the EDS (see attached "Radiation Safety Operating Procedures for

Prototype EDS"), including:

Source transfer between the EDS and the transport cask

Baggage activation monitor system procedure
Maintenance procedures

Leak test procedure

Emergency procedures

The baggage handlers will be trained in basic introductory radiation safety information. They will also get relevant training specific to the EDS such as the hazards of entering the system.

5. Periodic wipe tests (same schedule as the source leak tests) will be taken of the EDS-3 at the exit end and on the belt to find any possible contamination due to long term activation of the belt or debris adhering to it.

Further wipes around the area of the system would not be meaningful because there might well be contamination due to other causes since radio-pharmaceuticals are regularly carried as baggage or cargo on passenger aircraft; any contamination found there but with no finding in or on the system itself would be at best ambiguous.

6. A call list of FAA and/or SAIC emergency personnel near the airport and of relevant local, state and federal agencies will be posted at the system location.

7. The system operator can easily tell by direct visual observation whether the outer doors are operating. Operation of the inner panels can be verified by observing the indicator light panel.

The measured dose rates show that the failure of one door to close results in only a slight increase in dose rates; see dose rate information supplied. Even with all panels open at one end, the external dose rate moderate increase.

The design of the shield panels is such that a failure of the return mechanism of the four internal panels would most likely result in swinging to the closed position, since the most likely failure is breaking of the linkage transmitting the 400 pound force required to hold the panel open.

8. A copy of the operating procedures is attached.

9. A radiation survey of the EDS-3 is to be performed at the manufacturer's facility at initial assembly and after each field installation. The factory survey is compared with the survey at the installation site to identify abnormal readings to assure that the cast shielding has no voids and that the shield modules are assembled without significant gaps.

10. The attached operating procedures include response to exit monitor alarms. An ion chamber survey meter is kept at the installation site to perform the required measurements.

EXAMINATION

RADIATION SAFETY COURSE

Part 1 Fill In   Fill in the blanks to complete the statement.

1. The atom consists of two parts: the positively charged ______________ and the orbital ____________.

2. Atoms with the same number of protons but different number of neutrons are called _______________.

3. Any material that spontaneously emits ionizing radiation is called _____________ material.

4. Ionizing radiation can be divided into two general types, ___________ and ______________.

5. The particle in the nucleus that has no electric charge is the ____________________.

Part 2 Matching   Match the following kinds of radiation with their description below.

a. Alpha particle
b. Gamma Ray
c. Positron
d. Beta particle
e. Neutron
f. X-ray

1. Has no electric charge and interacts with matter by elastic and inelastic scattering and by absorption.

2. Can be generated by a high voltage electrical machine; originates outside the nucleus.

3. A very small particle that has a single negative charge and that originates from the nucleus.

4. Very small particle that has a single positive charge and originates from the nucleus.

5. Large particle that has a double positive charge and consists of two protons and two neutrons.

6. Electromagnetic radiation that comes from the nucleus.

Part 3 True or False Indicate with a T or F whether the statement is true or false.

_____ 1. Ionization is the most significant form of radiation interaction with matter.

_____ 2. Scattering interaction is only caused by positrons.

_____ 3. Beta particles generally interact with matter by causing ionization.

_____ 4. Gamma Rays can cause both direct and indirect ionization.

_____ 5. Neutrons generally interact with matter by causing annihilation.

_____ 6. Rem is a measure of ionization electrostatic units in dry air.

_____ 7. Radioactive decay is a process by which atoms can lose excess energy.

_____ 8. Half life is the amount of time required for the radioactive material to decay to background.

_____ 9. The becquerel (Bq) is a measure of the number of radioactive atoms decaying in a given time period which is one disintegration per second (dps).

_____10. The sievert (Sv) is a measure of the biological dose and is equal to 100 rems.

Part 4 Multiple Choice Circle the letter of the answer which best completes the statement.

1. Radioactive materials emit energy which has the power to damage living tissue by:

   a. Inorganic annihilation
   b. Directly and indirectly altering the structure of the molecule.
   c. Genetically altering your nerve cells.
   d. First attacking the bones.

2. Genetic effects are caused by radiation which can:

   a. Affect a person's ability to reproduce.
   b. Cause cancer and leukemia.
   c. Cause birth defects or mutations.
   d. Cause major change in the white blood count.

3. A high dose of radiation up to 400 rem could cause:

   a. Almost no damage to the individual.

b. Nausea, fever, cancer, leukemia and early death.
c. Rapid hair growth.
d. Is being tested as a cure for the common cold.

4. A dose of 5 rem per year or 1.25 rem per calendar quarter:

a. Is the regulated limit for whole-body occupational exposure.
b. Five times the allowable exposure.
c. Is the permissible dose for pregnant women.
d. Is the LD 50 dose.

5. The somatic effects of radiation are:

a. Those that produce birth defects and mutations.
b. The technical terms for direct and indirect ionization of red blood cells.
c. Of very little importance in the study of radiation damage to the cell.
d. Those effects experienced directly by the individual and they can be either prompt or delayed.

6. The ALARA limits are:

a. One half the occupational exposure limits.
b. Thrice the occupational exposure limits.
c. As low as reasonably achievable limits.
d. 5 Rem per year.

7. When looking at the RISK of radiation exposure, high doses have been proven to be harmful. Concerning low dose levels:

a. It has been proven that there is no danger.
b. There is a 25% increased risk of getting cancer above the norm.
c. The National Academy of Sciences has predicted that an additional 2,500 out of each 10,000 people will develop cancer.
d. It is known that the effects are very small, in fact; it is possible that the risk from low doses levels could be zero.

<u>Part 5 True and False</u> Indicate with a T or F whether the statement is true or False.

_____ 1. The ionization principle is the most common method used to detect and measure radiation.

_____ 2. The ion chamber is normally used as a dose rate meter.

_____ 3. Geiger counters are almost exclusively used as dose rate meters.

_____ 4. "Dead time" refers to the amount of time that the geiger counter sits on the shelf.

_____ 5. The film badge or TLD provides your legal record of radiation exposure.

_____ 6. You can protect yourself from radiation by using time, distance and shielding.

_____ 7. Radiation dose is directly proportional to the amount and time spent in a radiation field.

_____ 8. High density materials are best for shielding gamma rays.

_____ 9. Neutrons require high density materials for shielding.

_____ 10. Using distance from a source is a great way to protect yourself from radiation.

Part 6 Multiple Choice Circle the letter of the statement which best answers the question.

1. What set of Nuclear Regulatory Commission regulation covers the employer's responsibility to the employee.

   a. Title 17
   b. 10 CFR 19
   c. 10 CFR 20
   d. 49 CFR 182

2. Your allowable whole-body occupational exposure is:

   a. 1.25 Rem per calendar quarter.
   b. 5 Rem per calendar quarter.
   c. (N-18)
   d. 1.25 Rem per year.

3. At what dose level does an area become a High Radiation Area.

   a. 2.5 mr/hr
   b. 5 mr/hr
   c. 100 mr/hr
   d. 100 mr/week

4. Where does californium-252 come from?

   a. It is mined along with uranium.
   b. It is a uranium fission fragment.
   c. It is a human-made radioisotope, produced in the High Flux Isotope Reactor.
   d. It is a byproduct of the uranium separation process.

5. How does californium-252 decay?

   a. By alpha emission and by spontaneous fission.
   b. By emitting a beta particle along with a gamma ray.
   c. By fission caused by a thermal neutron.
   d. By emitting high energy x-rays.

6. What is the best method for protecting yourself while handling a Cf-252 source?

   a. Erect large shields and use mirrors to see what you are doing.
   b. Use the longest handling tools you can obtain.
   c. Rehearse and practice procedures, then carry the job out as quickly as possible.
   d. Just do the job and get out as fast as you can.

7. What are the best shield materials for California-252?

   a. Materials that contain a large amount of hydrogen mixed with materials that will readily capture the thermal neutrons.
   b. Iron and lead.
   c. Distance is the best shield.
   d. Depleted uranium.

8. Which type of radiation emitted by californium is considered to be useful?

   a. Alpha
   b. Beta
   c. Gamma
   d. Neutron

9. Shipping of radioactive materials is regulated by which agency?

   a. U.S. Department of Commerce
   b. U.S. Nuclear Regulatory Commission
   c. U.S. Food and Drug Administration
   d. U.S. Department of Transportation

10. When using radioactive materials, the important thing to do is:

   a. Wear a film badge
   b. Keep a radiation monitor handy
   c. Be aware of the source
   d. Plan carefully
   e. All of the above

Answer Sheet For Examination

Radiation Safety Course

Part 1

1. proton, electron
2. isotopes
3. radioactive
4. particulate, electromagnetic
5. neutron

7 points

Part 2

1. e
2. f
3. d
4. c
5. a
6. b

6 points

Part 3

1. True
2. False
3. True
4. True
5. False
6. False
7. True
8. False
9. True
10. True

10 points

Part 4

1. b
2. c
3. b
4. a
5. d
6. c
7. d

7 points

Part 5

1.	True	6.	True
2.	True	7.	False
3.	False	8.	True
4.	False	9.	False
5.	True	10.	True

10 points

Part 6

1.	b	6.	c
2.	a	7.	a
3.	c	8.	d
4.	c	9.	d
5.	a	10.	e

10 points

Total 50 points
Each answer is 2 points

Passing grade should be
90

(FOR LFMS USE)
INFORMATION FROM LTS

PROGRAM CODE: 03124
STATUS CODE: 0
FEE CATEGORY: ________
EXP. DATE: 19940228
FEE COMMENTS: ________

BETWEEN:

LICENSE FEE MANAGEMENT BRANCH, ARM
AND
REGIONAL LICENSING SECTIONS

LICENSE FEE TRANSMITTAL

A. REGION

1. APPLICATION ATTACHED
   APPLICANT/LICENSEE: TRANSPORATION, DEPAPTMENT OF
   RECEIVED DATE: 890420
   DOCKET NO: 3030885
   CONTROL NO.: 110601
   LICENSE NO.: 29-13141-05
   ACTION TYPE: AMENDMENT

2. FEE ATTACHED
   AMOUNT: $Ø
   CHECK NO.: Ø

3. COMMENTS

SIGNED L. J. Brown
DATE 89-04-24

B. LICENSE FEE MANAGEMENT BRANCH (CHECK WHEN MILESTONE 03 IS ENTERED /__/)

1. FEE CATEGORY AND AMOUNT: ________

2. CORRECT FEE PAID. APPLICATION MAY BE PROCESSED FOR:
   AMENDMENT ________
   RENEWAL ________
   LICENSE ________

3. OTHER ________

SIGNED ________
DATE ________

p1
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Thanks

Jim McKnight
DCR

10/27/89

Jim;

Copyright material has been removed. Please process.

Cheryl
346-5093
R-I