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Formerly Utilized Sites Remedial Action Program (FUSRAP)
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POST-REMEDIAL ACTION REPORT FOR THE ASSOCIATE AIRCRAFT SITE

Fairfield, Ohio

July 1996

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POST-REMEDIAL ACTION REPORT

FOR THE

ASSOCIATE AIRCRAFT SITE

FAIRFIELD, OHIO

JULY 1996

Prepared for

United States Department of Energy

Oak Ridge Operations Office

Under Contract No. DE-AC05-91OR21949

By

Bechtel National, Inc.

Oak Ridge, Tennessee

Bechtel Job No. 14501

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ACRONYMS

AEC	Atomic Energy Commission
ALARA	as low as reasonable achievable
BNI	Bechtel National, Inc.
DCG	derived concentration guide
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
FUSRAP	Formerly Utilized Sites Remedial Action Program
HEPA	high-efficiency particulate air
IVC	independent verification contractor
LLRW	low-level radioactive waste
MED	Manhattan Engineer District
NLO	National Lead of Ohio
NRC	Nuclear Regulatory Commission
ORNL	Oak Ridge National Laboratory
PPE	personal protective equipment
RSS	radiological support subcontractor
TN	Thermo NUtech (formerly ThermoAnalytical, Inc.)

UNITS OF MEASURE

cm	centimeter
cpm	counts per minute
dpm	disintegrations per minute
ft	foot
g	gram
h	hour
in.	inch
lb	pound
L	liter
m	meter
μCi	microcurie
ml	milliliter
μR	microroentgen
mR	milliroentgen
mrad	millirad
mrem	millirem
pCi	picocurie
psi	pounds per square inch
yd	yard
yr	year

1.0 INTRODUCTION

1.1 BACKGROUND

This report documents the remedial action conducted at the former Associate Aircraft Tool and Manufacturing, Inc. site in Fairfield, Ohio (Figure 1-1) from December 1994 to June 1995.

Remedial activities at the former Associate Aircraft site were performed as part of the U.S. Department of Energy (DOE) Formerly Utilized Sites Remedial Action Program (FUSRAP) following the protocols and procedures established by DOE under the Atomic Energy Act of 1954 and subsequent related legislation. FUSRAP was established to identify and clean up or otherwise control sites where residual radioactive contamination (exceeding current federal guidelines) remains from the early years of the nation's atomic energy program or from commercial operations causing conditions that Congress has authorized DOE to remedy.

The objectives of FUSRAP as applicable to the Associate Aircraft site are to

- identify and evaluate all sites used to support former Manhattan Engineer District (MED) and Atomic Energy Commission (AEC) nuclear development activities;
- remove or otherwise control contamination on sites identified as contaminated above current DOE guidelines;
- achieve and maintain compliance with applicable criteria for the protection of human health and the environment;
- certify the site, to the extent possible, for use without radiological restrictions after remediation; and
- remove hazardous waste that is mixed with radioactively contaminated waste resulting from AEC/MED work.

FUSRAP was established in 1974, and remedial actions began at FUSRAP sites in 1981. Administered by the Former Sites Restoration Division of DOE's Office of Environmental Management, FUSRAP currently includes 46 sites in 14 states. The primary legislation authorizing FUSRAP is the Atomic Energy Act of 1954.

Bechtel National, Inc. (BNI) is the project management contractor for FUSRAP. Oak Ridge National Laboratory (ORNL), the FUSRAP independent verification contractor (IVC), performed independent designation and verification surveys and will issue a report of post-

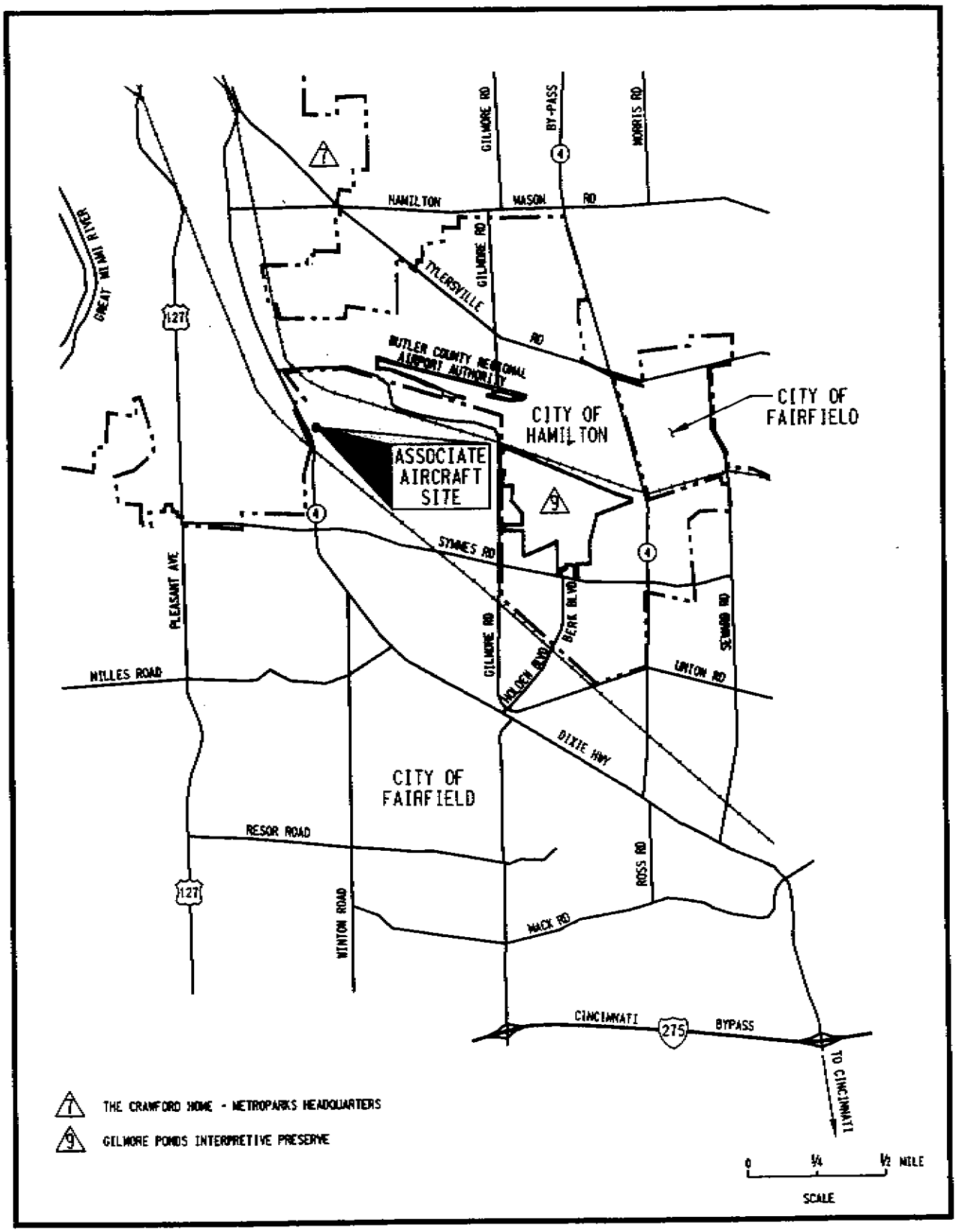

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Figure 1-1
General Site
Location

remedial verification survey results. Health physics and laboratory functions were provided by Thermo NUtech (TN) (formerly ThermoAnalytical, Inc.), the radiological support subcontractor (RSS).

1.2 HISTORY

AEC and National Lead of Ohio (NLO) contracted with Associate Aircraft Tool and Manufacturing, Inc., a Cincinnati-area machine shop, to machine hollow slugs from natural (i.e., neither depleted nor enriched) uranium for the AEC Hanford and Savannah River sites from February to September 1956. The primary activities carried out at the Associate Aircraft facility included machining, hollow drilling, reaming, and turning slugs to a final outside diameter. Contract records show that approximately 95,000 slugs were machined during the 8-month contract period. In September 1956, AEC decided that the capability provided by Associate Aircraft was no longer needed, and the contract was allowed to expire.

From October through November 12, 1956, the site was decontaminated to acceptable levels in accordance with the regulations in effect at that time. The decontamination was performed by Associate Aircraft under NLO supervision and health physics support. The final contract amendment required Associate Aircraft to decontaminate its plant and equipment as required by NLO and to return all machining equipment to NLO.

Radiological surveys were conducted by NLO during the machining operations and as a part of an intensive decontamination campaign. Alpha readings were not excessive; the highest reading was 207 dpm/100 cm^2 during the operations. The December 1956 decontamination report notes that site remediation required 5 weeks and that a fire had occurred in the drill press used for hollowing slugs. Survey measurements of alpha radiation were well below the current guidelines, while one gamma dose rate was at the current guideline of 20 μR/h above background. The maximum beta dose rate recorded was 0.8 mR/h. Contamination levels on machine surfaces as recorded in 1956 exceeded current guidelines, but final disposition of the equipment is unknown.

During a limited radiological survey conducted in June 1992, uranium contamination was found in some concrete expansion joints and on several overhead horizontal surfaces. Measurements as high as 3 mrad/h in concrete expansion joints and 0.5 mrad/h on the roof supports were found with portable survey instruments. One spot in a concrete expansion joint had a beta/gamma level of 120 μR/h at contact. In July 1992, one area of elevated radioactivity was found outside at the southwestern corner of the building. The process of taking samples removed all of this small volume of soil, and no other contamination was found in that portion of the property. A radiological survey of the remainder of the property was conducted during September 14-18, 1992; this survey identified additional residual uranium inside and outside the building. A complete radiological survey report, *Results of the Radiological Survey at the*

Former Associate Aircraft Tool and Manufacturing Company Site, Fairfield, Ohio (ORNL 1993) has been prepared.

The former Associate Aircraft building, at 3660 Dixie Highway, Fairfield, Ohio, is currently an operating machine shop with a total area of approximately 1,860 to 2,325 m^2 (20,000 to 25,000 ft^2) (Figure 1-2). The current owner and occupant of the site, Force Control Industries, Inc., purchased the site in 1969 from Dixie Machinery. An interview with a former employee of the Associate Aircraft facility revealed that the site has not changed extensively since the 1950s, except for an addition to the front of the building and some cosmetic changes such as wall repairs.

The limited survey in July 1992 verified that the front portion of the property did not contain residual uranium above background levels. This determination allowed a planned construction program to begin. The construction involved adding an office area to the front of the existing structure and landscaping the remaining area between the new building and Dixie Highway (Figure 1-2).

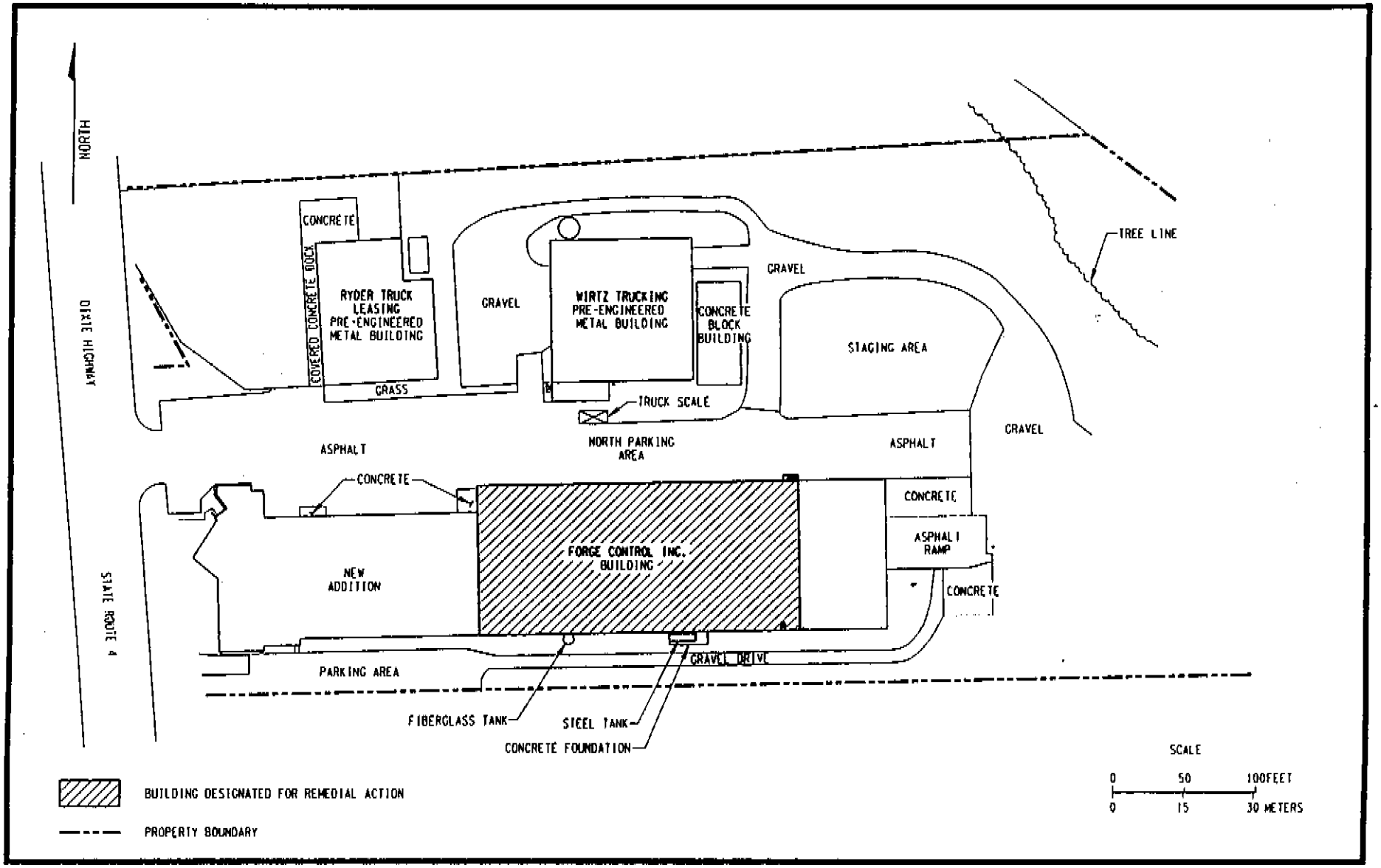

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Figure 1-2
Site Plan

2.0 REMEDIAL ACTION GUIDELINES

Contamination at the site originated from the machining of natural (neither depleted nor enriched) uranium slugs. Standards and criteria governing the release of properties for future use (Table 2-1) are included in DOE Order 5400.5, "Radiation Protection of the Public and Environment," and are comparable to those proposed by the U. S. Environmental Protection Agency (EPA) and the Nuclear Regulatory Commission (NRC). The remedial action guidelines for alpha activity from natural uranium, uranium-235, uranium-238, and associated decay products on indoor and outdoor structure surfaces are 5,000 dpm/100 cm^2 averaged over the whole surface area; 15,000 dpm/100 cm^2 (maximum); and 1,000 dpm/100 cm^2 (removable). The site-specific criterion for residual radioactive material in soil is 35 pCi/g for total uranium averaged over the remediated area. This guidance was based on DOE application of the as-low-as-reasonably-achievable (ALARA) principle to the site-specific scenarios, based on levels of 260 to 960 pCi/g, derived by Argonne National Laboratory (DOE 1995a). This soil concentration of 35 pCi/g applied under extremely conservative exposure scenarios would result in a dose of approximately 2 mrem/yr to the public; this level is indistinguishable from background and an insignificant amount when compared to the 100-mrem/yr primary dose limit.

Because only trace concentrations of radium and thorium remain in uranium metal after processing, extremely low concentrations of these two radionuclides were detected in characterization samples. Uranium isotopes account for virtually all the radioactive contamination at the site.

All lead-containing paint and asbestos-containing floor tiles that were contaminated with residual radioactive material above the site-specific criteria were removed from the site and managed as mixed wastes. Both of these materials were found within the office and bathroom areas of Zone V. These chemical constituents were the only regulated materials that were mixed with radioactive materials and needed to be removed.

Table 2-1

Summary of DOE Guidelines for Residual Radioactive Contamination

---

Base Dose Limits

The basic limit for the annual radiation dose (excluding radon) received by an individual member of the general public is 100 mrem/yr above background. In implementing this limit, DOE applies ALARA principles to set site-specific guidelines.

External Gamma Radiation Limit for Structures

The average level of gamma radiation inside a building or habitable structure on a site that has no radiological restrictions on its use must not exceed the background level by more than 20 μR/h.

Site-Specific Soil Guidelines

The site-specific criterion for soil is 35 pCi/g for total uranium (DOE 1995a).

Indoor/Outdoor Structure Surface Contamination Applicable to the Associate Aircraft Site

The residual contamination guidelines for fixed and transferable radioactive contamination (dpm/100 cm^2) (DOE 5400.5):

Radionuclide	Average	Maximum	Removable
Uranium-natural, uranium-235, uranium-238, and associated decay products	5,000 (alpha)	15,000 (alpha)	1,000 (alpha)
Beta/gamma emitters (radionuclides with decay modes other than alpha emmisions)	5,000 (beta/gamma)	15,000 (beta/gamma)	1,000 (beta/gamma)

3.0 REMEDIAL ACTION

3.1 CLEANUP/DECONTAMINATION ACTIVITIES

Before remedial action began, each work area was surveyed to accurately define the boundaries of radioactive contamination, to supplement existing characterization information, and to obtain the analytical data needed for classifying the waste to be generated during remediation. This classification was necessary for the waste to be accepted at the Envirocare low-level radioactive waste disposal facility in Clive, Utah. As the remedial actions were completed, radiological surveys were performed and samples collected when appropriate to ensure that the residual uranium material had been removed to attain levels below the guidelines established by DOE.

The contaminated portions of the building were subdivided into zones, and remediation proceeded in phases (Figure 3-1) so that it would not disrupt plant operations. As work in each zone neared completion, the next zone was prepared for decontamination. Preparation included relocating machinery and equipment, covering immovable structures with plastic, and establishing a control point (using plastic curtains, etc.). Communication with the property owner was maintained during the remediation of each zone.

The sequence of decontaminating an area began with the interior roof decking and proceeded down the walls to the floors and expansion joints and then to the soils below the floor slabs, as indicated by direct surveys (Figure 3-2). The contaminated interior roof decking, building ventilation fans, and the contaminated steel trusses in zones I, II, III, IV, and V were vacuumed, cleaned with dry rags, and where required, spot wiped with soapy rags, degreasing solution, or an approved equivalent. Any remaining contaminated areas were decontaminated by wire brushing or grinding down to the bare metal surface with a vacuum attachment on the surface grinder, without gouging or cutting.

The contaminated glass windows were remediated by vacuuming and/or wiping the glass windows with soapy rags, degreasing solution, or equivalent. When the decontamination efforts failed to reduce the contamination level of a window (or if the window was broken during the process), the window was replaced. Walls were decontaminated using a Vacublast™ system, chipping hammer, or surface grinder. The Vacublast™ system uses steel shot to mechanically pulverize and remove the top 0.32 to 0.64 cm (0.13 to 0.25 in.) of the wall or floor; the depth of the removal can be adjusted by the operator. All radioactively contaminated lead-containing paint was removed during this action, and the waste stream was handled in accordance with federal regulations as outlined in applicable work instructions.

The concrete floors in zones I, II, III, IV, and V were decontaminated using vacuuming, surface abrasion with a Blastrac™ unit, or grinding and vacuuming. The radioactively

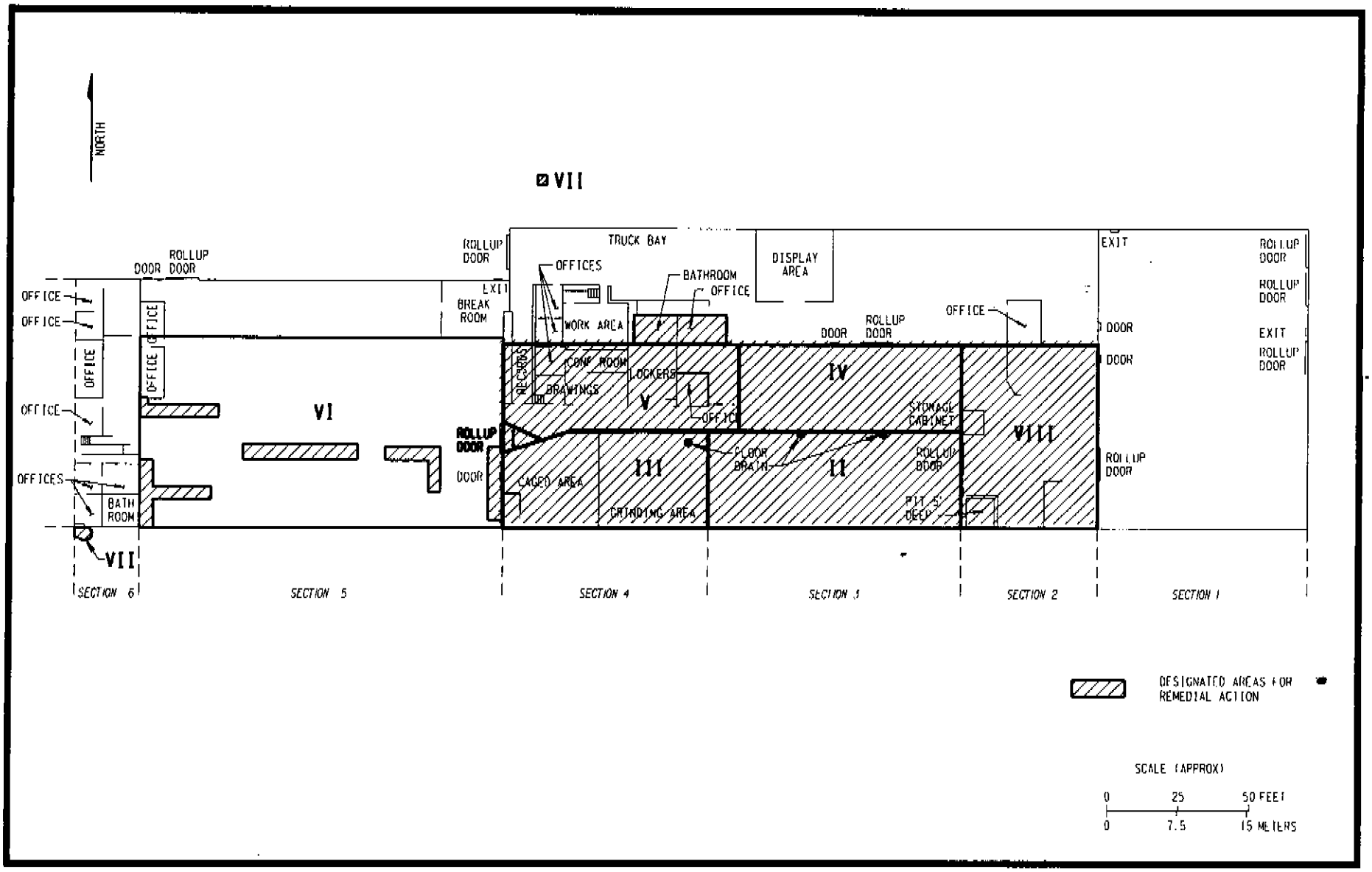

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Figure 3-1
Sequence of Work

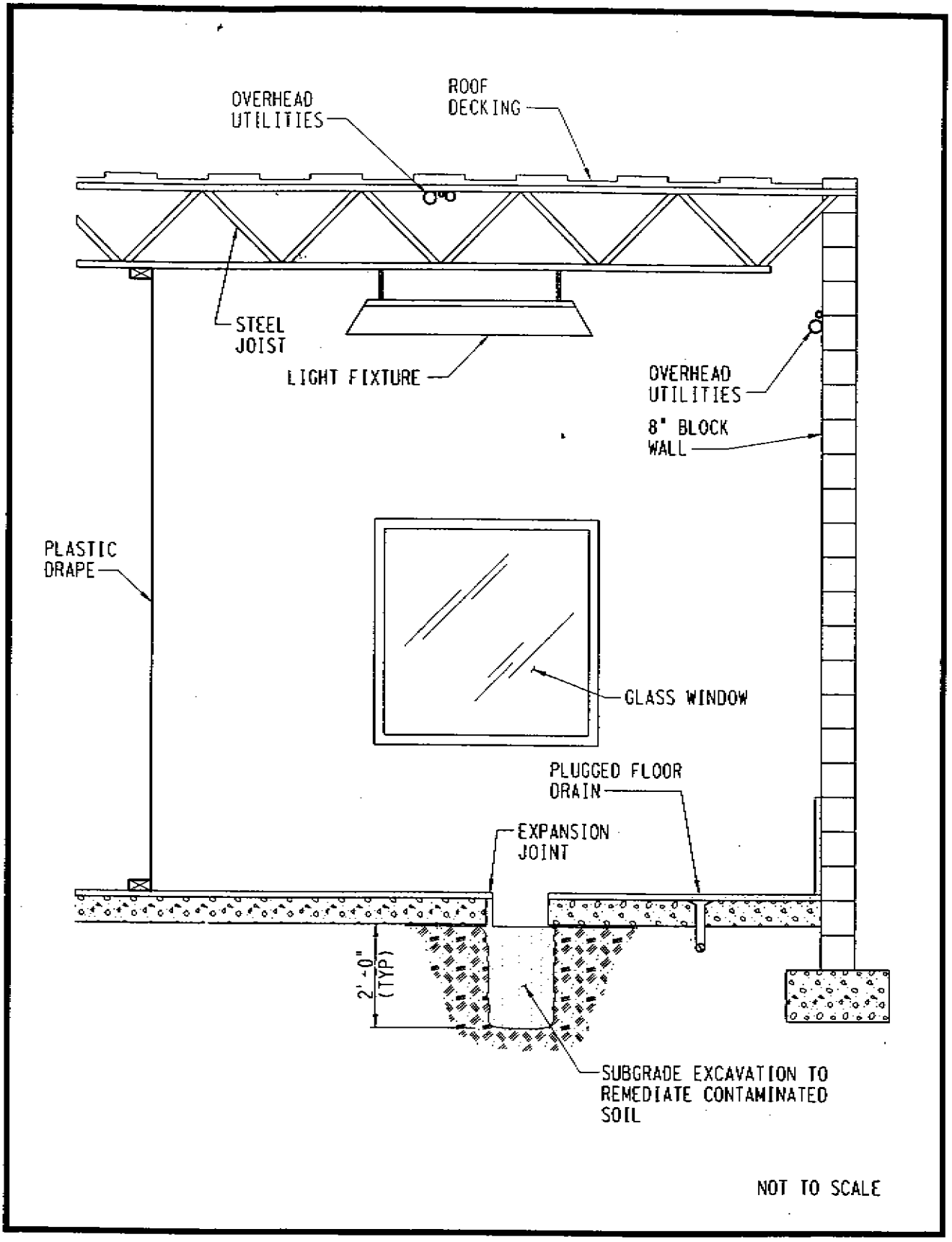

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Figure 3-2
Typical Components within a Zone

contaminated asbestos-containing vinyl flooring of Zone V was removed in accordance with asbestos abatement requirements. The exposed concrete floor was then resurveyed and decontaminated in the same manner as the floors in previous zones.

Some lead equipment supports embedded in the floors were not successfully decontaminated by Blastrac™ operations; these supports were removed with a lightweight jackhammer. All contaminated lead anchor and sleeve inserts embedded in the floor were removed with a coring bit. The contaminated lead waste was macroencapsulated before being shipped for commercial disposal.

The macroencapsulation process consists of bagging the materials in a plastic bag and placing the bagged materials on a rebar mold. High-strength (30,000-50,000 psi) concrete is then placed into the mold, encapsulating the bagged material, and finally the mold with the concrete set in place is containerized and shipped to the commercial disposal facility.

All contaminated expansion joint material in zones II, III, IV, V, VI, and VIII was cut out and disposed of as radioactive waste. The trenches remaining after the concrete was removed were surveyed to ensure that all contamination above the guideline had been removed.

All below-grade and exterior soils found to be contaminated above the 35-pCi/g guideline were removed, except for a 167-m^2 (200-yd^2) area below Zone VIII. Because of the depth of the residues remaining in Zone VIII, the total cost of remediating the material would not result in a significant cost versus dose reduction benefit. A hazard assessment was conducted to determine this benefit and subsequent exposure rates associated with potential land uses for the site (Appendix B).

The exterior areas remediated consisted of a 74-m^2 (88-yd^2) area along the southern side of the building and an approximately 75-m^2 (90-yd^2) area in the parking lot north of the Force Control building. All soils and material removed from the building and from the exterior areas were disposed of as low-level radioactive waste. All soils were surveyed during excavation and sampled for gamma spectral analysis after excavations were completed to ensure that all uranium contamination above the guidelines had been removed.

The bathroom and office area in Zone V contained radioactively contaminated lead-based paint that exceeded the Resource Conservation Recovery Act limits for leachable lead. Asbestos-containing floor tile contaminated with uranium material was found in the office area. These areas were enclosed in high-density plastic containment, in compliance with the EPA regulations for containment during remediation. The radioactively contaminated paint and asbestos-containing floor tile were removed, and the resulting waste was solidified, packaged, and shipped offsite for commercial disposal.

A main drainage system (located in zones II, III, and IV exiting the southern side of the building) and a bathroom drain (in the Zone V bathroom) were surveyed and found to contain levels of radioactivity above the guidelines. These piping systems were excavated, and the remaining area was surveyed to ensure that all contaminated piping, debris, and soil were removed. The resulting trenches were surveyed for any residual radioactive material and excavated further if they did not meet the guidelines established by DOE; they were then backfilled with clean material.

After the remedial actions were complete in each area and the IVC had verified the area to be free of any residual radioactive contamination above guidelines, BNI restored the area to the original or comparable condition. The roof and trusses were restored with a rust-inhibiting coating; the walls were patched, epoxied, and painted; the concrete floors and trenches were filled; and the concrete was replaced and top coated. The exterior areas were backfilled with clean fill material, graded, and seeded. The parking area was restored to the original condition after the excavation was backfilled.

3.2 CONTAMINATION CONTROL DURING REMEDIAL ACTION

During the remedial action, engineering and administrative controls and continuous monitoring were used to protect remediation workers and members of the general public from potential exposure to radiation in excess of applicable standards. These controls are outlined in the site health and safety work instructions.

All personnel working in contaminated areas were required to wear personal protective equipment (PPE), including disposable coveralls, safety glasses, disposable rubber boots, gloves, and hard hats. When conditions warranted, additional protective clothing and equipment such as hoods and respirators were required, as specified in the site health and safety work instructions.

Under the direction of a health physics technician, workers exiting radioactively contaminated work areas were subjected to a whole-body scan (frisked) at the control point with a hand-held radiation detection instrument to ensure that their protective clothing had prevented personal contamination and to prevent the spread of contamination to clean areas. Personnel were resurveyed (boots and hands) after exiting the support area to ensure that no material was transferred to uncontaminated areas. Contaminated PPE was sent to Envirocare for disposal.

The primary exposure pathways to radioactive material for members of the general public were inhalation and ingestion of radioactively contaminated airborne dust generated during the remedial action. The potential for contaminant migration was minimized by

- using wet dust suppression as needed during soil or concrete removal and transport,

- using intermodal boxes with metal lids to prevent loss of the contents during shipment,
- placing sediment barriers (silt fences) around contaminated work areas,
- enclosing work areas of the interior zones with high-density plastic sheeting and establishing a negative-pressure-filtered containment to restrict the movement of airborne materials,
- placing large sheets of plastic on floors in and around contaminated work areas where practicable to prevent materials on the floor from being spread, and
- vacuuming at the point of origin during selected activities.

Perimeter air particulate sampling was performed adjacent to areas being remediated to ensure that no member of the general public was exposed to radioactivity above the current DOE guidelines (DOE Order 5400.5). The limits expressed in DOE Order 5400.5 are derived concentration guides (DCGs); a DCG is the concentration of a particular radionuclide that would yield a committed effective dose equivalent of 100 mrem/yr, the DOE basic dose limit, to an individual continuously exposed to the radionuclide by one pathway for an entire year. This guideline was established to protect the environment and members of the general public against undue risk from radiation. High-volume air samplers were used to collect air samples to reflect the concentration of airborne radionuclides potentially accumulated in the surrounding area. The filters of the air samplers were accumulated daily and counted after sufficient time was allowed for radon progeny decay. Concentrations of uranium-238 accumulated by area particulate air samplers ranged from background to 7.7×10^{-14} μCi/ml (0.000077 pCi/L), nearly 26 times less than the DCG of 2.0×10^{-12} μCi/ml (0.002 pCi/L) for uranium-238.

4.0 POST-REMEDIAL ACTION MEASUREMENTS

Before any post-remedial action data were collected, radiological surveys and soil analyses were performed at three remote background locations. These locations (described in Table 4-1) were selected because they are near the Associate Aircraft site and can provide radiological data representative of the area but are not influenced by the Associate Aircraft work. Background measurements and soil samples provide a reference with which results obtained before, during, and after the remedial action may be compared.

To verify that no radioactivity exceeding guidelines remained in the remediated areas, BNI conducted radiological surveys after remedial actions were completed in each zone. These surveys included direct surface measurements on interior surfaces such as the roof decking, trusses, walls, concrete, piping, and the trenches that remained after the expansion and crack control joints were removed (Figure 3-2). Gamma spectroscopy analyses were conducted on soils from excavated areas, and external gamma exposure rates were determined using a pressurized ionization chamber. Soil analyses were performed both in the field and in the laboratory.

Direct surface contamination is the total amount of radioactive contamination on a surface; therefore, a survey of direct surface contamination quantifies both removable and fixed contamination. The removable component of surface contamination is transferable and can be picked up on clothing or skin upon contact.

To quantify direct surface contamination, a radiation detection instrument is placed directly over the surface to measure the radioactivity emitted from it. Direct alpha radiation is measured with an alpha scintillation detector connected to a rate meter, an instrument that counts the number of radioactive disintegrations detected in a specified amount of time. Direct beta/gamma radiation measurements are obtained with a Geiger-Mueller probe attached to a rate meter. The probe is placed over the surface to be surveyed, and pulses are allowed to accumulate for one minute on the rate meter, resulting in a measurement of counts per minute (cpm) for the surface area. These measurements are then converted, with appropriate calibration and conversion factors, to dpm/100 cm^2.

To measure transferable contamination, the surface is wiped with a soft absorbent paper. The paper is placed in a portable smear counter, and alpha and beta/gamma radiation are each counted for one minute. The resulting measurements in cpm are then converted to dpm/100 cm^2.

The external gamma exposure rates were measured with a pressurized ionization chamber at 1 m (3 ft) above the surface. Readings at this elevation provide an estimate of the potential exposure from gamma radiation to the critical body organs near the ground or floor.

Table 4-1

Uranium-238 Concentrations and External Gamma Radiation Exposure Rates at Background Locations

	Location	Gamma Radiation Exposure Rate (μR/h)	Total Uranium (pCi/g)
1.	Ohio National Guard Armory, Corner of Gilmore Road and Symmes Road, Hamilton/Fairfield	8.5	[a]
2.	Butler County Fairgrounds, Youth Activities Building, 1715 Fairgrove Avenue, Hamilton. Middle interior room at the intersection of expansion joints.	7.6	[a]
3.	Hamilton City Fire Department, House #6, Truck Bay	9.9	[a]
Average Background Radioactivity		8.7	0.41
Guidelines:		[b]	35.0

[a]All soils from background locations were composited and analyzed to give an average background result.
[b]Less than 20 μR/h above background in habitable structures, or maximum of 100 mrem/yr for all pathways, excluding radon.

The exterior soil samples from each area were collected at a frequency of 25 equally spaced plugs per 100-m^2 surface area with a depth of 15 cm (6 in.) and diameter of 2.5 cm (1 in.). This is a reliable and reproducible method of sampling an area of concern, and is based on DOE Order 5400.5. This method of surface soil sampling is a standard approach to post-remedial action surveys.

Interior (sub-slab) soil samples were also collected from each trench created by the removal of contaminated expansion or crack control joints. The method used was similar to that for exterior soil sampling in Zone VII. A 100-m^2 (120-yd^2) area was determined from the 15-cm (6-in.) width of the trench formed when a contaminated expansion or crack control joint was removed and from the length of the trench (Figure 4-1). Twenty-five equally spaced plug soil samples were collected within the 100-m^2 (120-yd^2) area and composited for gamma spectroscopy analysis to ensure that the residual uranium contamination was below 35 pCi/g.

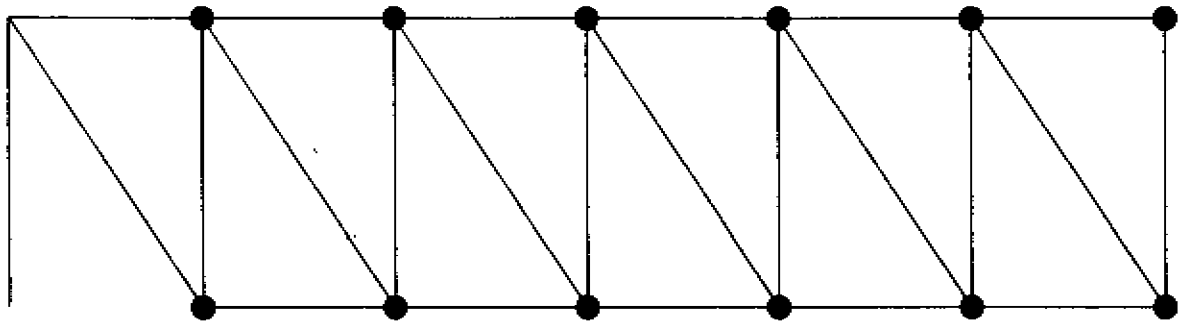
Initial post-remediation surveys were conducted by the RSS on behalf of BNI. Survey techniques used during the post-remediation and verification surveys included measurements of direct and transferable surface contamination, walkover gamma scans, exposure rate measurements, and soil sampling. Methods for the survey techniques are described in the *Associate Aircraft Site Post-Remedial Action Survey Plan,* which is included as Appendix A. The RSS also provided the laboratory functions for analyzing the collected samples. The IVC performed independent verification surveys of the remediated areas using identical survey techniques. The IVC survey data will be issued as a separate report by ORNL. When remedial action was completed, the property was restored to a condition agreed upon by both BNI and the property owner.

Because the interior of the building was remediated by zone, the discussion in the following section will present the post-remedial action results by zone, from Zone I to Zone VIII. The components decontaminated in each zone were very similar, including roof trusses, walls, floors, and expansion and crack control joints.

The components in each zone are listed in Table 4-2 along with the number of samples collected and the analytical results.

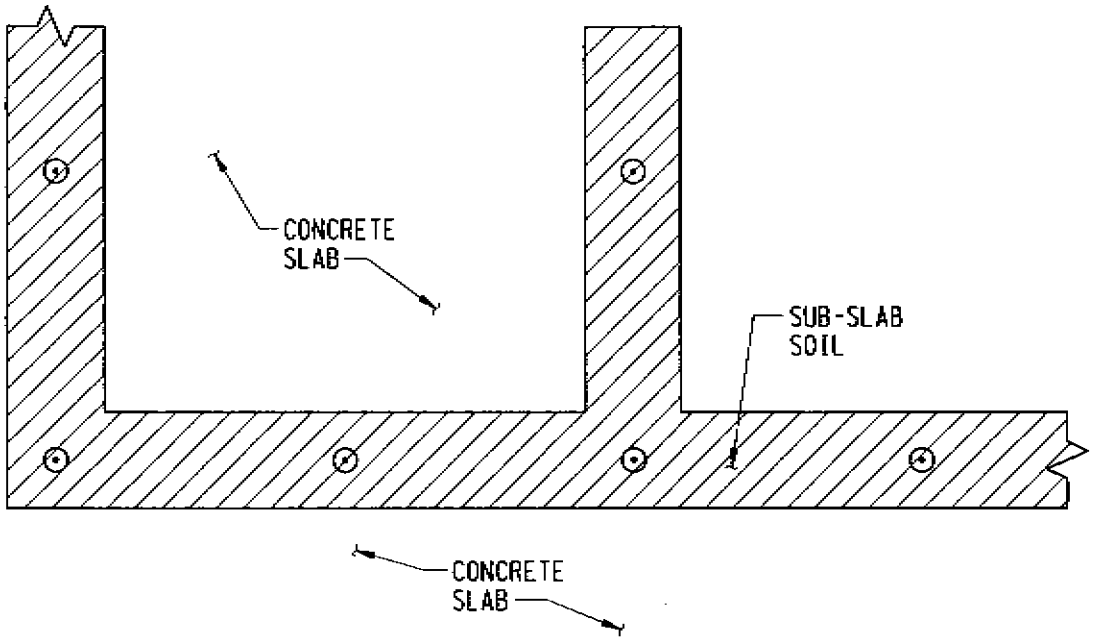
Zones III and IV were the two most contaminated areas within the building, based on the areal extent of contamination. These are believed to have been the major areas of production during the subcontract period. Each area was decontaminated using the methods discussed in Section 3.1.

Post-remedial action direct surface contamination measurements and soil samples were used to verify the removal of the residual radioactive material, and external gamma exposure rate measurements were taken within each zone to ensure that the exposure rate from all pathways, except radon decay, was well below the guideline of 20 μR/h above background for habitable structures.



TYPICAL SURVEY LOCATIONS OF A TRUSS

(CROSS-SECTIONAL VIEW)



TYPICAL SAMPLING LOCATIONS OF AN EXPANSION JOINT

(PLAN VIEW)

● DIRECT AND TRANSFERABLE SURVEY LOCATION

⊙ SOIL SAMPLING LOCATION

NOT TO SCALE

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Figure 4-1
Typical Survey and Sampling Locations

Table 4-2
Post-Remedial Action Radiological Survey Results for the Associate Aircraft Site

Zone	Component	Number of Samples/ Measurements	Direct Surface Contamination: Alpha (dpm/100 cm²)	Direct Surface Contamination: Beta/Gamma (dpm/100 cm²)	Transferable Surface Contamination: Alpha (dpm/100 cm²)	Transferable Surface Contamination: Beta/Gamma (dpm/100 cm²)	External Gamma Exposure Rate (μR/h)[a,b]	Total Uranium Concentration (pCi/g)[b]
I	Roof trusses	40	–[c]	52 - 2,716	<1 - 63	<1 - 205	–[d]	–[e]
II	Roof trusses	282	<2 - 444	27 - 3,070	<1 - 66	<7 - 247	6.9	
	Walls	19	<10 - 31	402 - 1,054	<-1 - 2[f]	<-4 - 29[f]		
	Floor	547	<-4 - 114[f]	<31 - 957	–[g]	–[g]		
	Eastern wall roll-up door	7	169 - 845	<54 - 845	–[g]	–[g]		
	Trenches		–[h]	–[h]	–[g]	–[g]		1.06 - 22.40
III	Roof trusses	198	<2 - 94	<25 - 1,898	<5 - 28	<39 - 102	6.9	
	Floor	465	<4 - 131	<29 - 914	–[g]	–[g]		
	Trenches		–[h]	–[h]	–[g]	–[g]		8.94[f]
IV	Roof trusses	297	<2 - 69	<24 - 569	–[g]	–[g]	6.9	
	Walls	153	<4 - 141	<25 - 781	–[g]	–[g]		
	Floor	290	<2 - 142	<24 - 1,680	<1 - 5	<86 - 90		
	Trenches	88	<2 - 52	146 - 1,485	<1 - 8	<5 - 90		9.78[f]
V	Roof trusses	251	<2 - 1,013	<29 - 3,481	<1 - 36	<3 - 62	7.7	
	Walls	266	<2 - 192	<31 - 2,416	<1 - 5	<7 - 18		
	Floors	1,145	<2 - 110	<43 - 2,947	<1 - 5	<3 - 52		
	Trenches	27	<2 - 92	<29 - 922	–[g]	–[g]		23.06[f]
VI	Trenches	27	<2 - 92	<29 - 922	–[g]	–[g]	6.8	16.52[f]
VII	Northern parking lot	10	<2 - 65	54 - 265	–[g]	–[g]		6.86[f]
	Southern side Force Control building	198	<2 - 89	50 - 695	–[g]	–[g]		
	Southern side trenches	5	<-36 - (-7)[f]	553 - 829	–[g]	–[g]		4.36[f]
VIII	Trenches	69	<9 - 74	<27 - 1,740	<-1 - 5[f]	<-4 - 44[f]	6.4	0.86 - 1.3
DOE Guideline:			5,000	5,000	1,000	1,000	<20[i]	35

[a]The external gamma exposure rate was measured for the zone listed.
[b]Results include background levels for the Fairfield area.
[c]Alpha measurements on the roof traces not taken.
[d]Because of the size and location of Zone I, the external gamma exposure rate for Zone I is included in the measurements for Zones III and V.
[e]No excavation performed or soil removed in Zone I.
[f]"<-" sign indicates that the measurement was less than the MDA and that after background was subtracted, the numerical value was negative (e.g., <MDA result minus >MDA background = negative result indicated by "<-").
[g]Transferable measurements required when the criterion for transferable surface contamination (1,000 dpm/100 cm²) is exceeded in direct measurements.
[h]Direct surface contamination measurements are included in the results for the entire zone floor.
[i]One measurement or composite sample collected because of the limited area remediated.
[j]Less than 20 μR/h above background in habitable structures, or a maximum of 100 mrem/yr for all pathways, excluding radon.

5.0 POST-REMEDIAL ACTION STATUS

All residual radioactive materials above the site-specific guidelines were removed from the Associate Aircraft site and disposed of as low-level radioactive waste at Envirocare of Utah, except for material in a 167-m^2 (200-yd^2) area immediately east of the eastern wall roll-up door of Zone VIII. The depth [1.2 m (4 ft) sub-slab] and concentrations of the low-level radioactivity, predicted future use, and the costs of remediation (relocation of equipment, lost productivity for Force Control, Inc., volume for shipping, labor, etc.) were evaluated in a decision to conduct a hazard assessment. Sample results indicated that the maximum total uranium contamination in soil is 134 pCi/g. This level exceeds the DOE site-specific soil criterion of 35 pCi/g total uranium but not the uranium concentration guide derived by Argonne National Laboratory for this site of 260 to 960 pCi/g (DOE 1995a). Therefore, a hazard assessment was conducted and approved by DOE (DOE 1995b); the assessment describes the effects of this localized area of residual radioactive material and any future use restrictions of this area. The *Associate Aircraft Site Hazard Assessment for Identified Soil Contamination* is attached as Appendix B.

Waste volumes from the remedial action and their final disposition are listed in Appendix C.

The post-remedial action survey data indicated that all areas of the Associate Aircraft site determined to be contaminated during characterization surveys are now in compliance with applicable cleanup guidelines. Considering a review of post-remedial action measurements, survey procedures, and quality assurance data, the IVC confirmed on May 20, 1995, that the site had been decontaminated to the radiological guidelines approved by DOE.

After completing verification activities, the IVC notified DOE-Headquarters, Division of Facility and Site Decommissioning, and DOE-Oak Ridge Operations, Former Sites Restoration Division, of its findings and recommendations. DOE reviewed the data to determine whether the remedial action was successful. Based on this review, radiological conditions at the site were determined to be in compliance with DOE decontamination criteria and standards to protect health, safety, and the environment, and DOE certified the site as suitable for appropriate future use without radiological restrictions.

REFERENCES

Bechtel National, Inc. (BNI), 1994. Memorandum from D. Sexton to G. Palau, "Scoping Notice: Former Associate Aircraft Tool and Manufacturing, Inc. Site, Fairfield, Ohio," BNI CCN 122494 (November 1).

Department of Energy (DOE), 1995a. Memorandum from W. Wagoner (DOE-HQ) to L. Price (DOE-FSRD), "Uranium Guidelines for the Associate Aircraft Site, Fairfield, Ohio," BNI CCN 126469 (February 10).

DOE, 1995b. Memorandum from W. Wagoner (DOE-HQ) to L. Price (DOE-FSRD), "AAS - Hazard Assessment for Radioactive Contamination," BNI CCN 130903 (June 5).

Oak Ridge National Laboratory, (ORNL), 1993. *Results of the Radiological Survey at the Former Associate Aircraft Tool and Manufacturing Company Site, Fairfield, Ohio* (March).

GLOSSARY

Alpha-emitting - See **Radiation**.

Ambient Background Radiation - Ambient background radiation refers to naturally occurring radiation emitted from either cosmic (e.g., from the sun) or terrestrial (i.e., from the earth) sources. Exposure to this type of radiation is unavoidable, and its level varies greatly depending on geographic location. For example, New Jersey typically receives 100 millirem per year (mrem/yr), Colorado receives about 115 mrem/yr, and some areas in South America receive up to 7000 mrem/yr. Naturally occurring terrestrial radionuclides include uranium, radium, potassium, and thorium (see **Radionuclide**). The dose levels do not include the concentrations of naturally occurring radon inside buildings.

Beta-gamma-emitting - See **Radiation**.

Centimeter - A centimeter (cm) is a metric unit of measurement for length; 1 inch is equal to 2.54 cm; 1 foot is equal to approximately 30 cm.

Contamination - The term "contamination" is used generally to mean a concentration of one or more radioactive materials that exceeds naturally occurring levels. Contamination may or may not exceed the DOE cleanup guidelines.

Disintegrations per minute - Disintegrations per minute (dpm) is the measurement indicating the amount of radiation being released from a substance per minute.

Dose - As used in this report, dose is actually dose equivalent and is used to relate absorbed dose (mrad) to an effect on the body. Dose is measured in mrem. For comparison, a dose of 500,000 mrem to the whole body within a short time causes death in 50 percent of the people who receive it; a dose of 5,000,000 mrem may be delivered to a cancerous tumor during radiation treatment; normal background radiation at or near sea level results in an annual dose of about 100 mrem; DOE radiation protection standards limit the dose that may be received by members of the general public to 100 mrem/yr above background levels; living in a brick house typically results in a dose of about 75 mrem/yr above the background level.

Exposure Rate - Exposure rate is the rate at which radiation imparts energy to the air. Exposure is typically measured in microroentgens (μR), and exposure rate is typically expressed as μR/h. The dose to the whole body can be approximated by multiplying the exposure rate by the number of hours of exposure. For example, if an individual were exposed to gamma radiation at a rate of 20 μR/h for 168 h/week (continuous exposure) for 52 weeks/yr, the whole-body dose would be approximately 175 mrem/yr.

Gamma Radiation - See **Radiation**.

Meter - A meter (m) is a metric unit of length; 1 m is equal to approximately 39 inches.

Microroentgen - A microroentgen (μR) is a unit used to measure radiation exposure. For further information, see **Exposure Rate**.

Millirem - The millirem (mrem) is the unit used to measure radiation dose to man. The DOE dose limit is 100 mrem above background radiation levels within any one-year period for members of the general public. Naturally occurring radioactive substances in the ground result in a yearly exposure of about 100 mrem to each member of the population. To date, no difference can be detected between the health of population groups exposed to 100 mrem/yr above background and the health of groups who are not exposed.

Natural Background Radiation - Natural background radiation refers to radiation emitted from the naturally occurring radionuclides found in manmade materials. The concentrations of the radionuclide, and thus the radiation, will vary widely because of variations in the composition of the materials.

Radiation - There are three primary types of radiation: alpha, beta, and gamma. Alpha radiation travels less than an inch in air before it stops, and it cannot penetrate the outer layers of human skin. Beta radiation can penetrate the outer layers of skin but cannot reach the internal organs. Gamma radiation, the most penetrating type, can usually reach the internal organs.

Radionuclide - Radioactive elements are also referred to as radionuclides. For example, uranium-235 is a radionuclide, uranium-238 is another, thorium-232 is another, and so on.

Remedial Action - Remedial action is a general term used to mean "cleanup of contamination that exceeds DOE guidelines." It refers to any action required so that a property may be certified as being in compliance with guidelines and may therefore be released for future use. Remedial action also includes restoring remediated properties to their original conditions as far as possible.

Uranium - Uranium is a naturally occurring radioactive element. The principal use of refined uranium is for the production of fuel for nuclear reactors. Uranium in its natural form is not suitable for use as a fuel source.

APPENDIX A

Associate Aircraft Site
Post-Remedial Action Survey Plan

ASSOCIATE AIRCRAFT TOOL AND MANUFACTURING COMPANY POST-REMEDIAL ACTION SURVEY PLAN

PURPOSE

The purpose of this plan is to describe the methodologies that the Formerly Utilized Sites Remedial Action Program (FUSRAP) will use for post-remedial action radiological surveys, sampling, and analysis to document the final condition of the Associate Aircraft Tool and Manufacturing Company property as radioactively clean according to the release standards of Department of Energy (DOE) Order 5400.5 (reference 1). This plan addresses the DOE protocol for verification and certification of sites under FUSRAP (reference 2).

Bechtel National, Inc. (BNI) will be the FUSRAP remedial action contractor, and the Oak Ridge National Laboratory (ORNL) will act as the Independent Verification Contractor (IVC).

REFERENCES

(1) DOE Order 5400.5, Radiation Protection of the Public and Environment, Washington, D.C.

(2) DOE, 1990, Verification and Certification Protocol for the Office of Environmental Restoration FUSRAP and D&D Program, Revision 3, November.

(3) ORNL, 1993, Results of the Radiological Survey at the Former Associate Aircraft Tool and Manufacturing Company Site, Fairfield, Ohio (FOH001), ORNL/RASA-88/59, Martin Marietta Energy Systems, Inc., Oak Ridge National Lab, February 1990.

(4) ThermoAnalytical (TMA), Health Physics Operational Procedures Manual

- A) 3C.2 "Determination of Background"
- B) 3B.1 "Delineation of Survey Areas in Open Land"
- C) 3B.3 "Gamma Ray Exposure Rate Surveys at 1-Meter in Open and Enclosed Areas"
- D) 3A.2 "Direct Surface Contamination Survey"
- E) 3A.3 "Transferable Surface Contamination Survey"
- F) 4A.1 "Systematic and Bias Surface Soil Sampling (Radiological)"

(5) BNI, 1993, Instruction Guide for Post-Remediation Survey of Soil, 191-IG-032, Revision 0.

(6) BNI, 1992, Instruction Guide for Decontamination of Field Sampling Equipment at FUSRAP Sites, 191-IG-011, Revision 5

(7) BNI, 1993, Instruction Guide for Surface Water and Sediment Sampling Activities, 191-IG-028, Revision 0.

(8) BNI, 1994, How to Ship Samples from a FUSRAP Site, PI R4.7, Revision 2.

(9) DOE/CH/8901, A Manual For Implementing Residual Radioactive Material Guidelines, June 1989.

(10) BNI, 1994, Health and Safety Plan for Decontamination and Restoration for Associate Aircraft.

(11) ORNL/TM-8600, Procedures Manual for the ORNL Remedial Action Survey and Certification Activities (RASCA) Program.

(12) BNI, 1994, Work Instruction for Analysis of Soil Samples by High Resolution Gamma Spectroscopy.

BACKGROUND

From February to September, 1956, Associate Aircraft Tool and Manufacturing Company owned and operated a facility at 3550 Dixie Highway, Fairfield, Ohio, which performed work for National Lead of Ohio (NLO), a prime contractor to the U.S. Atomic Energy Commission (AEC) at that time. NLO was one of several companies performing work concerned with the development of nuclear energy for defense-related projects under contract to AEC. The machine shop at the Fairfield site was one of two Cincinnati area shops selected by AEC and NLO to supplement the capacity of the Feed Materials Production Center at Fernald by the production of hollow natural uranium slugs. Operations consisted of hollow drilling, reaming, and turning slugs to a final outside diameter. Based on the contractual records, approximately 95,000 slugs were machined during the eight-month term of the contract. During the final three months of the contract, Associate Aircraft production was maintained at a minimum operating level of 10,000 to 15,000 slugs per month as future AEC requirements were not known.

RESIDUAL CONTAMINATION GUIDELINES

The source of contamination of the designated property was natural uranium metal milling operations. Contamination in the building is the result of migration of that material by such mechanisms as disposal (sweeping or washing) and tracking on shoes and clothing.

The applicable residual contamination guidelines are as follows:

- The residual contamination guidelines for fixed and transferable radioactive contamination (dpm/100 cm^2) (reference 1):

Radionuclide	Average	Maximum	Removable
U-Natural, U-235, U-238, and associated decay products	5,000 σ	15,000 σ	1,000 σ
Beta-gamma emitters	5,000	15,000	1,000

- The site-specific contamination guideline for soil is as follows (see Reference 1)

Radionuclide	Soil Concentration
U-238	35 pCi/g (above background)

DECONTAMINATION ACTIVITIES

Appropriate design drawings include: 124-DD460-C01 Former Associate Aircraft Site-Site and Vicinity Plans, 124-DD460-C02 Former Associate Aircraft Site-Decontamination and Sequence of Work Plans, and 124-DD460-C03 Former Associate Aircraft Site-Roof and Floor Plans.

A Real Estate Instrument shall be in place prior to the initiation of remediation activities.

At a minimum, remediation of the site will consist of decontamination of structures exceeding the DOE guidelines for fixed and transferable radioactive contamination as well as excavation and disposal of radioactively contaminated soil exceeding the 35 pCi/g site-specific guideline for uranium.

Consequently, post-remedial action and verification surveys, as well as soil sampling, will focus on confirming that after remedial action, residual radioactive contamination at concentrations exceeding applicable guidelines is not present. Areas where remediation activities will be conducted will include, but not be limited to, those identified by the designation contractor in the site designation reports (reference 3). To the extent necessary, equipment used during the decontamination activity will be cleaned and surveyed for surficial contamination prior to release.

POST-REMEDIATION SURVEYS AND SAMPLING

Following remediation, the FUSRAP Radiological Support Subcontractor (RSS) ThermoAnalytical (TMA) will perform post-remedial action surveys and sampling to determine the completeness of the corrective action and to document that the site now complies with the applicable criteria.

Survey Equipment

The recommended equipment for use by FUSRAP for release of equipment and materials from the site includes:

- Alpha Scintillation detector (Eberline AC-3 or equivalent)
- Beta/Gamma Pancake GM detector (7 mg/cm^2 mylar shielded (Eberline HP-210 or equivalent)
- Alpha Scintillation Counter (Eberline SAC-4 or equivalent)

The recommended equipment for use by FUSRAP for Post-RA survey and verification includes:

- Canberra 96-6697 Procount (gamma spectroscopy system)
- Floor Monitor (Ludlum 239)
- Portable Ratemeter/Scaler (Eberline PRS-1 or equivalent)
- Gamma Scintillation Detector (Eberline SPA-3 or equivalent), or low range/high range HP-270 or equivalent
- Reuter-Stokes Pressurized Ion Chamber (PIC)
- Field Instrument for Detection of Low-Energy X-Rays (FIDLER)
- HP-260 or equivalent pancake GM detector

Similar types of calibration sources (i.e., same radionuclide) and methods for instrument calibration will be used by Bechtel and ORNL to insure compatibility and reproducibility of survey results.

The Canberra 96-6697 Procount (gamma spectroscopy system) will be used to analyze the soil samples and will be operated in accordance with WI-95-034 (Analysis of Soil Samples by High Resolution Gamma Spectroscopy).

As per the procedure, on floors and wall surfaces prior to discrete post-remedial action survey locations being identified and measurements taken, the entire area will be scanned with a floor monitor (or equivalent) to ensure that no small, isolated areas of contamination were missed during the removal action. Measurements will be biased within specific 1-m^2 (10.75-ft^2) areas to demonstrate that previously contaminated areas are no longer contaminated above criteria. Direct readings will also be taken in adjacent areas within 0.5 m (1.6 ft) of the formerly contaminated areas to verify that contaminates had not spread to previously clean areas during the removal activities.

Transferable (removable) alpha and beta/gamma contamination will also be measured, at a minimum, at any location that exhibits direct alpha or beta/gamma contamination above the guideline for removable contamination (1,000 dpm/cm^2).

Soil samples shall be collected from an approximately 100 m^2 grid (suggested 10m by 10m) as directed in 191-IG-032, and TMA procedure 4A.1 (reference 4F, 5). The approximate depth to the bottom of the excavation for each grid will be recorded in the sampling logbook. Point sources ("Hot Spots") will be taken into account by using the averaging criteria contained in "A Manual for Implementing Residual Radioactive Material Guidelines" (reference 9). Composite samples of the soil will be taken from each sample grid. Composite samples will be collected by taking individual samples (25 per 100 m^2) from each sample grid and compositing these individual samples into one composite sample for that grid. ORNL may collect samples concurrently.

Samples from each grid shall be collected using properly decontaminated sampling equipment (reference 6).

TMA samples shall be handled using the same custody and labeling methodology described for sediment samples in the "Instruction Guide for Surface Water and Sediment Sampling Activities" 191-IG-028 (reference 7) and the sample surveying, packaging, and shipping methodology in PI R4.7 "How to Ship Samples from a FUSRAP Site" (reference 8).

Background Measurements

Prior to performing post-remedial action surveys, TMA will obtain site-specific background measurements. These measurements may be obtained from three remote background locations in the general vicinity of the site (0.5 to 3 miles) according to TMA procedure 3C.2 (reference 4A). If similar materials (concrete, mortar, brick, etc.) cannot be found within 0.5 to 3 miles of the facility, then interior (non-surface) samples of materials taken from uncontaminated portions of the facility may be used for determining background. The location for background measurements will be selected by Bechtel and TMA, and background measurements will be made at each location by TMA and ORNL.

Surveys

After completion of decontamination, TMA shall conduct post-remedial action surveys to document the satisfactory decontamination of the building. The structure left after remediation will be surveyed for alpha and beta/gamma direct and transferable contamination according to TMA procedures 3A.2 and 3A.3 (references 5D and 5E).

Safety and Health

Safety and Health risks associated with tasks described herein have been identified and addressed by the Health and Safety Plan for Decontamination and Restoration for Associate Aircraft.

The work will be performed under a Hazardous Work Permit specific to the survey activities.

Quality Assurance/Quality Control

QA/QC field duplicate samples and measurements shall be collected at a frequency of one additional sample/measurement for each 20 collected.

Rinse blanks from decontaminated sampling equipment shall be collected at the rate of one rinse per day of sampling. Rinse blanks shall be collected according to the recommendations in 191-1G-028 (reference 8).

Data Quality Objectives

The detection limit for total uranium by gamma spectroscopy shall be less than 14 pCi/g; therefore, the detection limit for uranium-238 shall be less than 7 pCi/g. Quality indicator goals shall be as follows: Precision, ± 2 sigma; completeness, 75%; Accuracy, ± 25%). QA/QC samples are discussed in the previous section.

BECHTEL/ORNL COORDINATION

Bechtel is the contractor responsible for completing the remedial action. To define the areas for remediation, Bechtel used data collected by ORNL during designation, as well as supplemental information obtained by Bechtel as part of pre-RA planning and scoping.

Bechtel will have responsibility for decontamination. Upon completion of these activities, ORNL will commence verification of the remediation of the Associate Aircraft site property. ORNL will perform a walkover survey using a FIDLER or equivalent to measure beta-gamma radiation directly. The result of this walkover survey shall be used to determine whether there are areas requiring additional remediation. This survey is expected to include all areas previously identified as being contaminated on the Associate Aircraft site property. Bechtel will assist ORNL in this survey by interfacing with the property owner in advance to secure their approval for property access.

Bechtel will initiate remediation concurrent with ORNL verification activities, to the extent that remediation does not interfere with verification. Bechtel will provide ORNL access to remediation results as they become available. The Bechtel Site Superintendent will notify ORNL when remediation of an area is complete, and ORNL will perform final independent verification surveys of the area. ORNL may collect soil sample splits concurrent with Bechtel sampling efforts. When ORNL has collected all of the samples and instrument readings needed for their independent verification of the site, they will sign the "Findings of Independent Verification Survey" form (Attachment 1).

Remedial action will continue until ORNL agrees decontamination is complete based on direct reading measurements and field gamma spectroscopy results. Bechtel and ORNL may both utilize the field gamma spectroscopy system. Final site conditions must meet cleanup objectives (reference 2). Measurements taken by Bechtel and ORNL at identical locations should agree within the 95 percent confidence interval for the analytical methods used (reference 11). For consistency and ease of data comparison, Bechtel and ORNL shall utilize the same type of calibration techniques, calibration sources, and survey techniques in

conducting the surveys. Bechtel and ORNL shall establish a mutually agreeable survey grid across the decontaminated areas and shall conduct their surveys referring to that grid.

Upon agreement by both parties that the site is decontaminated, ORNL will then demobilize, and Bechtel will remain to restore the site to the condition agreed upon by the property owner(s).

Bechtel will provide final verified sample results to ORNL as soon as they are available. Bechtel will prepare a post-remedial action report (PRAR) for DOE review (copy to ORNL) within 3 months following demobilization, and then begin completion of the Certification Docket. ORNL will issue a verification report to DOE (copy to Bechtel) within 4 months following demobilization (reference 2).

APPENDIX B

Hazard Assessment for Residual Contamination at the Former Associate Aircraft Site

129543

Bechtel

Oak Ridge Corporate Center
151 Lafayette Drive
P.O. Box 350
Oak Ridge, Tennessee 37831-0350

Facsimile: (615) 220-2100

Job No. 14501, FUSRAP Project
DOE Contract No. DE-AC05-91OR21949
Code: 7340/WBS: 135

MAY 08 1995

U.S. Department of Energy
Oak Ridge Field Office
P.O. Box 2001
Oak Ridge, Tennessee 37831-8723

Attention: David G. Adler, Site Manager
Former Sites Restoration Division

Subject: Hazard Assessment for Residual Contamination at the Former Associate Aircraft Site (AAS)

Dear Mr. Adler:

Based on sample results obtained at AAS, uranium-238 concentrations above the site specific criteria (35 pCi/g) were found in a small sub-slab area in Section 1 of the former AAS building. The sample results of the location indicated radioactive contamination at a maximum concentration of 134 pCi/g. This is well below the derived guidelines for this site and equates to a dose of 4.154 mrem/yr for current and likely future use of the site. The vertical and areal extent of contamination was established for the location by additional sampling.

The enclosed Hazard Assessment (HA) was prepared under my direction or supervision in accordance with a system designed to ensure that the information submitted was properly gathered and evaluated. To the best of my knowledge and belief, they are true, accurate, and complete.

Based on this HA and the additional cost that would be entailed (≈$260,000), no additional characterization or remediation is planned for this isolated area of contaminated soil in Section 1. Mike Murray (ORNL) has reviewed the HA and has given IVC concurrence.

Bechtel National, Inc.

129543

Please forward the enclosed submittal letter to A. Williams for concurrence.

It is requested that DOE-HQ provide approval of this Hazard Assessment by May 12, prior to completion of work at the Associate Aircraft site. If you have any questions, contact me at (615) 576-1710.

Sincerely,

Janice S. Allison
for

G. L. Palau
Project Manager - FUSRAP

BWJ:kt:HAZMEMO

Concurrence: B. Johnson @ BWJ
J. Wood JW
M. Kaye JM

ACTION REQ'D ☒ YES ☐ NO DUE DATE 5/06/95
RESPONSE TO CIRCON NO. _____
☐ FFA ☐ Permit ☐ Milestone ☐ OcR ☐ CCN ☐ CAR ☐ Mid-Yr ☐ Yr-End ☐ Periodic Rpt

United States Government

memorandum

Department of Energy
Oak Ridge Operations Office

DATE: May 8, 1995

REPLY TO
ATTN OF: EW-93:Adler

SUBJECT: HAZARD ASSESSMENT FOR RESIDUAL CONTAMINATION AT THE FORMER ASSOCIATE AIRCRAFT SITE (AAS)

TO: Dr. W. A. Williams, Trevion II Building, Department of Energy, Washington, D.C. 20585-0002, EM-421

Uranium-238 concentrations above the site specific criteria (35 pCi/g) were found in the soil in a small sub-slab area of the former AAS building. The sample results of the location indicated a maximum concentration of 134 pCi/g. This is well below the derived guidelines for the site and equates to a dose of 4.154 mrem/yr for current and likely future use of the site.

Based on this HA and the additional cost that would be entailed (=$260,000), no additional characterization or remediation is planned for this isolated area of contaminated soil in Section 1. Mike Murray Oak Ridge National Laboratory has reviewed the HA and has given IVC concurrence.

Please review the enclosed Hazard Assessment and provide your approval by May 12, 1995. The remediation of the site is in the final stages is currently scheduled for May 15, 1995.

David G. Adler, Site Manager
Former Sites Restoration Division

Enclosure

ASSOCIATE AIRCRAFT SITE HAZARD ASSESSMENT FOR IDENTIFIED SOIL CONTAMINATION

1.0 PURPOSE

To determine the hazard associated with the localized sub-slab contamination found at the Associate Aircraft Site (AAS) in Fairfield, Ohio under a portion of the former AAS building (see figure 1). This assessment leads to the conclusion that the potential dose from the residual soil contamination is well below the current or likely use guideline, as proposed in 10 CFR 834.

2.0 INITIAL DERIVATION OF CLEANUP GUIDELINES

The Environmental Assessment Division of Argonne National Laboratory published *Derivation of Guidelines for Uranium Residual Radioactive Material in Soil at the Former Associate Aircraft Tool and Manufacturing Company Site, Fairfield, Ohio* in January 1995 (Reference 1). This work was sponsored and approved by the U.S. DOE, Office of Environmental Restoration.

The Associate Aircraft site has been identified for remedial action under the U.S. DOE's Formerly Utilized Sites Remedial Action Program (FUSRAP). Uranium guidelines were derived on the basis of the requirement that following remedial action, the 50-year committed effective dose equivalent to a hypothetical individual living or working in the immediate vicinity of the site should not exceed (1) 30 mrem/yr for the current-use and likely future-use scenarios or (2) 100 mrem/yr for less likely future-use scenarios (Yu et al. 1993).

The DOE residual radioactive material guideline computer code, RESRAD (version 5.41), which implements the methodology described in the DOE manual for establishing residual radioactive material guidelines, was used in the evaluation.

Three scenarios were considered in which it was assumed that the site would be used without radiological restrictions for a period of 1,000 years following remedial action. The three scenarios varied with regard to the type of site use, time spent at the site by the exposed individual, and sources of food consumed. The evaluation indicated that the EPA dose limit of 30 mrem/yr would not be exceeded for uranium (including U-234, U-235, and U-238) within 1,000 years provided that the soil concentration of total uranium at the site did not exceed 970 pCi/g for scenario 1 (industrial worker: current use scenario) or 280 pCi/g for scenario 2 (resident: municipal water supply, a likely future-use scenario). The DOE dose limit of 100 mrem/yr (DOE Order 5400.5) would not be exceeded at the site if the uranium concentration of the soil did not exceed 790 pCi/g for scenario 3 (subsistence farmer: on-site well water, a plausible but unlikely future-use scenario).

The uranium guidelines derived in the analysis applied to the total activity concentration of uranium isotopes (i.e., U-238, U-234, and U-235 present in their natural activity concentration of 1:1:0.046). In setting the actual uranium guidelines to be used at the Associate Aircraft site, DOE applied the as-low-as-reasonably-achievable (ALARA) policy to the decision-making process. After these considerations the actual uranium guideline used for residual radioactivity in soil was 35 pCi/g (1/8th of the most conservative derived guideline).

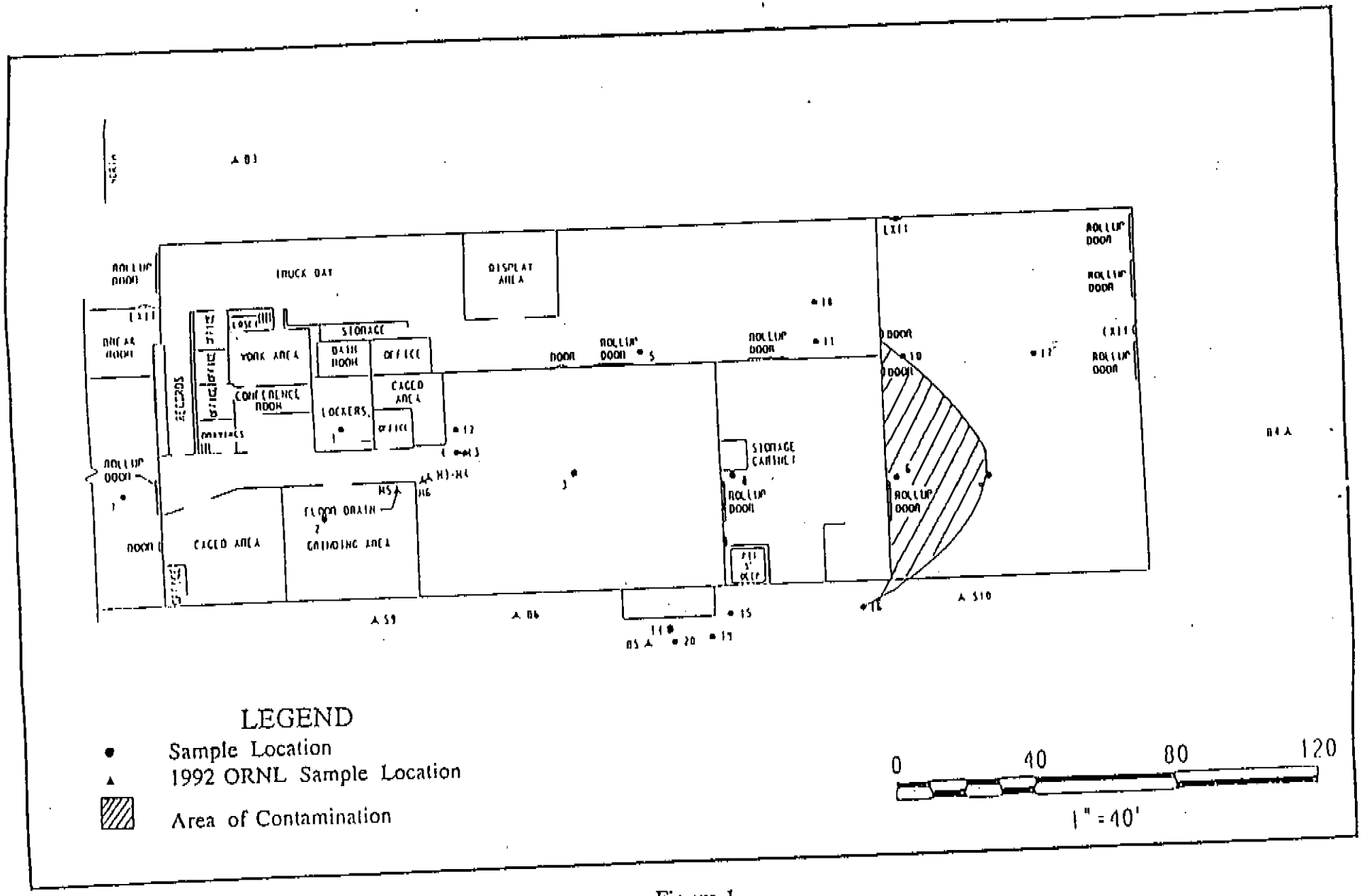

Figure 1
Former Associate Aircraft Site

3.0 HAZARD DETERMINATION FOR RESIDUAL SOIL CONTAMINATION AT AAS

In December 1994 and February 1995, 111 samples were collected from 15 locations inside the former AAS building, and 34 samples were collected from 13 locations outside the building. These locations were selected to further delineate boundaries (both vertical and horizontal) of contamination identified in the ORNL report. Figure 1 shows interior and exterior sampling locations.

Based on the results obtained, uranium-238 concentrations above the site specific criteria (35pCi/g) were found at locations 1, 4 and 6. Uranium-238 concentrations from the sampling locations in these areas are presented in Table 2. The radioactive contamination detected at locations 4 and 6 were delineated in a second phase of sampling by placement of sample locations 10, 9 and 16 for location 6, and additional sample locations 12 and 13 for location 4. Vertical and areal extent of contamination has thereby been established for these locations. The areas around location 1 and 4 were adjacent to a radioactively contaminated expansion joint and have since been remediated. Therefore this hazard assessment applies to the area in the proximity location 6.

The sample results of location 6 indicate radioactive contamination at a maximum concentration of 134 pCi/g. Table 1 summarizes the results of the sampling at location 6, 9, 10, and 16.

Table 1 - Sampling Results

Borehole	Depth (ft)	Field Counts (cpm)*	U-238 (pCi/g)**
6	0 - 1	40	< 2.3
	1 - 2	40	< 2.4
	3 - 4	1400	134
	4 - 5	60	5.8
	5 - 6	50	< 5.0
	6 - 7	50	< 1.9
	7 - 8	50	< 2.5
9	0 - 1	45	< 1.7
	1 - 2	45	< 1.3
	2 - 3	50	< 1.5
	3 - 4	50	< 1.3
	4 - 5	50	< 2.6
	5 - 6	45	< 3.8
	6 - 7	45	< 2.9
	7 - 8	45	< 1.9
	8 - 9	45	< 2.7
	9 - 10	50	< 4.4
	10 - 11	50	< 1.7
	11 - 12	45	< 2.2
10	0 - 1	42	.44
	1 - 2	42	< 1.4
	3 - 4	44	< 2.0
	4 - 5	55	.63
	5 - 6	52	1.8
	6 - 7	52	.40
	7 - 8	70	.47
	8 - 9	70	< 1.5
	9 - 11	54	< 1.4
16	0 - 1	58	.84
	1 - 2	41	.60
	2 - 3	55	< 1.3
	3 - 4	50	< 1.2

* Measured with HP 210 or HP 260 field radiation detection instrument

** Measured with Gamma Spectroscopy radiation detection instrument

3.1 CALCULATIONS

Using the derived maximum dose/source ratios (see Attachment A), calculations were performed for all three scenarios. Based on the calculations, utilizing RESRAD, it has been determined that this material represents a minimal hazard.The results of the calculations are shown in Table 2 below.

Table 2
Maximum Annual Dose From Residual Radioactive Contamination at the Former Associate Aircraft Site

Scenario #	Dose/Source Ratio x Soil Activity Conc= (mrem/yr)/(pCi/g) (pCi/g)				Dose (mrem/yr)
1[a]	3.1×10^{-2}	x	134	=	4.154
2[b]	1.1×10^{-1}	x	134	=	14.74
3[c]	1.3×10^{-1}	x	134	=	17.42

a-Industrial worker: no consumption of water or foods obtained on the site.
b-Resident: water used for drinking, household purposes, and irrigation was assumed to be from uncontaminated municipal sources.
c-Subsistence farmer-water used for drinking, household purposes, livestock watering, and irrigation was assumed to be from an on-site well.

3.2 SUMMARY OF RESULTS

Scenario 1 - The results of the RESRAD calculations determined that in scenario 1 an industrial worker would receive an annual exposure of 4.154 mrem/yr due to the residual contamination on the site.

Scenario 2 - The results of the RESRAD calculations determined that in scenario 2 a resident would receive an annual exposure of 14.74 mrem/yr due to the residual contamination on the site.

Scenario 3 - The results of the RESRAD calculations determined that in scenario 3 a subsistence farmer would receive an annual exposure of 17.42 mrem/yr due to the residual contamination on the site.

All of the calculated values are below the 30 mrem/yr for current or likely land use, as proposed in 10 CFR 834. Furthermore, the calculations only allowed for a shielding factor of 30% for the attenuation of external gamma radiation in scenario 1, in reality the shielding provided would provide much greater than 30% shielding. In scenarios 2 and 3, it is likely that large amounts of the contaminated soil would be removed in preparing the site for residential or farming use. The initial dose/source ratios were determined on a large homogeneously contaminated area. For a small, isolated area of contamination, such as the area in question (see figure 1), the annual dose would be even less due to the smaller amount of contact possible (Yu et al. 1993). Therefore, the calculated annual doses are very conservative.

4.0 CONCLUSION

The calculations performed for this assessment lead to the conclusion that the potential dose from residual radioactive contamination for in all three scenarios is well below the 30 mrem/yr current or likely land use guideline, as proposed in 10 CFR 834. All scenarios use conservative assumptions and address all credible pathways. Furthermore, scenario 1 is most likely at this site, consideration of scenarios 2 and 3 provide additional evidence of the minimal hazard.

Results of these calculations show that supplemental limits are warranted for the area of location 6. Leaving the residual contamination in place does not pose a potential present or future exposure risk, and the cost (≈ $260,000) and time involved in remediation and restoration of this area is high relative to the long-term benefits that would result.

5.0 REFERENCES

1. Yu, C., et al., 1995, *Derivation of Guidelines for Uranium Residual Radioactive Material in Soil at the Former Associate Aircraft Tool and Manufacturing Company Site, Fairfield, Ohio*, ANL/EAD/LD-2, Argonne National Laboratory, Argonne, Ill., Jan.

2. Yu, C., et al., 1993, *Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD, Version 5.0*, ANL/EAD/LD-2, Argonne National Laboratory, Argonne, Ill., Sept.

3. Spieker, A.M., 1965, *Hydrogeologic Aspects of an Analog Model Study of the Fairfield-New Baltimore Area, Ohio*, Doctoral Thesis, Stanford University, Stanford, Calif.

4. Orlandini, K.A., 1994, personal communication from Orlandini (Environmental Research Division) to C. Yu (Environmental Assessment Division), Argonne National Laboratory, Argonne, Ill., Dec. 19.

ATTACHMENT A

DERIVATION OF TOTAL DOSE/SOURCE CONCENTRATION RATIOS FROM

Derivation of Guidelines for Uranium Residual Radioactive Material in Soil at the Former Associate Aircraft Tool and Manufacturing Company Site, Fairfield, Ohio

1.0 Scenario Definitions

Three potential exposure scenarios were considered for the assessment of residual radioactivity guidelines for the soil. For each scenario, it was assumed that at some time within 1,000 years, the site would be released for use without radiological restrictions following remedial action. Potential radiation doses from nine exposure pathways were considered. The pathways are listed in Table A-1.

Table A-1

Summary of Exposure Pathways for Scenarios 1,2, and 3 at the Former Associate Aircraft Site

Pathway	Scenario 1[a]	Scenario 2[b]	Scenario 3[c]
External Exposure	Yes	Yes	Yes
Inhalation	Yes	Yes	Yes
Radon	Yes	Yes	Yes
Ingestion/plants	No	Yes	Yes
Ingestion/meat	No	No	Yes
Ingestion/milk	No	No	Yes
Ingestion/fish	No	No	Yes
Ingestion/soil	Yes	Yes	Yes
Ingestion/water	No	No	Yes

a-Industrial worker: no consumption of water or foods obtained on the site.
b-Resident: water used for drinking, household purposes, and irrigation was assumed to be from uncontaminated municipal sources.
c-Subsistence farmer-water used for drinking, household purposes, livestock watering, and irrigation was assumed to be from an on-site well.

The RESRAD computer code (YU et al. 1993) was used to calculate the potential radiation doses for the hypothetical future industrial worker (scenario 1) and the resident and subsistence farmer (scenarios 2 and 3 respectively) on the basis of the following assumptions:

- During one year, the industrial worker spends 2,000 hours (23%) indoors at the site, 250 hours (3%) outdoors at the site, and 6,510 hours (74%) away from the site. During one year, the resident and subsistence farmer spend 4,380 hours (50%) indoors, 2,190 hours (25%) outdoors, and 2,190 hours (25%) away form the site (Yu et al. 1993).

- The walls, floor, and foundation of the building reduce external exposure by 30%; the indoor dust level is 40% of the outdoor dust level.

- The airborne dust loading is 0.1 mg/m^3.

- The depth of the house or building foundation is 1 m below ground surface, with an effective radon diffusion coefficient of 2×10^{-8} m^2/s.

- The size of the decontaminated areas is sufficiently large that 10% and 50% of the plant food diet consumed by the resident and farmer for scenarios 2 and 3, respectively, is grown in a garden in the decontaminated area. The industrial worker does not consume these plant foods.

- The size of the decontaminated area is large enough to produce 50% of the forage used to feed livestock for meat and milk consumed by the subsistence farmer i scenario 3. The resident and industrial worker does not consume these animal products.

- For scenario 3, 50% of the fish and other aquatic food consumed by the subsistence farmer is obtained from an on-site pond.

- The current supply of water for the industrial building is from uncontaminated municipal sources.

- The soil is sand and gravel (Spieker 1965) and typical values for sandy soils tabulated in Yu et al. (1993) were used for the density, total and effective porosities, soil "b"parameter, and hydraulic conductivity in the contaminated, unsaturated, and saturated zones.

- The uranium distribution coefficient was measured at 100 cm^3/g for soil (Orlandini 1994); this value is used for all uranium isotopes in the various zones

- A distance of 3.8 m to the water table was assumed on the basis of the average water table in area wells.

- After remedial action, no cover material is placed over the decontaminated area.

- No erosion of the contaminated material occurs.

2.0 Dose/Source Concentration Ratios

To develop residual radioactivity guidelines for soil at the former Associate Aircraft Site, the RESRAD computer code, version 5.41 (Yu et al. 1993), was used to calculate the dose/source concentration ratio $DSR_{ip}(t)$ for uranium isotope i and pathway p at time t after remedial action. The time frame considered in this analysis was 1,000 years. Radioactive decay and ingrowth were considered in deriving the dose/source concentration ratios. The various parameters used in the RESRAD code for this analysis are listed in the appendix of Reference 1. For all three scenarios, the maximum dose/source concentration ratios occur at time zero (immediately after remedial action).

The summation of $DSR_{ip}(t)$ for all pathways p is the $DSR_i(t)$ for the ith isotope; that is,

$$DSR_i(t) = \Sigma_p DSR_{ip}(t).$$

The total dose/source concentration ratio for total uranium can be calculated as

$$DSR(t) = \Sigma_i W_i DSR_i(t),$$

where W_i is the existing activity concentration fraction in soil at the site for uranium-234, uranium-235, and uranium-238.

For this analysis, W_i is assumed to represent the natural activity concentration ratios of 1/2.046, 1/2.046, and 0.046/2.046 for uranium-238, uranium-234, and uranium-235, respectively. The total dose/source concentration ratios for single radionuclides and total uranium are provided in Table A-2. These ratios were used to determine the allowable residual radioactivity for uranium in soil at the former Associate Aircraft site. These ratios will also be used to determine the level of hazard that will remain on-site at the given concentration of residual soil contamination.

Table A-2

Total Dose/Source Concentration Ratios for Uranium at the Former Associate Aircraft Site

	Maximum Dose/Source Concentration Ratio (mrem/yr)/(pCi/g)		
Radionuclide	Scenario 1[a]	Scenario 2[b]	Scenario 3[c]
Uranium-234	1.6×10^{-2}	5.9×10^{-2}	8.0×10^{-2}
Uranium-235	1.9×10^{-1}	6.1×10^{-1}	6.3×10^{-1}
Uranium-238	3.9×10^{-2}	1.3×10^{-1}	1.5×10^{-1}
Total uranium	3.1×10^{-2}	1.1×10^{-1}	1.3×10^{-1}

a-Industrial worker: no consumption of water or foods obtained on the site.
b-Resident: water used for drinking, household purposes, and irrigation was assumed to be from uncontaminated municipal sources.
c-Subsistence farmer-water used for drinking, household purposes, livestock watering, and irrigation was assumed to be from an on-site well.

Because the maximum dose occurs at time zero in all three scenarios, uncertainties in parameters that affect the leaching of radionuclides from the contaminated zone and their transport through unsaturated and saturated strata do not affect results. Breakthrough time (the time it takes the uranium to reach the water table) was estimated to occur in 600 years after remediation (Yu et al. 1995), however, the dose contribution from water-dependent pathways in scenario 3 is smaller than the contribution of the water-independent pathways at the time of peak dose. Changing the depth of the water table would only affect the breakthrough time, it would not significantly affect the magnitude of the dose contributed by water-dependent pathways.

The RESRAD default values were used in the calculations if no site-specific data were available. These default values are based on national average or reasonable maximum values.

APPENDIX C

Waste Minimization Summary

WASTE MINIMIZATION SUMMARY
FOR THE ASSOCIATE AIRCRAFT SITE

The decontamination of the Associate Aircraft site was conducted in a manner that prevented the overexpenditure of funds while expediting the remedial action. Refining contamination boundaries, decontaminating walls rather than demolishing them, and surveying PPE for disposal as clean trash were a few of the measures used.

The volume and waste streams at the site are listed in Table C-1. This table shows that the total volume shipped for disposal and the total volume excavated are the same. None of the excavated material was used as fill material; all material was disposed of as low-level radioactive waste. The cost and time of separating the uncontaminated debris from the "clean" material were not justified by any need for separation.

TABLE C-1

REMEDIAL ACTION SUMMARY

WBS 124

SITE Associate Aircraft Tool and Manufacturing Company

OWNER Mr. James L. Besl

SITE ADDRESS 3660 Dixie Highway

CITY, STATE Fairfield, Ohio

REMEDIATION AUTHORITY

- ■ NEPA/CERCLA
- ☐ SUPERFUND
- ☐ RCRA

ACTION	DATE	RESPONSIBLE ENTITY	DOCUMENT
DESIGNATION	05-03-1993	DOE	Designation/Authorization Report
CHARACTERIZATION	03-15-1993	ORNL	Results of Radiological Survey at the Former Associate Aircraft Tool and Manufacturing Company, Fairfield, Ohio.
FINAL RA	05/95	DOE/ORNL/BNI	Post-Remedial Action Report for the Former Associate Aircraft Tool and Manufacturing Company, Fairfield, Ohio

TOTAL VOLUME 115.6 yd^3

To Remain In Situ 0

Volume Reduction 0

Net Disposal 115.6 yd^3

Documentation Used: N/A

TYPE OF WASTE FOR NET DISPOSAL:

REGULATORY		VOLUME	DISPOSAL SITE
■	LLRW	107.6 yd^3	Clive, Utah
☐	11(E)2		
■	MIXED	8 yd^3	Clive, Utah
☐	CHEMICAL		
PHYSICAL			
☐	BUILDING RUBBLE		
☐	SOIL		
☐	LIQUID		
☐	OTHER		

TREATMENT TECHNOLOGIES APPLIED AT THE SITE:

Macroencapsulation and stabilization.

144457

Bechtel

Oak Ridge Corporate Center
151 Lafayette Drive
P.O. Box 350
Oak Ridge, Tennessee 37831-0350

Telephone: (423) 220-2000

Job No. 14501, FUSRAP Project
DOE Contract No. DE-AC05-91OR21949
Code: 7330/WBS: 124

JUL 23 1996

U.S. Department of Energy
Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, TN 37831-8723

Attention: David G. Adler, Site Manager
Former Sites Restoration Division

Subject: Associate Aircraft Site - Publication of PRAR

Dear Mr. Adler:

Enclosed is a copy of the subject document, which is being published in accordance with your instructions on April 5 (CCN 140961). Comments on the previous draft have been addressed, and a comment response package is also enclosed.

This document and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that the information submitted was properly gathered and evaluated. To the best of my knowledge and belief, they are true, accurate, and complete.

If you have any questions, please call me at 241-2192.

Sincerely,

, P.E.

K. Albin
Project Manager - FUSRAP

BAF:onl:LR_1832.DOC
Enclosures: (1) Published AAS PRAR
(2) Comment response package

cc: S. K. Oldham, w/a
B. Atkin, w/a

Concurrence: W. Cosey D. Hughel B. Fogelman

ACTION REQ'D ☐ YES ☐ NO DUE DATE _____
RESPONSE TO CHRON NO. _____
☐ FFA ☐ Permit ☐ Milestone ☐ OcR ☐ CCN ☐ CAR ☐ Mid-Yr ☐ Yr-End ☐ Periodic Rpt

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