Radium in Military Surplus Commodities

JEROME A. HALPERIN, M.P.H., and JOHN M. HESLEP, Ph.D.

MILITARY SURPLUS commodities containing radioactive materials, primarily radium, are released by Department of Defense facilities through the General Services Administration and the Defense Supply Agency to commercial retail channels of trade. In some respects military surplus constitutes one of the largest unidentified sources of radioactive material reaching the general public.

Radium has been used by the military services for more than 50 years. The chief uses have been the illumination of gunsights, watch dials, compass cards, and wherever other forms of illumination at night might betray one's presence to the enemy. Radium has been used to illuminate instrument panels in aircraft in the event of power failure. An early reference to the use of radium in aircraft states that instruments with self-luminous dials were used in the Navy flying boat NC–4, which flew across the Atlantic in 1919 (*1*). Estimates by the British placed radium usage at 10 gm. (*2*) for military purposes during World War I. As high as 500 mg. of radium per month were used in manufacturing luminous compounds during the war (*2*).

During the early part of World War II, sufficient pitchblende to produce 100 gm. of radium was imported into the United States from Belgium (*3*). Production data during World War II were not available because of security reasons or because of company confidential figures; however, estimates placed the quantity of radium used in luminous compounds at several hundred grams (*3*).

Since World War II, many items no longer needed by the military services have been released to the general public. Some of the surplus commodities represent portions of the several hundred grams of radium used by the military during the last 50 years.

Mr. Halperin was formerly a radiological health specialist with the California State Department of Public Health, Berkeley. He is now chief of the radiological health section, Kansas State Department of Health, Topeka. Dr. Heslep is chief of the bureau of radiological health, California State Department of Public Health.

Project Investigations

In September 1964 the Bureau of Radiological Health of the California State Department of Public Health undertook to identify, in a pilot project, the typical surplus articles that contain radioactive material. Thirty-seven retail "surplus" stores in San Francisco, Oakland, Berkeley, Los Angeles, and San Diego were visited and surveyed for radioactive material. The stores selected were chosen from those listed under Surplus Merchandise in the yellow pages of telephone directories.

An effort was made to select stores specializing in electronic components, aircraft instruments, and related commodities, as these classes of merchandise were considered more likely to contain radioactive material than other classes of surplus such as soft goods, office equipment, vehicles, and so on. No attempt was made to visit all the stores handling such items throughout the State, as it was felt that the sample chosen from four major population areas of California should be representative of those most likely to be found in other parts of the State.

Of the 37 stores surveyed, 20 offered items containing radioactive material for sale. Most of the stores had less than 50 radioactive ob-

jects, although several had large stocks of merchandise containing radioactive material. One store, specializing entirely in surplus electronic equipment, had thousands of radioactive switches, circuit breakers, meters, and so on.

Dose rates, which were measured with a portable GM instrument (*A*)—and should be considered only as indicative of the range in which the true dose rates may be—at the faces of bins were as high as 5 mr. per hour and in the center of aisles 2 mr. per hour, or high enough for the establishment of a controlled area under the California Radiation Control Regulations.

The visits were conducted by a bureau staff member in the following manner. After arriving at the store, the investigator contacted the person in charge, explained the purpose of the visit, and obtained permission to survey the merchandise. The shelves and bins where the merchandise was stored were examined with the use of a Gelman Sparrow model 28100–L monitoring instrument (*B*). When the audible click rate increased above background rate, the responsible item or items were removed to a remote part of the store and examined more closely with a GM instrument. At this time, identifying information on the object and the number of these objects was recorded. This approach was preferable to using a survey meter directly, as the sight of a person examining the merchandise with a survey meter proved to be disconcerting to both customers and sales personnel. The following list of radioactive merchandise was inventoried while surveying the retail military surplus stores:

A. Aircraft instruments
   1. Bendix turn and bank indicator, type A–11, part 1722–2V–A2
   2. Sperry Gyro—Horizon, part 643710
   3. Fairchild indicator, identification No. 1–81–F, order No. 2544–WF–42
   4. Bendix indicator—Magnesyn, type 10070–1S–A1, mark I, model I; contract No. NXSS059688
   5. Bendix tuning meter, identification No. R16–BxR–mr–57B
   6. Sperti instrument, function unknown; part 11585
   7. Weston instrument, function unknown; part 103357
   8. Manifold pressure gauges, no identification
   9. Altimeters, no identification
   10. Luminous dial faces for various aircraft instruments, no identification

B. Meters and gauges
   1. Microtone meters, function unknown, part BF7194; packed in boxes of 25 each, each box labeled, in magenta and yellow, DANGER—RADIATION HAZARD, with radiation symbol
   2. Delco oxygen flow indicator, part 1506523, contact No. W–11–107–ac–632(127)
   3. GE indicator, type DJ–11, model 80J11PFS, sub. 17
   4. GE tuning meter, type 1–70–D
   5. Weston gauge, function unknown, model 1329
   6. Oxygen regulator, identification No. 106 D/24
   7. Electric engine speed indicator, identification No. MKIIE
   8. Oil pressure gauge, no identification
   9. Lewyt black light meters, type US/AM

C. Switches, knobs, and circuit breakers
   1. Cutler-Hammer switches, identification No. 8801K2.
   2. Cutler-Hammer toggle switches, identification No. 8905K515
   3. Cutler-Hammer toggle switches, identification No. ST52K
   4. Cutler-Hammer circuit breaker, identification No. 87501K3
   5. IRC switches, components of power rheostats; 25 watt, type PR–25; 50 watt, type PR–1088.
   6. Spencer switches (Klixon), type D–6751–2
   7. Switch knobs, identification Nos. BA–720323, AF33–600–10060, item 15
   8. Circuit breakers, identification No. B–7A
   9. Switch knob, identification No. BA–720323

D. Communications equipment
   1. Admiral remote control indicator unit, type CQC–23496, a unit of model TDZ–RDZ Mars radio equipment; contact No. N5–SR 4633
   2. Colonial portable transmitter-receiver, type CRI–43044, a unit of model TBY–4 radio equipment
   3. Hoffman portable transmitter-receiver, type CKB–43069–A
   4. Garod portable transmitter, type CGQ–43060
   5. Bendix portable transmitter, identification No. BC–778–E
   6. ARM field telephone components, identification No. C–664/VIA–1

E. Miscellaneous items
   1. Two-hole junction boxes with luminous buttons, identification No. 9–S–4808L
   2. GE ships clocks, type A, contract 29621 (1935)
   3. Daystrom surface lookout alidade, mark V, model 0
   4. Lionel and Brunson pocket compasses, marked with radiation symbol and specifying Ra–226 in magenta and yellow
   5. Red Star army instrument field test set, type C–1
   6. Westinghouse luminous dial face, type AX–39, style 1274803

7. Radioactive test samples, identification No. MX-952-PP
8. Temperature gauge (used by Japanese Navy), Fuji Kokukeiki Kabushiki Kaisha (Fuji Aero-Instrument Corp. Ltd.), model Am74N1, Serial No. 67523, manufactured January 1941
9. Western storage pig (lead and paraffin in steel shell): diameter 10¾ inches, height 13 inches. (A wipe of interior of the well of pig, analyzed by the State department of public health, indicated no radioactive material was present.)

F. Electron tubes of many different kinds and manufacturers: for example, BOMAC 347 marked as containing cobalt 60, BOMAC BL-601 marked as containing cobalt 60, METCOM MST 17, OC3, and IB22

Specifically, if this one-time survey can be considered representative, the radioactivity appears mainly limited to aircraft panel instruments, switches, knobs and buttons, electron tubes, dials, gauges and meters, portable radio transmitters, ships clocks, and pocket compasses.

Except for a few generally licensed devices, mostly electron tubes and wave guides, marked as containing cobalt 60, the radioactive material was not identified; in fact, there was no indication that an object contained radioactive material. For the most part, the radioactive material consisted of luminous compounds. Many luminous objects that did not exhibit external radiation measurable by the instruments used were also noted. It was not determined whether any of these contained tritium.

Several radioactive items were purchased by the investigator, and others were turned over to him by the dealer for disposal. Seven items in this group were sent to the State health department's sanitation and radiation laboratory. All were found to contain radium 226 and its daughters, with the radium content varying from 0.06 to 14.6 μg. The results of the analyses follow:

Item	*List No.*	*Radium 226 activity, μg.*
Luminous dial face	A10	0. 06
Switch knob	C7	. 3
Toggle switch	C3	. 3
Luminous dial face	A10	1. 1
Switch knob	C5	1. 3
Luminous dial face	E6	4. 4
Japanese meter	E8	14. 6

Radium in quantities not exceeding 0.1 μg. each for unsealed sources and 1.0 μg. each for sealed sources may be possessed under a general license in California. Most of the objects noted could not be considered sealed sources and would be subject to specific licensure if they contained greater than 0.1 μg. of radium. In addition, only ten 0.1-μg. quantities may be possessed under a general license. Possession of more than 10 such quantities requires authorization by specific license. Most of the radioactive objects and virtually all the stores possessing radioactive objects would be subject to specific licensure under State regulations. Since California's regulations are similar to the recommendations of the Council of State Governments, licensure may be applicable in other States where regulations follow the council's recommendations.

Discussions with several dealers revealed that considerable scavenging of usable switches, meters, and dials from larger and otherwise unusable chassis takes place. The chassis are then disposed of to scrap metal dealers. Such scavenging can result in breakage that violates the integrity of the source closure and can allow the escape of some radioactive material by flaking. Wipes taken of several bins that contained broken-faced objects were analyzed by the department's sanitation and radiation laboratory. Minor contamination was found in one instance.

During each visit to retail surplus stores, the investigator attempted to ascertain how the dealer obtained surplus commodities. It was learned that the material usually was purchased on bid from the Defense Supply Agency. Visits were then made to the defense surplus sales offices of the Defense Supply Agency, U.S. Naval Supply Centers in Oakland and San Diego, Calif., in an attempt to determine the routes of supply. A review of the "Defense Disposal Manual" (*4*) elicited the following information.

Routes of Supply

The Federal Property and Administrative Services Act of 1949 as amended (Act of June 30, 1949, 63 Stat. 377, 40 U.S.C. 471) assigned the responsibility for and supervision over the disposition of domestic excess and surplus Federal property to the Administrator of General Services, General Services Administration. The disposition of foreign excess was assigned to the Secretary of Defense.

The Administrator of General Services dele-

gated responsibility for Department of Defense-generated excess and surplus to the Secretary of Defense. The Secretary of Defense, in turn, established the Defense Supply Agency and assigned the responsibility for disposition of the Department of Defense-generated excess and surplus to the Director of the Defense Supply Agency.

The Director of the Defense Supply Agency established the Defense Logistics Supply Center, its regional offices, and the defense surplus sales offices.

Military property that is determined to be potential excess by a military facility is reported to the Defense Logistics Supply Center, where it is screened to determine whether other Department of Defense facilities can use it. The property that cannot be used by the Department of Defense is reported to the General Services Administration for civilian Federal agency screening.

The General Services Administration circulates listings of excess property to other Federal agencies such as the Department of Health, Education, and Welfare, which has the responsibility for selecting property determined to be usable and necessary for educational, public health, civil defense, and public library purposes, including research for any such purpose; and the Federal Aviation Agency, which has the responsibility for selecting property determined to be essential, suitable, or desirable for the development, improvement, operation, or maintenance of a public airport.

The Assistant Secretary of Defense (Manpower) is authorized to donate surplus property to service education activities such as the Reserve Officers Training Corps at schools and colleges; State maritime academies; civilian youth organizations such as the Boy Scouts of America, Girl Scouts of America, Camp Fire Girls, and Boys Clubs; the American National Red Cross; and others.

Any material remaining on the excess lists after these agencies have had the opportunity to acquire it is designated surplus property and is offered for sale by auction, sealed bid, and spot bid to registered bidders through the Defense Supply Agency's defense surplus bidders control officer.

Besides purchasing directly, retailers also purchase surplus from other retailers and combine with others to make group purchases of large lots of material. Surplus material may change ownership and physical location many times before reaching the retail store where it is offered for sale to the general public.

Disposal Procedures

Defense Supply Agency disposal procedures were reviewed to determine if items being offered for donation or sale are screened for radioactive material and, if so, whether they are removed from the donable or salable property.

The Defense Supply Agency defines radioactive material as: "Any item or material which is in itself radioactive or which is contaminated with radioactive material giving readings in excess of background radiation as measured on an instrument designed specifically for the type of radiation being emitted" (*4a*). This definition does not seem to take into account items that, although not radioactive themselves, incorporate radioactive material in one or more parts of subassemblies; for example, meters with luminous dials. However, this point seems to be included in the disposal directives.

Part 3, chapter 7, of the "Defense Disposal Manual," Special Conditions of Sales, subchapter K, Special Items and Circumstances, lists conditions that are to be included in sales invitations when the appropriate item is offered for sale. Condition 8 of this subchapter states:

> 8. Article: Radioactive Material. Purchasers are warned that some property purchased here under, such as, but not limited to, switches, circuit breakers, knobs, controls, pointers, instrument dials, markers, etc., may be capable of emitting ionizing radiation in varying degrees. Various electron tubes may also be capable of emitting ionizing radiation in varying degrees. The Government assumes no liabilities for damages to the property of the Purchaser, or for personal injuries or disabilities to the Purchaser or his employees, or to any other person arising from or incident to the purchase of this material or its use or disposition by the Purchaser. The Purchaser shall hold the Government harmless from any and all such claims. As a safety precaution, the Purchaser should also warn the future possessor or user of this property that it may be capable of emitting ionized radiation.

A similar disclaimer is put on the shipping documents of donated property (*4b*).

Condition 16 of the same subchapter pertains to purchases of radium and reads:

16. Article: Certification for Radium Item(s) no. _____

(1) The purchaser certifies that he will comply with all Federal, state, and local laws, ordinances, and regulations with respect to the care, handling, storage and shipment, resale, export and other use of the radium herein purchased and that he is a user, manufacturer, processor of, or dealer in such materials, and is capable of complying with all applicable Federal, state, and local laws.

(2) Bids from individuals or firms not possessing the experience, organization, and technical qualifications to re-encapsulate and handle material of the nature offered (either through its own facilities or the facilities of another individual or firm) will be rejected.

In part 3, chapter 15, Property Requiring Special Handling, paragraph B.52 details the procedures to be followed in disposing of radioactive material.

52. Radioactive material. a. Following are those persons or organizations within the Military Departments having overall knowledge and responsibility for disposal of radioactive material within their respective departments.

(1) Army—Commanding General, U.S. Army Chemical Center and Chemical Corps Materiel Command, Army Chemical Center, Edgewood, Md.

(2) Navy—Bureau of Medicine and Surgery.

(3) Air Force—Director of Base Medical Service (Surgeon). (See Technical Order 00–110A1 and Technical Order 00–110N–2.)

b. Disposal organizations will not normally accept, store or make shipments of radioactive material. However, the services of such organizations may be used in selling such surplus property for which a commercial demand exists.

c. Some property having low levels of radioactivity, such as electron tubes and instruments containing radium or other radioactive luminous compounds, may be received in disposal activities. Whenever there is any doubt as to the radioactive content of an item or its acceptability in disposal activities, the appropriate authority cited in Subparagraph a above will be contacted for determination. Whenever there is the slightest possibility that any item offered for sale may contain low levels of radioactivity, the warning contained in Chapter VII, Paragraph K.8, this Part, will be made a part of the sales document as a provision of sale.

d. (1) There are no Federal restrictions for handling of radium and a much broader market exists for the sale of radium than the restrictive bidders to which sales have been previously made.

(2) In order to take advantage of this market, future offerings of radium should be made by the sealed bid method of sale unless conditions surrounding the sale warrant the use of another method.

(3) When radium is offered for sale, the clause listed in Chapter VII, Paragraph K.16, this Part, will be included in the invitation for Bids.

Individual items of surplus are seldom, if ever, labeled as containing radioactive material. If the surplus is not surveyed to identify and remove the radioactive items, they go undetected to the retail dealers, who for the most part are unaware that some of the items may be radioactive. Directions for the disposal of dangerous property state that extreme care is to be exercised in the disposal of property that is dangerous to the health of the public and further state that property which is strictly military in character or lacking in commercial value be rendered innocuous before being turned over to a disposal officer (*4c*).

Conclusions

It appears that no major health problem is involved. On the other hand, the present situation deserves serious consideration if the basic philosophy of radiation protection, that is, the elimination of all unnecessary radiation exposure, is to be followed. The disposal procedures of the Defense Supply Agency should be directed toward the removal of radioactive items rather than toward notification of potential purchasers of items that may contain radioactive material.

The Army has made a start toward controlling the use and disposal of radioactive coating compounds. Department of the Army Circular 700–4, dated May 5, 1965, states that the use of radioactive coating compound FSN–8010–964–4016 must be ceased and that all stocks must be sent to Edgewood Arsenal, Md., for disposal. The circular also requires that a report on each user of the compound be sent to the deputy chief of staff for logistics, Department of the Army, Washington, D.C. Each report is to include (*a*) name, grade, service number, and address; (*b*) dates the coating compound was used; (*c*) conditions under which it was used; for example, indoor or outdoor, windy or calm, with or without gloves or other protective clothing; and (*d*) a description of the item or items on which the compound was used.

Also included in the circular is a directive

which states that the use of radium materials with activities of 1.0 μg. or higher must be authorized by regulation AR–700–52. All use and procurement of radium compounds must now comply with that regulation. Similar procedures for other kinds of radioactive property should be instituted.

In California and most other Agreement States, radium is subject to licensure and regulation for protection from radiation. Were the source of supply different, the surplus dealer and usually each purchaser would be licensed. Presently, however, licensure of the surplus dealers is unfeasible. The surplus dealer—and even less the individual purchaser—does not know what he is buying in terms of radioactive material. This ignorance is compounded by the fact that usually neither the Defense Supply Agency nor the individual military installation has knowledge of which items in a sale are radioactive, much less what the nuclides and activities are.

Because the State department of public health is not notified of purchases of surplus items made by retail surplus dealers, there is no practical way of determining which dealers require licenses and which items are subject to licensure. The only way this information can be obtained is to survey each retail surplus store and check each piece of surplus that it contains. This would be a monumental task in cost and effort and would not be meaningful because the inventory could change daily by acquisition or sale of surplus commodities.

Removing radioactive items from surplus by the military installations before releasing such commodities to the General Services Administration and the general public appears to be the most effective method of control. This would prevent radioactive items from appearing in retail channels and also would prevent the materials from being donated to organizations such as the Boy Scouts, Girl Scouts, and similar youth organizations where exposure to unnecessary radiation is even less justifiable than exposure of adults. This procedure would require that all military surplus be screened to remove radioactive items.

One objection to this method has been that such a policy is difficult to implement in practice, and undoubtedly this is true. On the other hand, considerably more control is required than is now being exercised. The solution that appears most feasible is control exercised at the source of supply. The Department of Defense and the Defense Supply Agency should investigate the problem and adopt appropriate regulations so that most, if not all, radioactive items would be removed from surplus commodities before the surplus is released to the general public.

Another matter of importance is the fate of items found to be radioactive. In view of the Defense Supply Agency's directions for disposing of dangerous property, much of the material could probably be discarded as radioactive waste. In the more valuable items in which the radioactive component is not crucial, the radioactive component should be removed and replaced with a nonradioactive component. If this is not feasible, the Defense Supply Agency should require the purchaser of a radioactive item to comply with the radiation control regulations of the State in which the sale takes place or the State in which the device will be used.

Action Taken to Date

In April 1965, summaries of our investigation and covering letters were sent to the other Agreement States, to several States having continuing radium programs, to the Public Health Service, and to the Atomic Energy Commission. The letters requested comments on our conclusions and solutions to the matter. The replies received expressed agreement with the conclusions stated and agreed that some action must be taken. At that time no concrete ideas for a solution were offered.

The authors then met with California's coordinator of atomic energy development and radiation protection to explore mechanisms for effectively presenting our findings to the Department of Defense. When this paper was being written, the coordinator was exploring means by which this problem could be attacked at that level.

The coordinator met with representatives of the Defense Supply Agency to pursue possible solutions to the problem brought to light by the investigation. The Defense Supply Agency, although sympathetic to the problem, indicated it could not revise its disposal proce-

dures unless several complaints were registered in opposition to the present system. The procedures cannot be revised based alone upon California's complaint. If other States go on record in opposition to the agency's disposal practices, some changes might be effected.

Summary

The problem of military surplus property containing radioactive material that is available to the general public in California was investigated by the California State Department of Public Health. Physical surveys of surplus commodities in retail stores were made using appropriate radiation detection instruments. Many items were identified as containing radioactive material. The radioactive items were luminous dials or components of aircraft panel instruments, electronic equipment, gauges, and meters. The radionuclide of greatest concern was found to be radium 226 in amounts varying from 0.06 to 14.6 micrograms.

A review of the disposal procedures of the Defense Supply Agency, Department of the Army, revealed that surplus commodities containing radioactive materials were available to civilian Federal agencies and authorized groups such as colleges and universities, Boy Scouts of America, American National Red Cross, and others. The disposal procedures were found to contain directives on how potential purchasers are to be informed of the possible radioactive content of certain items, but were not found to contain specific directives for the screening and removal of radioactive items before release of the surplus property to nonmilitary users.

Because the amounts of radioactive material found in surplus commodities are high enough to warrant licensure and regulation for protection against radiation and because all unnecessary radiation exposure should be eliminated, it is contended that such items should be removed from surplus property before it is released for public consumption.

The results of the investigation were presented to the Defense Supply Agency. The reactions of that agency are reported.

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(*4*) Defense Supply Agency: Defense disposal manual. DSA Publication DSAM 4160.1, AR 755–20, AFM 67–4, MCO P4500. Department of Defense, Washington, D.C., Jan. 16, 1964; (*a*) Radioactive material; definition 92. Pt. 1, ch. 2; (*b*) Service educational activities. Pt. 3, ch. 3, subch. G, par. 3, subpar. i; (*c*) Property requiring special handling. Pt. 3, ch. 15, par. B.12.

EQUIPMENT REFERENCES

(*A*) Thyac II, model 489, Victoreen Instrument Co., Cleveland, Ohio.

(*B*) Sparrow, model 28100–L, Gelman Instrument Corp., Ann Arbor, Mich.