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PART I:BUILDING 17 - TOXIC CHEMICAL STORAGE BUILDING

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DECOMMISSIONING OF PROTECTIVE SCIENCES DIVISION (PSD) FACILITIES/BUILDINGS

PART I: BUILDING 17 - TOXIC CHEMICAL STORAGE BUILDING (U)

by

S.H.C. Liang, B.H. Harrison and J.W. Bovenkamp

DEFENCE RESEARCH ESTABLISHMENT OTTAWA
REPORT NO. 1230

Canada

April 1994
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National Defence / Défense nationale

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ABSTRACT

This report describes the decommissioning of Building 17, a storage facility for toxic chemicals. The decommissioning process, from its planning stage to the final stage of a clean empty building has been detailed. The planning phase addressed the health and safety concerns and the achievable level of cleanliness of Building 17. The actual decommissioning then followed, paying particular attention to monitoring of chemicals and the verification that none exists at the detection limit of the equipment employed.

RÉSUMÉ

Ce rapport décrit la désaffectation de l'edifice No 17 qui était utilisé pour l'entreposage des agents chimiques. Le processus de la désaffectation de son étape de planification à son étape finale d'édifice vide et propre a été détaillé. L'étape de planfication concernait la santé et la securité et le niveau de propreté faisable de l'édifice No 17. La désaffectation véritable a suvi, portant particulièrement attention à la détection et à la vérification des produits chimiques et qu'aucun produits chimiques n'a été détectés avec les appareils utilisés a leur limite de détection.

EXECUTIVE SUMMARY

The chemical protection program of Defence Research Establishment Ottawa (DREO) will be relocating to Defence Research Establishment Suffield (DRES). In preparation for the move, Protective Sciences Division (PSD) is preparing decommissioning plans for the buildings and facilities to be vacated. This document has been prepared by PSD to describe the decommissioning of Building 17, which has been used as a storage facility for chemical warfare (CW) agents. The move to Suffield will obviate the need for CW agent storage at DREO, and free Building 17 for other uses. The decommissioning consisted of decontamination and removal of all items that have been in contact with CW agents and other hazardous chemicals. This will ensure that Building 17 is suitable and aesthetically acceptable for general use in the future with no residual environmental or health and safety liability for DND related to CW agent storage inside the building.

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1.0 INTRODUCTION

In June 1992, CRAD announced the relocation of the Protective Sciences Division (PSD) from Defence Research Establishment Ottawa (DREO) to Defence Research Establishment Suffield (DRES) in Ralston, Alberta and Defence and Civilian Institute of Environmental Medicine (DCIEM) in Toronto, Ontario. The Environmental Protection Section (EPS), with major research emphasis in winter and environmental clothing and equipment will relocate to DCIEM. The chemical defence program in PSD, operated through the Chemical Protection Section (CPS) is to become part of the Defence Sciences Division at DRES. The move of these two sections is to be completed by 1 July 1994.

Relocation of PSD personnel and facilities also required proper vacating of the offices and laboratories currently occupied by PSD personnel at DREO. To vacate the PSD laboratories/facilities, the following activities are involved:

(1) Removal of all equipment from the laboratory, so that they can be packed and shipped out to DRES or DCIEM, or to be declared surplus and returned to Crown assets;

(2) Removal of all chemicals and chemical wastes and preparation of them for proper disposal;

(3) Cleaning up of all laboratory benches (counter-top), sink-traps and fumehoods in removing all residual chemicals;

(4) For CPS laboratories, in which work with toxic chemical warfare (CW) agents had been carried out, special care had to be taken to ensure that all CW agents, their wastes and decomposition products are absolutely absent before, during and after the cleanup.

The activities mentioned above can be collectively called "decommissioning", as defined according to:

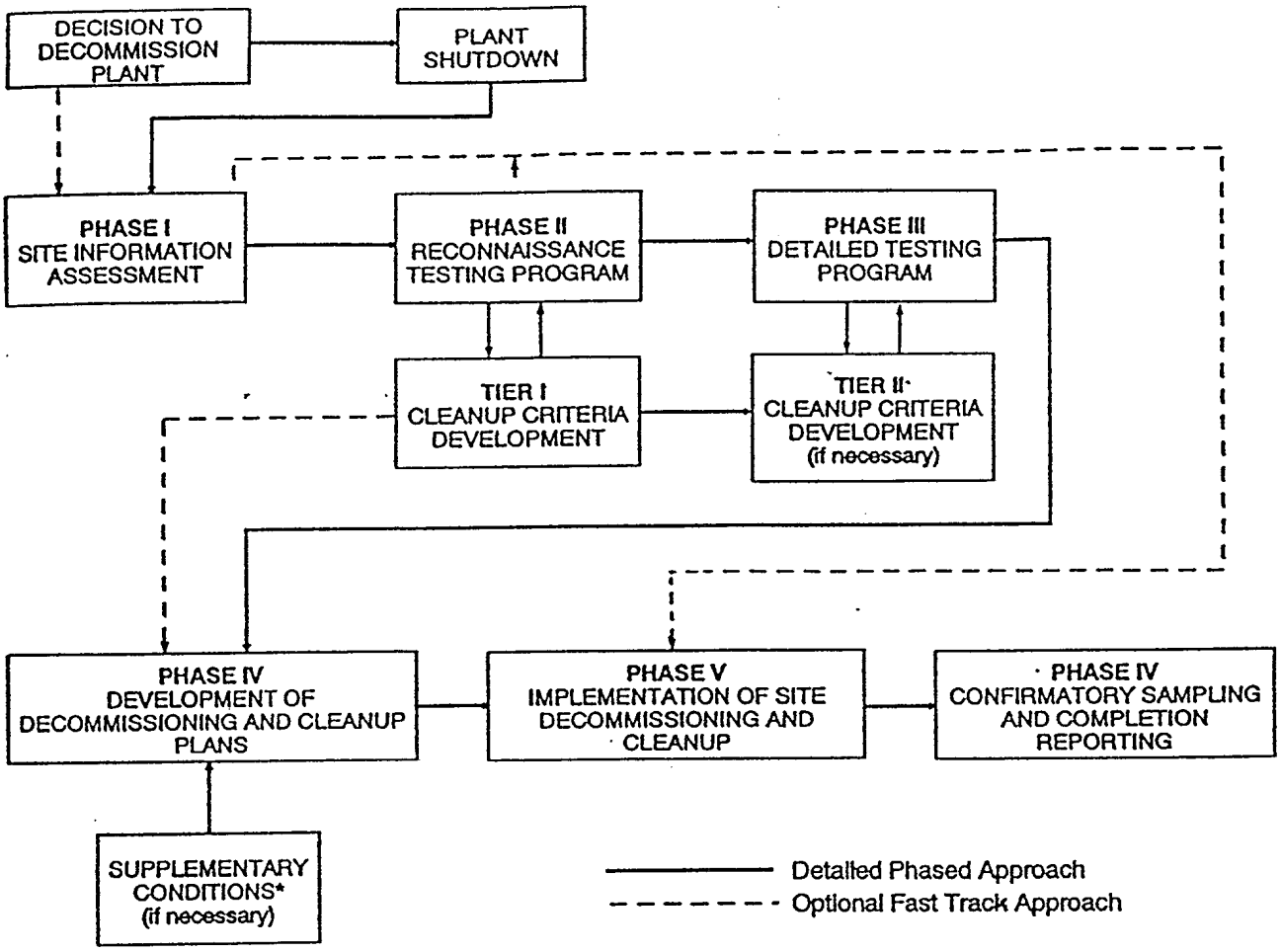
> "...the close down of operations; the removal of process equipment, buildings, and structures, and site cleanup and remediation...."

mentioned in the Canadian Council of Ministers of the Environment (CCME) "National Guidelines for Decommissioning Industrial Sites" (1). The purpose of decommissioning was to ensure that all PSD buildings/facilities were suitable and aesthetically acceptable for general use in the future with no residual environmental or health and safety problems for DND. Since the research projects conducted

by EPS do not involve hazardous chemicals/material (therefore, there were no hazardous wastes and residuals), the decommissioning of EPS space is trivial. For the laboratories currently occupied by CPS, more serious consideration has to be undertaken because of the diverse activities involved within CPS, and also the fact that CW agents were used in some of the laboratories.

2.0 DECOMMISSIONING CONSIDERATIONS

Schematic 1 shows the phased approach (1) to industrial site decommissioning and cleanup.



Schematic 1. Industrial Site Decommissioning and Cleanup

Since the decommissioning of PSD facilities is relatively simple compared to that of industrial sites, it was decided that a fast-track approach could be adopted.

2.1 PLANNING AND SITE ASSESSMENT

In planning for the decommissioning of the PSD facilities/ laboratories (the major activity is with CPS only), it was decided that four decommissioning plans would be prepared for all facilities/buildings occupied by PSD:

(1) Building 17 - A storage facility for CW agents only;

(2) Building 5B and Room 201 in Building 5A - these are the main CPS laboratories where CW agents and other chemicals were used in routine operations;

(3) Building 9 and Polymer Research Laboratory (PRL) in Building 5A - These two facilities were used for bench scale and pilot-scale production of plastics, rubber, paper, and carbon-impregnated fabrics;

(4) Toxic Pits and Leach Pits - where hazardous chemicals were disposed of (either by incineration or chemical destruction) in the early-days of operation at DREO in the 1950's to 1980's.

This decision was based on past activities and current use of the buildings/facilities, and on the information obtained from site/building visits. The site/building visits determined how extensive the planning should be (according to Schematic 1), and what were the major concerns in the decommissioning activities.

For Buildings 17 and 5B, the primary concern of the decommissioning was the removal of all CW agents. For the primary concern, the operation included first, the removal and destruction of all CW agents. This was followed by decontamination of the containers and anything which had come in contact with, or held CW agents (such as the refrigerator where the agents were stored or the fumehoods where the agents were handled). The final operation was the disposal of the chemical wastes and the CW agent decomposition products (which are non-toxic). The secondary concern was focused on the removal of laboratory services, which included:

(1) Fumehoods, ductings and fan-motor assemblies (after decontamination);

(2) Sinks, traps and pipes (after removal of all residues in the trap;

(3) High voltage AC lines;

(4) Gas, water, compressed air, oil lines and pipes inside the service strips;

(5) A thorough cleaning and vacuuming of the laboratory wall and floor by industrial cleaners to remove all chemical spills and mercury build-up.

Note that the secondary concern covered operations which are routine in renovating a laboratory or an office. It was included in the decommissioning planning because if CPS personnel discovered the use of other hazardous material such as asbestos or PCB's (polychlorinated biphenyls), etc., during the operation within the domain of primary concern, these discoveries were recorded (as warning flags) to alert other workers about possible exposure. The secondary concern also reflected the approach adopted by PSD in decommissioning these facilities. PSD was assuming the worst case scenario in which hazardous substances (such as asbestos, chemical spill, mercury spill, etc.) already existed in the laboratories, and they were cleaned up accordingly. This approach may not be cost-effective, but this is the only procedure by which all the expertise from the Chemical Protection Section can be utilized for the decommissioning project before the relocation move.

Thus there were four decommissioning plans produced, some more elaborate than the others, to ensure that all PSD buildings/facilities were properly cleaned out and suitable for future use. Features of the decommissioning plan include the health and safety consideration in all operations and proper reporting of all events.

2.2 CONSULTATION AND APPROVAL

It was important to ensure that the decommissioning plans and the decommissioning activities would not cause any environmental and health and safety problems, and that they also satisfied the requirements of the laws and regulations set up by the three levels of governments. Thus Environment Canada and the Ontario Ministry of Environment and Energy (MOEE) were consulted on this matter. An outside consulting firm, Acres International in Calgary, Alberta was retained by contract to review all decommissioning plans to ensure the technical correctness of the plans while satisfying all the environmental laws and regulations.

3.0 DECOMMISSIONING PLANNING OF BUILDING 17

Building 17 was used as a storage facility for chemical warfare (CW) agents. A detailed description of this building and the operations carried out within will be given later. Since it

was a CW agent storage facility, the primary concern of the decommissioning project was to remove all CW agents, and then decontaminate all containers which had come in contact with the CW agents. The secondary concern will be to clean and remove all equipment and furniture and clean the building.

The first step in the decommissioning planning was to conduct a site visit of the building. This was done twice in July and August 1993. The purpose of the site visit was to assess if past practices in this building have resulted in environmental contamination (such as spills) or unsafe conditions. The other objective was to document all DREO's actions in relation to the safe operation of this facility (e.g. site security, waste collection, storage and disposal, etc.). The major consideration in this planning was first, to ensure that human health and safety were protected, secondly, to prevent the spread of contamination (if any) to the environment, and finally to decide upon any appropriate interim remedial actions.

Since decommissioning was a new project at DREO, two procedures had to be followed. The first procedure was to file a DREO Project Registration Form and an Environmental Assessment and Review Process (EARP) report. These two documents are included as Appendix 1 of the document: "Decommissioning Plans for PSD Facilities: Part I" (which is included in this report as Annex A). The DREO Project Registration and EARP forms were prepared in such a way that they could be used for all buildings and facilities currently occupied by PSD, and not only Building 17. The filing of the EARP form was to ensure that two concerns: health and safety of workers, and the possible environmental damage and subsequent mitigation procedures were addressed. As was indicated in Appendix 1 of Annex A, there was only insignificant adverse effects to the environment caused by this project, thus this decommissioning project could proceed.

The second procedure to be followed was to ensure that all the relevant governmental departments and authorities were consulted, and that the proper procedures were being followed in this decommissioning. Environment Canada and the Ontario Ministry of Environment and Energy (MOEE) at the federal and provincial government level respectively were consulted. Since DREO is situated inside federal lands, the Ontario government has no jurisdiction over any activities conducted inside these lands. Their only concern is the chemical wastes generated by this decommissioning project. DREO is a registered waste generator in Ontario (ON0046518), and the list of wastes include decontaminated CW waste, and solutions containing these wastes. The Industrial Programs Branch (of the Environmental Protection Programs Directorate: Conservation and Protection) and the Ottawa District Office and Federal Programs of Environment Canada were contacted separately. Since DREO is not an industrial site, both offices advised that this decommissioning operation did not come under

their jurisdiction. The DEnvP (Directorate of Environmental Protection) at National Defence Headquarters and Associate Chief of Research and Development (Assoc CRAD) were consulted. Both directorates responded that while they could assist in drafting the decommissioning plans, they have no authority in approving the plan. It was then decided that the Director of PSD would have the final authority in approving the decommissioning plan and in supervising all decommissioning activities.

All CW agents were stored inside stainless steel containers which also contain charcoal (to pick up any spilled agent). These containers were kept inside a refrigerator. Although the containers for CW agents were never opened inside Building 17, and there was no reported incident of any CW spill, the aim of this decommissioning plan was to anticipate "What if there is any?" (very unlikely). Since CW agent was involved, extra precaution had to be undertaken. In the decommissioning planning, it was important to set up the control limit of all CW agents because of their acute toxicity. There is no Canadian standard for decommissioning a building/site which is used for CW agent storage. In its absence, guidance was found in the recommendation developed by the US Department of Health and Human Services Centers for Disease Control, entitled "Final Recommendations for Protecting the Health and Safety Against Potential Adverse Effects of Long Term Exposure to Low Doses of Agents GA, GB, VX, Mustard Agent (H, HD, T) and Lewisite (L)" (2). All the control limits have been reproduced in the decommissioning plan which is attached as Annex A. This will set up the maximum allowable concentrations of CW agents so that all workers (mainly PSD employees) could work in a safe environment while monitoring (for CW agents) and cleaning equipment from possible contamination by CW agents.

In the decommissioning plan two methods were used to monitor for residual CW agents: by air-sampling and swab-testing methods. The instrument used for air sampling was the MINICAMS, manufactured by CMS Research Corporation, Alabama, USA. Swab samples were taken using 10 cm x 10 cm cotton swabs and then extracted with a solvent. Both monitoring method and the equipment involved will be described later.

Finally, in the decommissioning plan, a procedure for the clean up of Building 17 is also described. Basically, decommissioning activities are divided into two categories: primary, anything having to do with the handling, removal and disposal of CW agents (i.e. in containers); and secondary, all subsequent actions, including cleanup of other areas, removal of furniture, etc., and decontamination (i.e. in dealing with situations where there is a possibility, however remote that CW agent may be present). Thus the cleaning activities were divided according to the hazard level (usually, the primary activities are more hazardous).

The final version of the Decommissioning Plans for Protective Sciences Division Facilities - Part I. Building 17 - Toxic Chemical Storage Buildings has been enclosed in this report as Annex A. This plan has been critically reviewed by Acres International of Calgary, Alberta. Their comments were favourable, and the letter of approval is included in this report as Annex B.

4.0 DECOMMISSIONING OF BUILDING 17

4.1 STEERING COMMITTEE AND REPORTING

A Decommissioning PSD Facilities Working Group (WG) consisting of Mr. W. Osborne (Chairman), Ms. J. Ross, Dr. B. Harrison, Dr. J. Bovenkamp, Dr. S. Liang and Mr. N. Gibson was formed in April 1993. The purpose of this WG is several fold: (i) DREO management will be briefed on the progress of all decommissioning projects within PSD; (ii) the Program Support Division coordinated all activities with CRC upon requests from PSD decommissioning personnel; and (iii) Program Support Division acquired and coordinated the funding from CRAD towards the PSD decommissioning projects. There were five meetings held. The minutes of these meetings (and all memoranda pertaining to PSD decommissioning) can be accessed through DREO file system 7625-4. S. Liang and J. Ross also briefed the DREO Health and Safety Committee every 2 months (for a total of five presentations) on the progress of all PSD decommissioning activities. These presentations can be accessed through DREO file system 1150-110/G1.

4.2 REMOVAL OF CW AGENTS

The Chemical Safety Officer (CSO) had removed all CW agents from this building prior to the decommissioning. All VX (o-ethyl-S-(2-diisopropylaminoethyl)-methylphosphonothiolate) was removed on 21 December 1992. The rest of the CW agents, HD (sulfur mustard) and G-agents (nerve gases) were removed on 22 March 1993. These CW agents were transported back to Building 5B, in accordance with standard operating procedures (3). These CW agents were then destroyed according to known procedures (3). All wastes generated were disposed of through licensed contractors from Public Works Canada.

4.3 ALARM SYSTEM

The intrusion alarm system plus other safety features were disconnected in April 1993, after all the CW agents had been removed.

4.4 DECONTAMINATION, MONITORING AND VERIFICATION

Residual CW agents monitoring using air-sampling was performed by S. Liang and N. Gibson in June 1993. A description of the equipment and the analytical procedure employed in the monitoring have been enclosed as Annex C. All eight corners inside the building, the inside of refrigerators, and around all equipment inside the building was monitored for CW agents. No GB, GD or HD was found. This result is not surprising since the cylinders containing the CW agents were never opened in Building 17, thus there cannot be any spill.

The inside of the two refrigerators were then scrubbed with Javex bleach solution, rinsed with alcohol and water, and then dried with towels. The freon (employed as coolant) from the refrigerators was collected into a cylinder and disposed of through a licensed contractor. The doors to the refrigerators were then removed and punctured so that they could not be used again. All these protocols are probably unnecessary since there was no recorded spill of CW agents. However, these extra steps are in line with our approach that asked: "What if there is any?". The floor, and all equipment inside Building 17 were then scrubbed with Javex bleach, left for 24 hours, rinsed with alcohol then water, and mopped dry with towels. Monitoring for CW agents by air-sampling was carried out again. No trace of GB, GD or HD was found.

Farrington, Lockwood Co. Ltd (FLCL), an analytical R&D laboratory was brought in on contract to verify the absence of CW agents in Building 17 in January 1994. FLCL has extensive experience with CW agents from previous contracts with DREO. Air-samples and swab samples were taken from various parts of Building 17 and on all equipment. A description of the equipment and analytical procedures employed in swab-samples has been enclosed as Annex D. There was no trace of GB, GD or HD found inside Building 17. The letter report from Farrington, Lockwood Co. Ltd. is included as Annex E in this report.

There were no floor drains or sinks in Building 17. This feature was to ensure that even in the case of CW agent spill, it would not leave the building and contaminate the environment. Thus, no soil or water samples were taken for CW agent (and their decomposition products) analyses.

4.5 CLEAN-UP

All furniture and equipment (telephone, spill kit, emergency equipment, etc.) after being scrubbed with bleach solution were removed from Building 17 in February 1994. The floor of the

building was swept clean. Building 17 was declared decommissioned and formally returned to DREO on 22 February 1994. It can now be used for any required purpose.

5.0 CONCLUSION TO DECOMMISSIONING ACTIVITIES IN BUILDING 17

1. Plans for decommissioning Building 17 were drawn up in accordance with existing regulations and reviewed by a private environmental firm.

2. All CW agents were removed from Building 17 and destroyed.

3. All equipment in Building 17 was decontaminated and removed. Building 17 itself was thoroughly cleaned.

4. Monitoring by DREO personnel and by a private company showed the complete absence of any trace of CW agents.

6.0 REFERENCES

1. National Guidelines for Decommissioning Industrial Site, CCME-TS/WM-TRE013E, published by the Canadian Council of Ministers of the Environment (Mar 91).

2. Federal Register 53 (50) pp 8504-8507 (1988).

3. J. Mayhood and J.J. Norman, The DREO CW-Agent Safety Manual: Part 1 - The Methods for Security, Storage, Transport and Laboratory Use of Chemical Warfare Agents at DREO. DREO Special Publication 4-90 (1990).

ANNEX A

DECOMMISSIONING PLANS FOR PROTECTIVE SCIENCES DIVISION FACILITIES. PART I: BUILDING 17 - TOXIC CHEMICAL STORAGE BUILDING

ANNEX A

DECOMMISSIONING PLANS FOR

PROTECTIVE SCIENCES DIVISION FACILITIES

PART I. BUILDING 17 - TOXIC CHEMICAL STORAGE BUILDING

By

S.H.C. Liang, J.R. Coleman and B.H. Harrison

JULY 1993

1.0 PURPOSE

The Protective Sciences Division (PSD) of Defence Research Establishment Ottawa (DREO) will be moving to Defence Research Establishment Suffield (DRES) and vacating the building and facilities that it currently occupies at DREO. In preparation for the move, the PSD is preparing decommissioning plans for the buildings and facilities to be vacated. This document has been prepared by the Protective Sciences Division to outline a plan to decommission Building 17, which has been used as a storage facility for chemical warfare (CW) agents. The move to Suffield will obviate the need for CW agent storage at DREO, and free Building 17 for other uses. The decommissioning will consist of decontamination and removal of all items that have been in contact with CW agents or other hazardous chemicals. This will ensure that Building 17 is suitable and aesthetically acceptable for general use in the future with no residual environmental or health and safety liability for DND related to CW agent storage inside the building.

It is DND policy (CFAO 36-50) to meet the environmental protection responsibilities and the pollution control standards and objectives in applicable federal and provincial statutes and regulations. NDHQ Policy Directive P5/92 commits DND to meet or exceed the letter and spirit of all applicable federal environmental laws and, where appropriate, to be compatible with provincial and international standards.

This plan specifies how the decommissioning will be carried out in a manner that meets or exceeds the letter and spirit of all applicable federal environmental laws, regulations and pollution control standards and objectives and that is compatible with related provincial and international standards and municipal zoning regulations.

2.0 DREO PROJECT REGISTRATION AND EARP DECISION FORM

As a result of judicial decision, the EARP (Environmental Assessment and Review Process) now has the status of law, and must be followed in decommissioning operations. CFAO 36-50, referred to above, is the authority for implementing EARP in DND. From the "DND Environmental Assessment Manual" (A-LM-007-009/AX-000) it is apparent that EARP is applicable in the present decommissioning project, and must be followed. The DREO Project Registration and EARP Decision Form, and the DREO Environmental Screening Form for the proposed decommissioning of all buildings occupied by PSD are included in Appendix 1. Since Building 17 is one of the buildings occupied by PSD, the same EARP and Environmental Screening Forms would apply.

3.0 BUILDING INFORMATION AND ASSESSMENT

3.1 Historical Use of Building 17

The following material is taken verbatim from a report by Dr. J.J. Norman (a retired scientist from DREO), "Use History of DREO Lands and Buildings".

> "This Steelox building has been on site from 1950 and was part of the field-construction hut system during the site construction phase, 1950-1954. In early 1955, a concrete pad was poured at the present location of this building, and the construction hut was relocated onto this pad for storage of special-hazard materials. These were defined as CW Agents, related materials, and starting materials, but did not include run-of-mill toxic chemicals nor compounds containing radioactive isotopes.
>
> The building was subdivided soon after it was relocated to the pad. The front section was used for short-term storage of gas cylinders (both full and empty) etc. while the new rear section was used to store bulk quantities of CW agents and related supertoxic materials. The two sections were separately padlocked. The front was under the control of Stores Staff. The rear was controlled by the then-"Chemical Warfare Section" and only a few individuals on a select list of fully-qualified members of that Section were allowed access to the agent-storage side. All individual entry to this side required accompaniment by at least one other qualified member of the Section, and that all entrants had their NBC protective masks with them.
>
> In 1978, the stocks of WWII agents, the surpluses of H, G, and V Agents, and the reference stocks of non-standard agents were removed and sent to DRES for destruction (OPERATION APEX).
>
> Following reports of attempted thefts from the CW-Agent-storage facilities of our Allies, the building was completely rebuilt during 1980-1981, to incorporate much higher security standards. The exterior walls, roof, etc. of the front section were rebuilt to bank-vault standards and a vault-type security door frame and door were installed. Cylinders, pressure vessels, and highly-flammable materials were removed and all agent storage was shifted to this side. This front facility also was upgraded to provide for heating, cooling, and power ventilation (at two levels). A deep-freeze unit enclosed in a specially-fabricated steel security frame was installed for secure, cold storage of CW agents. In addition, the whole building was surrounded by an 8-ft security fence to establish its' own secure compound.

Rules regarding the items to be stored in the rear section were changed. Now, only those materials required for packaging agents for long-term storage or for transport (charcoal, vermiculite, steel drums, etc.) were permitted. Activated-carbon charcoals had to be stored in fully-locking steel drums. This rear section now came under control of the agent custodians and Stores Staff were no longer permitted entry.

In 1991, the Site intrusion alarm was extended to this building.

Use History

Front Section

- Storage of Cylinders 1955 - 1980
- Rebuilding Facility to Vault Standards 1980 - 1981
- New Storage for agents 1981 - to date

Rear Section

- Storage of bulk agents 1955 - 1980
- Rebuilding (not to vault standards) 1980 - 1981
- Storage of packing materials 1981 - to date"

3.2 Recent Use of Building 17

Following removal of bulk agents in 1978 and rebuilding in 1980, the front section was reconfigured to hold two refrigerators (where CW agents were stored), and materials used in connection with storage and the safe handling of agents - gloves, Javex (for decontamination) and charcoal. There was also furniture present - a cabinet, tables, etc. These, together with the ventilating system, and interior surfaces - floors, walls, ceiling - were the objects whose possible contamination had to be considered. It is to be noted that there is no record of vials, bottles, etc. ever being opened in the building, either before or after the reconstruction of 1980 - handling rules called for their transfer to Building 5B for sampling (in any case a more convenient procedure); nor is there record of any leakage or other release of chemicals in this building.

It is also known with certainty that no biological warfare materials were ever stored in the building.

3.3 Site Inspection

Figure 1 shows the location of building 17 inside DREO in relation to other buildings on the Shirleys Bay site. Several visits to Building 17 were made in July and August 1993 by the

first two authors, accompanied when required by the Chemical Safety Officer (CSO) and the Establishment photographer. A number of observations on the photographs taken at that time appear below, some of them too lengthy for inclusion in the captions. Figure 2 shows that building 17 is fenced, isolated and free standing. The drums standing outside the fence were left there from previous DREO operations, and have no connection with the current activity in Building 17. Figures 3 and 4 show the close-up views of Building 17. In Figure 3, the electrical panels, fire extinguishers (inside the red box), air vent, refrigerator-failure signals (red light) are clearly shown. Figure 4 shows the door to the rear section of Building 17 which is situated on the north side of the building. The air vent shown in the centre is the air inlet to the front section of the building. The two round air ducts are remnants from previous construction (i.e. before new construction in 1980). Figure 5 shows deterioration of building exterior paint. It has been ascertained by Ms. J. Ross, Establishment Environment Officer, that lead-based paints have never been employed at DREO; this has been confirmed by inquiry of the Shirley Bay site operators, the Communications Research Centre. Figure 6 shows a concrete slab in the ground near the building. Two of these were found. On overturning, only bare ground was seen beneath; they were evidently left over from the last construction and had been tipped out. Figure 7 shows the security systems installed in Building 17. Intrusion alarm is connected directly to the Guard House at the entrance to the Shirleys' Bay site. Figures 8 to 10 show features of the toxic storage area as used in recent years. The areas of staining on the floor in Figure 9 probably date back to the twenty-five year period in which cylinder storage under uncontrolled climatic conditions was the major use of this section. Rust deposition from cylinders brought in by open truck, during rain or snow, probably occurred. Figure 10 shows storage (in very small quantities) of CW agents as practised in recent years. All agents were stored in vials which were then placed inside the steel cylinders packed with charcoal and provided with an exit valve. These drums were then placed over charcoal held in a tray.

A few other general observations may be made here. The floor was a single concrete pad, without drain. The ventilation system was straight in-and-out, without filters, these being deemed unnecessary with the use regime described above. There are no transformers, and as the building had been remodelled in 1980-81, with no electrical equipment other than that pictured in the figures, it is not thought that PCB's are a concern. There are no transformers; hence PCBs are not a concern. There were also no signs of the presence of asbestos. The rear section (used latterly for storage of packing materials) contained a pail and a drum as shown in Figure 11, partly filled with charcoal, that served to replenish the refrigerators in the front section, in which containers of agent were stored (Figure 10). There is a narrow space between front and rear sections, created when the building was refurbished and security upgraded in the front section

in 1980-1. The rear section also contained a much-rusted propane cylinder, which has been removed. The stains on the wall shown in Figure 11 showed signs of uncontrolled climatic conditions employed in early days.

3.4 Regulatory Agency Concerns

The Waste Management Branch of Ontario Ministry of the Environmental and Energy (MOEE) in Toronto has been contacted with regard to the decommissioning planning and operation of Building 17. Since DREO is situated within federal lands, MOEE has no legal jurisdiction over this operation, except for waste generated during the decommissioning. DREO is a registered waste generator, and the list of wastes includes decontaminated CW waste, and solutions containing these wastes.

The Ontario Branch of Environment Canada was also contacted. A conversation with Mr. F. D'Addario indicated Environment Canada's concerns are limited to the decommissioning of industrial sites and contaminated areas. Since there is no record of a spill of CW agent (or other chemicals) in or around Building 17, this decommissioning operation does not come under federal jurisdiction.

Major John Critchley, decommissioning officer at Directorate of Environmental Protection (DEP) and Mr. Gene Belovich of Associate Chief of Research and Development (Assoc CRAD) both at Department of National Defence Headquarters (NDHQ) were consulted. Both agreed that NDHQ considers decommissioning a routine project, and that the Director of Protective Sciences Division (PSD) should be the one who signs off this plan and operation.

4.0 CLEAN UP CRITERIA

The DND Department Policy and Procedures for the Decommissioning of Defence Facilities includes a commitment to achieve an environmental standard consistent with Canadian Council of Ministers of the Environment (CCME) environmental criteria and, in the absence of zoning regulations to the contrary, to apply the industrial/commercial CCME environmental cleanup criteria.

4.1 Inventory of Hazardous Substances

Building 17 has been used for the storage of "special-hazard" materials, which are CW-related. A clear distinction between toxic/hazardous materials and CW agents has to be made here. For example, hydrogen cyanide is a toxic chemical employed extensively in the mining industry, but it is also know that it can be used as a CW-agent. It is considered as a toxic and hazardous substance, but not a CW agent in the present context. With this clarification, only chemicals of CW-origin have ever been stored in this building. Charcoal is used to stop and pick-up all accidental

spills of CW agents, and is considered non-toxic in its present use. It is known that Building 17 has at various times, held nerve and blister agents: H, HD, GA, GB, T and VX. The chemical names of these agents are listed below:

GA	=	Tabun, Ethyl N,N-dimethylphosphoroamidocyanidate
GB	=	Sarin, Isopropylmethylphosphonofluoridate
VX	=	O-ethyl-S-(2-diisopropylaminoethyl)-methyl-phosphonothiolate
H,HD	=	Sulfur mustard, di-2-chloroethylsulfide
T	=	Bis(2-chloroethylthioethyl)ether

4.2 Contaminants, Spills and Residues

There is no record or recollection of any spill in Building 17. From Section 3.1 it is apparent that it would be a highly improbable occurrence. All agents in Building 17 as of March 1993 have been returned to Room 228, Building 5B, for destruction.

4.3 Establishment of Clean-Up Criteria

According to CCME, the principal application of remediation (clean-up) criteria is to provide for the establishment of site-specific remediation objectives. When remediation objectives have been established for a site, remediation is considered to be complete when contamination levels have been reduced below the levels of the objectives. In other words, clean-up criteria are used to indicate when one can stop cleaning up. For the current decommissioning project, the clean-up criteria will be set at a CW-agent concentration of zero or as low as the detection limit of the analytical instrument would allow in the monitoring exercise.

5.0 DECOMMISSIONING PLANNING

5.1 Health, Safety and Emergency Response Planning

Since the removal and decontamination (if required) of CW agents from Building 17 are routine operations within PSD, there is no need for any site-specific health and safety plan (including emergency procedures).

The DREO Safety Manual, 4th Edition, the DREO CW-Agent Safety Manual, Parts I and II, the Chemical Protection Section Emergency Response Manual and in general, the Protective Sciences Division - Standard Operating Procedures will prescribe the health, safety and emergency response procedures to be followed during decommissioning activities.

To protect the health and safety of the clean-up workers, control limits for exposure to CW agents have to be set up. In the ideal case (and to the best of our knowledge), there should not be

any chance that a clean-up worker may come in contact with CW agents. The following paragraphs discuss analytical methods and control limits by which PSD used to institute a health and safety protection mechanism for all workers. Sampling of both air and debris (in corners, ducts, etc.) will be undertaken. The air sampling, by methods described below, determines agents down to levels at least two orders of magnitude below those at which physiological effects are observed (in the case of nerve agents, this is miosis, i.e. contraction of the eye pupils with resulting tunnel vision, a phenomenon observed before other symptoms of the presence of agents).

Swab sampling of solid residues will be carried out by wiping down surfaces and rooting in corners with absorbent cotton pads soaked in acetonitrile. These swabs, after evaporation of the acetonitrile, will be packed into small vessels and closed; air samples will be drawn and analyzed by the MINICAMS (to be described below). It cannot be stated what the detection limit with this procedure is, but the collection of any agent that might be present in a confined space in which its vapour pressure can build up will certainly result in higher concentrations than a superficial air sampling in a room.

If these sampling methods disclose negligible levels of nerve or blister agent, zero or well below "physiological" limits (see above) one can be reasonably confident that any work-removal, dismantling, or destruction, will not present a hazard to those engaged in it. The air sampling deals with "static" levels of agent in the air, the swabbing with material that might be raised in destruction or removal operations.

All the sampling will be performed by PSD personnel, who are experienced in this work and thoroughly familiar with all necessary precautions.

There is no Canadian standard for decommissioning a building/ site which is used for CW agent storage. In its absence, guidance was found in the recommendation developed by the US Department of Health and Human Services Centers for Disease Control, entitled "Final Recommendations for Protecting the Health and Safety Against Potential Adverse Effects of Long Term Exposure to Low Doses of Agents GA, GB, VX, Mustard Agent (H, HD, T) and Lewisite (L)" published in Federal Register 53(50) 8504-8507 (1988). This recommendation was adapted for the decommissioning plan for Building 17.

From the above reference, the control limits (mg/m^3) for CW agents are summarized in Table 1. This will set up the maximum allowed concentration for workers during decommissioning in an 8 hour period. The toxicity of these agents has been detailed in the DREO CW Agent Safety Manual, Parts I and II. For nerve agents, there appears to be little risk either of adverse health effects

from long term exposure to low doses or of delayed health effects from acute exposure. Human health is adequately protected from exposure to GA, GB and VX vapour at the concentrations shown in Table 1. Even long-term exposure to these concentrations would not create any adverse health effects. Note that the control limits contained in Table 1 are substantially below concentrations at which adverse effects have been observed for mustard agent. It is known that mustard agent is a mutagen and a suspected human carcinogen. However, the proposed work place limits appear to provide adequate protection for workers during the limited time of potential exposure in the Chemical Stockpile Demilitarization Program mentioned in 53FR 8504-8507 (1988).

After the clean-up, there will be a total absence of CW agents (to the detectable limit of monitoring equipment) inside the building.

Table 1. Control Limits (mg/m^3) for CW Agents

Agent	General Population	Workers
GA, GB	$3x10^{-6}$	$1x10^{-4}$
VX	$3x10^{-6}$	$1x10^{-5}$
H, HD, T	$1x10^{-4}$	$3x10^{-3}$
Average Time	72 hours	8 hours

5.2 Analytical Procedures

These must be able to quantify agent concentrations down to and well below the limit at which the first physiological response is observed. The levels given in Table 1 are related to this response, with a generous safety margin (commonly 50 to 100) factored in.

The instrument to be employed is the MINICAMS, a product of CMS Research Corporation, with accessories to multiply the sampling and analysis capacity. This device samples air, collects agent (if any) in an adsorption tube, where it is desorbed and determined by gas chromatography, the instrument having been calibrated with known quantities of CW agent. The same detection limit will be applied to both air-sampling and swab testing methods.

5.3 Procedure for Clean-Up of Building 17

Activities are divided into Primary, anything having to do with the handling, removal and disposal of known agents (i.e. in containers) and Secondary all subsequent actions, including survey

and decontamination (i.e. the dealing with situations in which there is a possibility, however remote that an agent may be present).

5.3.1 Primary Activities

(i) Removal of CW agent to Bldg 5B for destruction, (All VX was removed on 21 Dec 92 and the rest, HD and GD were removed on 22 Mar 93);

5.3.2 Secondary Activities

(i) Decontamination of charcoal used in the storage tray (Figure 10), and check for presence of residual CW agents and disposal by established procedures.

(ii) Survey for agents. The building (front and back sections) to be closed, and all air inlets and outlets to be blocked. The building to be allowed to stand a minimum of three days (preferably in summer heat, in any case before cold weather) entered (with minimum disturbance) and sampling of MINICAMS conducted in centre, and in close proximity to interior of refrigerators, surface of table, sites on floor, ducting;

In the event the operation cannot be carried out before winter, heaters will be installed, preferably with provision to blow warm air against, say, refrigerator surfaces to increase volatility of any agent present. It is inconveivable that the electrical heater elements would consume any agent. The swab testing described in Section 4.2, above, will look at dust and other residues on the floor, in corners and in ducting.

(iii) Cleanup of refrigerators, ducts and fans by spraying with Javex, followed by water rinsing, and recheck for presence of CW agents if necessary as in (ii) above.

(iv) Disabling and removal of decontaminated refrigerators and dismantling of ducts, fans, etc. and then their disposal. Freon (refrigerator coolant) has been removed and disposed of through licensed waste disposal agents;

(v) Decontamination of all safety and spill kits and check for residual CW agents and then removal for disposal;

(vi) Closure of all vents, check for residual CW agents, and clean up floors, etc.;

(vii) Dismantling of security and alarm systems;

5.4 Securing all Hazardous Areas

The building is surrounded by a chain link fence with three strands of barbed wire along the top and a locked gate. All CW agents have been removed. The Shirley Bay site is a restricted access area. While decommissioning is proceeding, staff will be in the compound, and casual entry can be prevented by closing the gate. Operations will be conducted only in daylight. It is not felt that any security considerations arise.

5.5 Submission for Approval

This decommissioning plan will be submitted to an outside consultant with knowledge of DREO, environmental regulatory affairs and decommissioning practices; to check for omissions and consistency with all laws and regulations (federal, provincial and municipal) and an outside consultant with experience in CW agents. The reviewed plan will then be submitted to the director of PSD for final approval before any decommissioning work proceeds. Any wastes generated will be appropriate for disposal by methods already approved by MOEE.

5.6 Tender for Bids

The clean up of Building 17 will be performed by DREO personnel. The monitoring of residual CW agents will be carried out by both DREO employees and an outside independent agency with knowledge of analytical techniques, under contract to DREO. These contractors will enter the area only after monitoring and decontamination have been carried out by PSD personnel (i.e. the activities of 5.3.2) to confirm independently the absence of agents. Since these contractors will only be monitoring the presence of residual CW agents and not carrying out the actual removal and decontamination of CW agents, they need to be briefed on all health and safety aspects listed in the second paragraph of Section 5.1 only. No separate health and safety plan needs to be written up separately for the contractors.

6.0 DECOMMISSIONING OPERATIONS

The decommissioning of Building 17 is intended to be a test case for the decommissioning of all PSD buildings and facilities. Since Building 17 was used to store CW agents which are persistent (such as G and H agents), care has to be taken so that all workers

involved in this operation are adequately trained in health and safety, and emergency response on CW agents. This will be taken care of by employing for the decontamination and initial monitoring (to ensure zero agent levels) only present and past PSD employees experienced in agent handling.

6.1 Safety Meetings

Regular briefings will be presented to the DREO Health and Safety Committee on the progress of all decommissioning activities, especially on clean-up and CW agent monitoring. This safety committee meets bi-monthly, and two preliminary briefings have already been given by one of the authors (S.H. Liang).

Weekly meetings will be held on-site to discuss health and safety matters, and the concerns of all workers (including contractors).

6.2 Scheduling

The order of activities has been set out in 5.3.1 and 5.3.2. It is difficult to tell in advance how long the work would take, but, assuming all equipment and personnel were available, the physical activities in and around the building itself should require not more than one week at most. Analytical results on samples collected during this period might require a little longer to process.

The start date depends primarily on availability of analytical equipment calibrated for the 3 or 4 agents of interest.

6.3 Site Supervision

The site foreman will be the DREO Chemical Safety Officer.

6.4 Removal and Classification of Wastes

As mentioned in earlier sections, there are no CW agents in Building 17 to be decontaminated. Concern is required for other materials, which may be contaminated by CW agents. Charcoal will be decontaminated by procedures in place, and interior surfaces and objects (as in 5.3.2 (iv) and (vi)) similarly treated. The residues of this decontamination will be taken away by licensed waste disposal contractors.

6.5 Clean-Up Verification

DREO personnel will monitor the concentration of residual CW agents in Bldg 17, after it has been cleaned out with a decontaminating solution containing bleach. The concentration of residual agents must reach zero (or the detection limit of the monitoring equipment). This will ensure that no CW hazard will exist when the building is used for future work.

Outside contractors (see 5.6) will also be contracted to perform on-site CW agent monitoring after the initial CW agent monitoring conducted by DREO personnel. Using acceptable (to DREO) methodology and spectroscopic techniques, the independent agency will confirm the absence of CW agent (to the detection limit of the analytical equipment employed). If they should detect any agent at non-zero levels, the building will again be decontaminated by DREO, and monitoring for agent again conducted, by DREO and then by the contractor.

7.0 RECORD KEEPING AND REPORTING

7.1 Progress Reports

Progress reports will contain a list of what work was done and details of clean-up operations, including monitoring results, and notice of any problems encountered or incidents.

7.2 Waste Records

Copies of all waste manifests must be retained along with chain of custody forms. These manifests will contain the waste classification record, and the exact amount, pertaining to the federal TDG Regulations. Copies of the hazardous waste records will also be submitted to the Ontario Ministry of Environment and Energy to satisfy the small quantity exemption.

A record will be kept of all refrigerators, ducting and other articles that are removed and decontaminated prior to disposal; these records will confirm that no agents were detectible after decontamination.

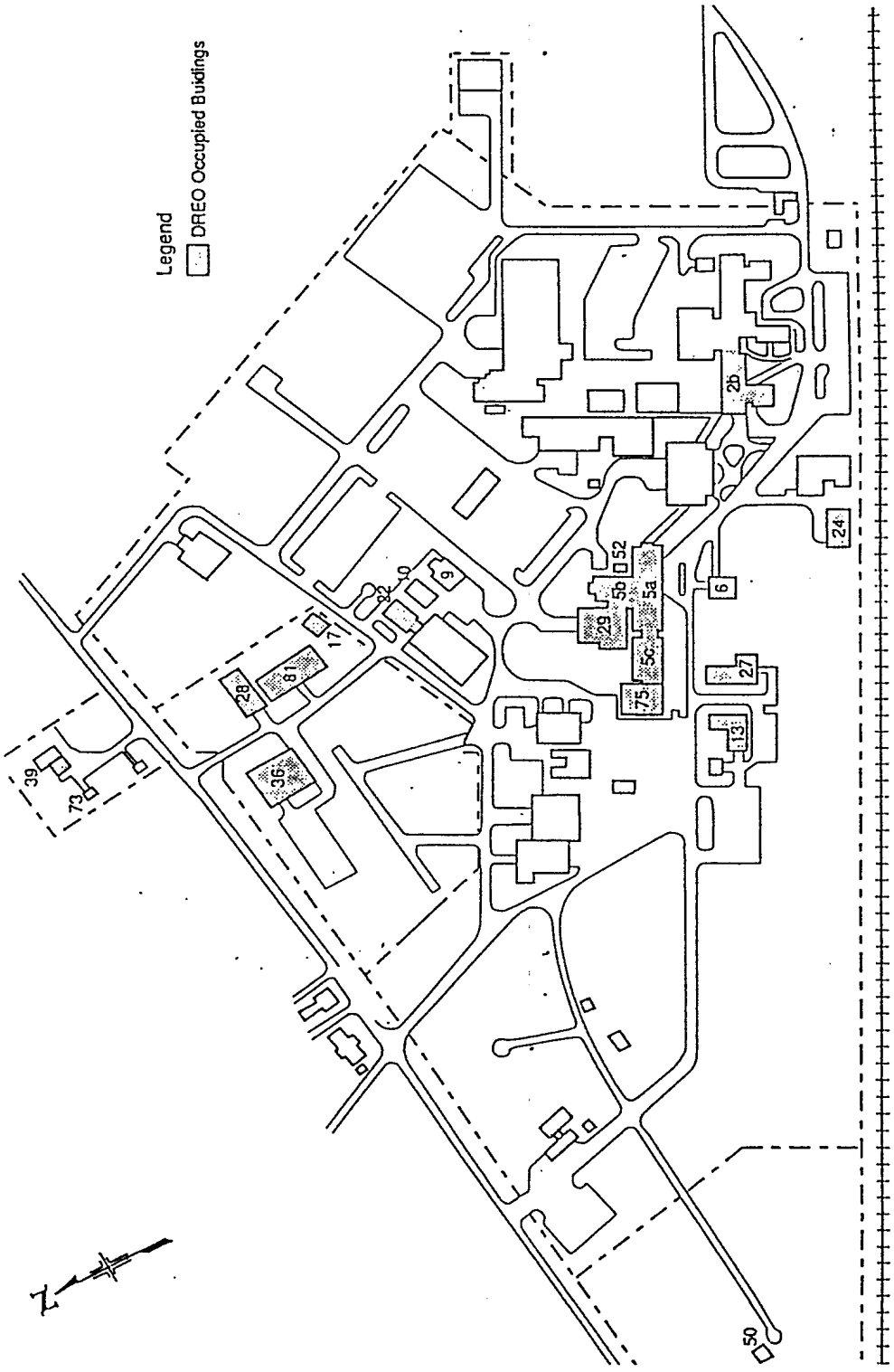


Figure 1: DREO Site Map showing location of Building 17 relative to other buildings on site.

Figure 2: Photograph of Building 17 showing that the building is fenced, isolated and free standing.

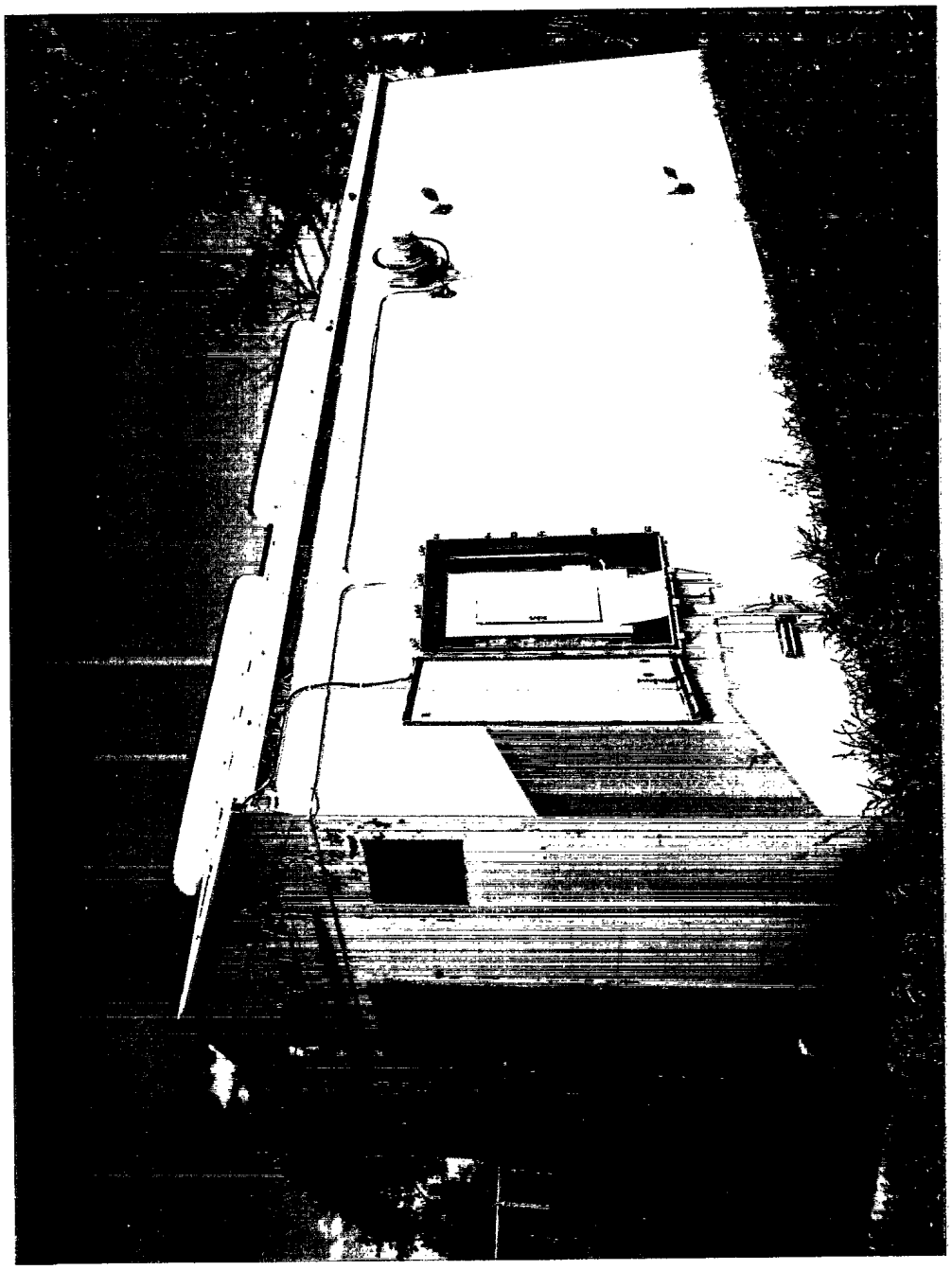


Figure 3: Close-up view of Building 17.

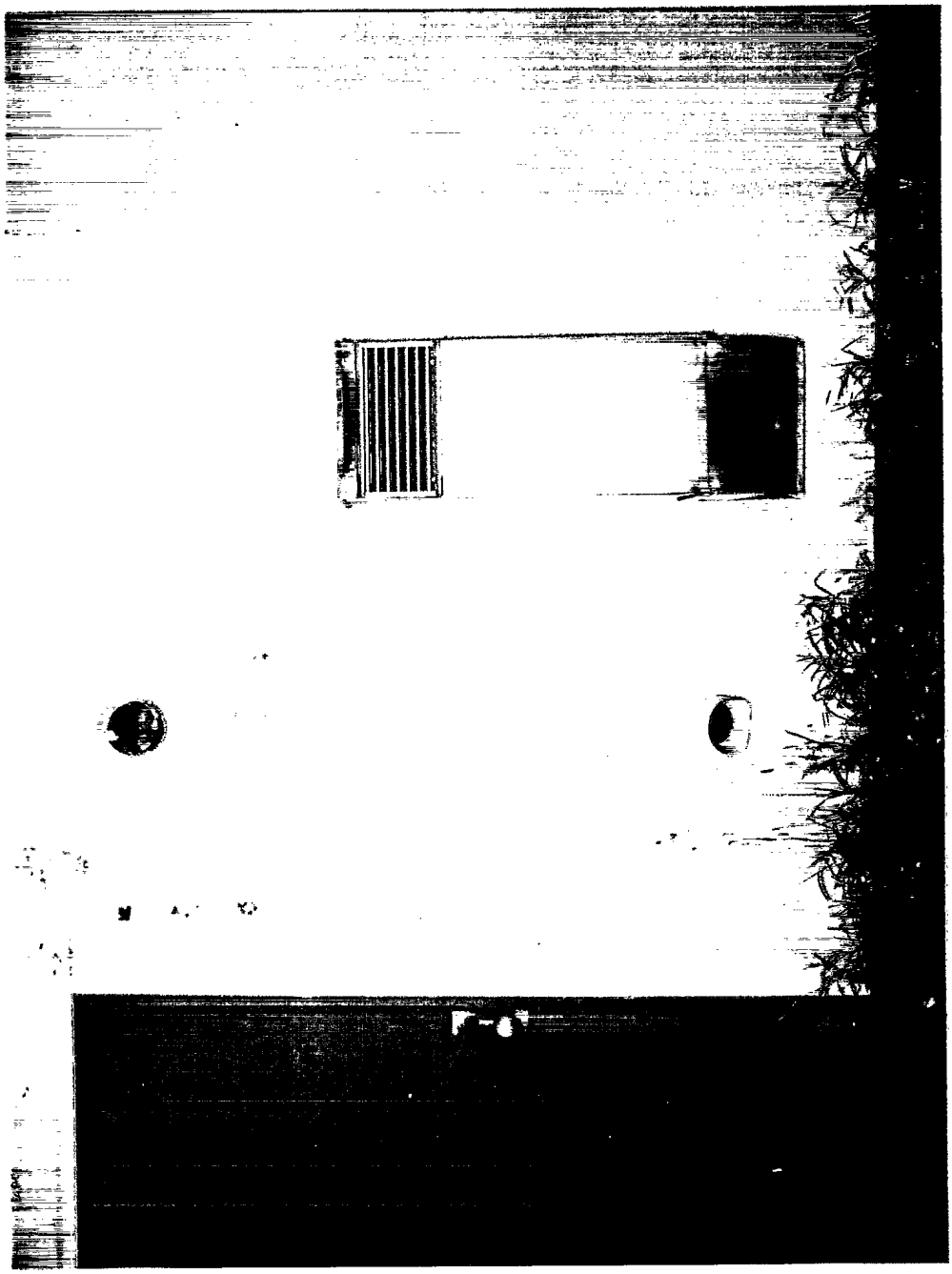


Figure 4: Side door admitting to rear section of Building 17.

Figure 5: Shows deterioration of building outside paint.

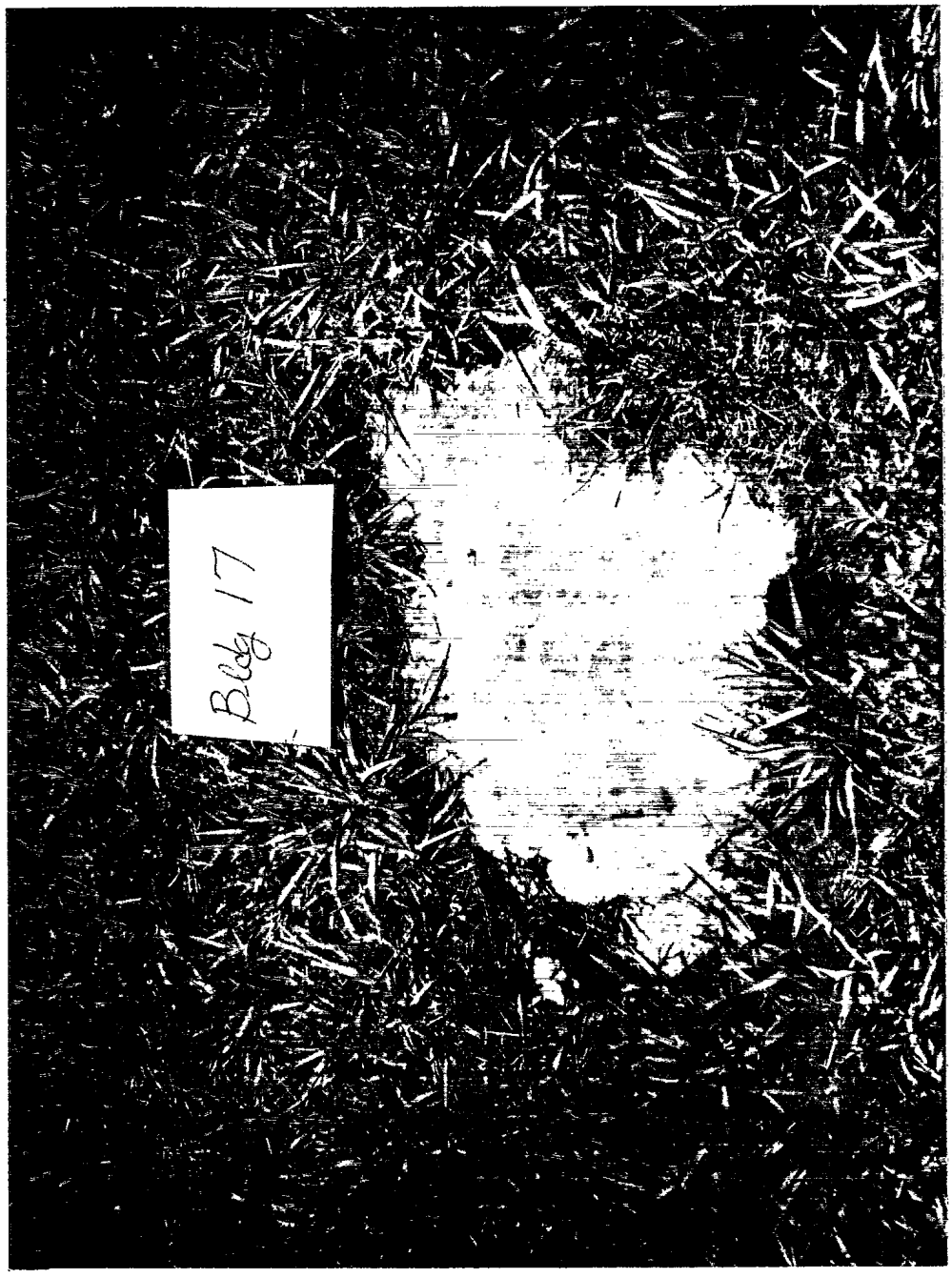


Figure 6: Concrete slab in ground near side door of Figure 4.

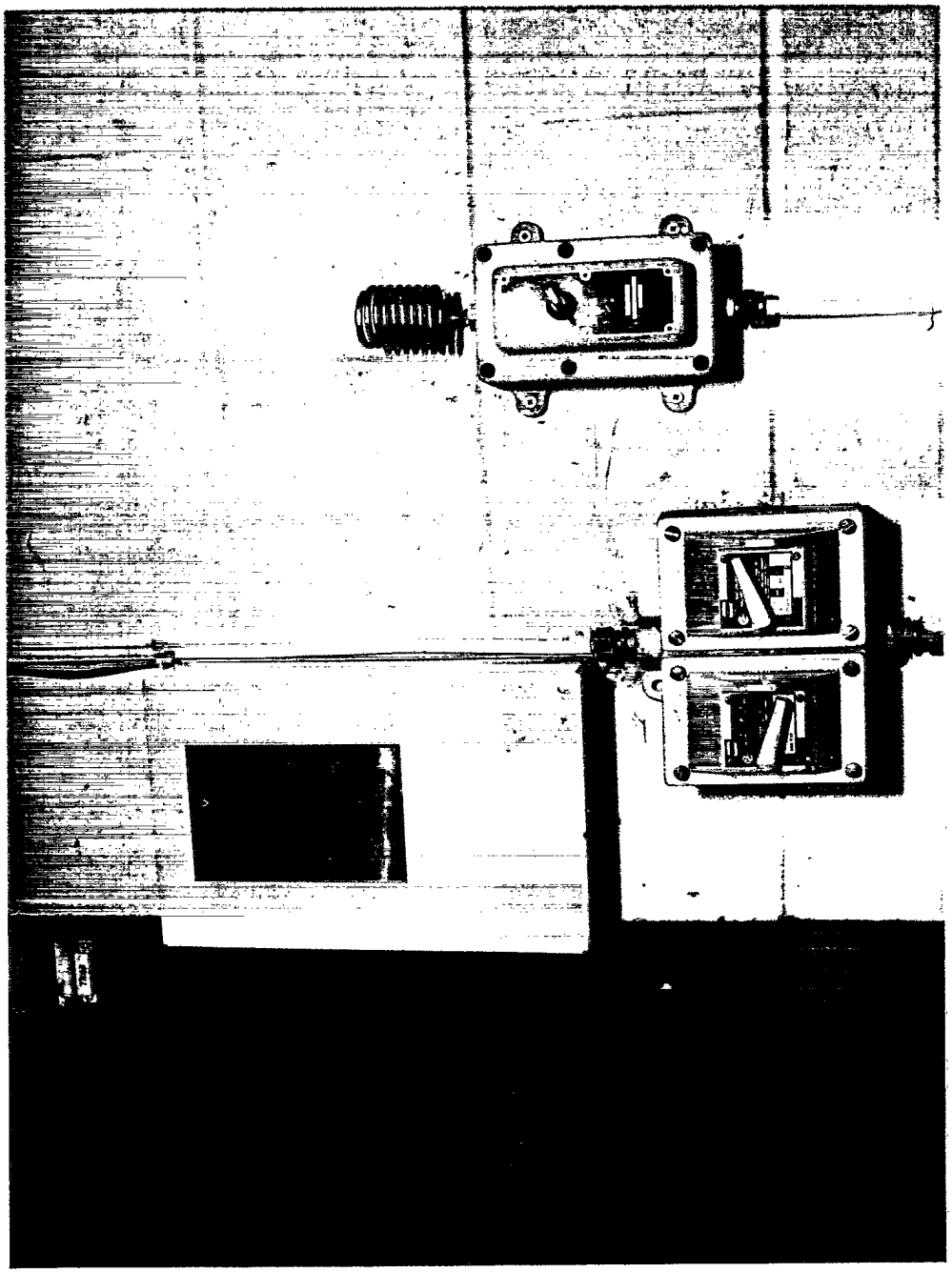


Figure 7: Photograph of security alarm system.

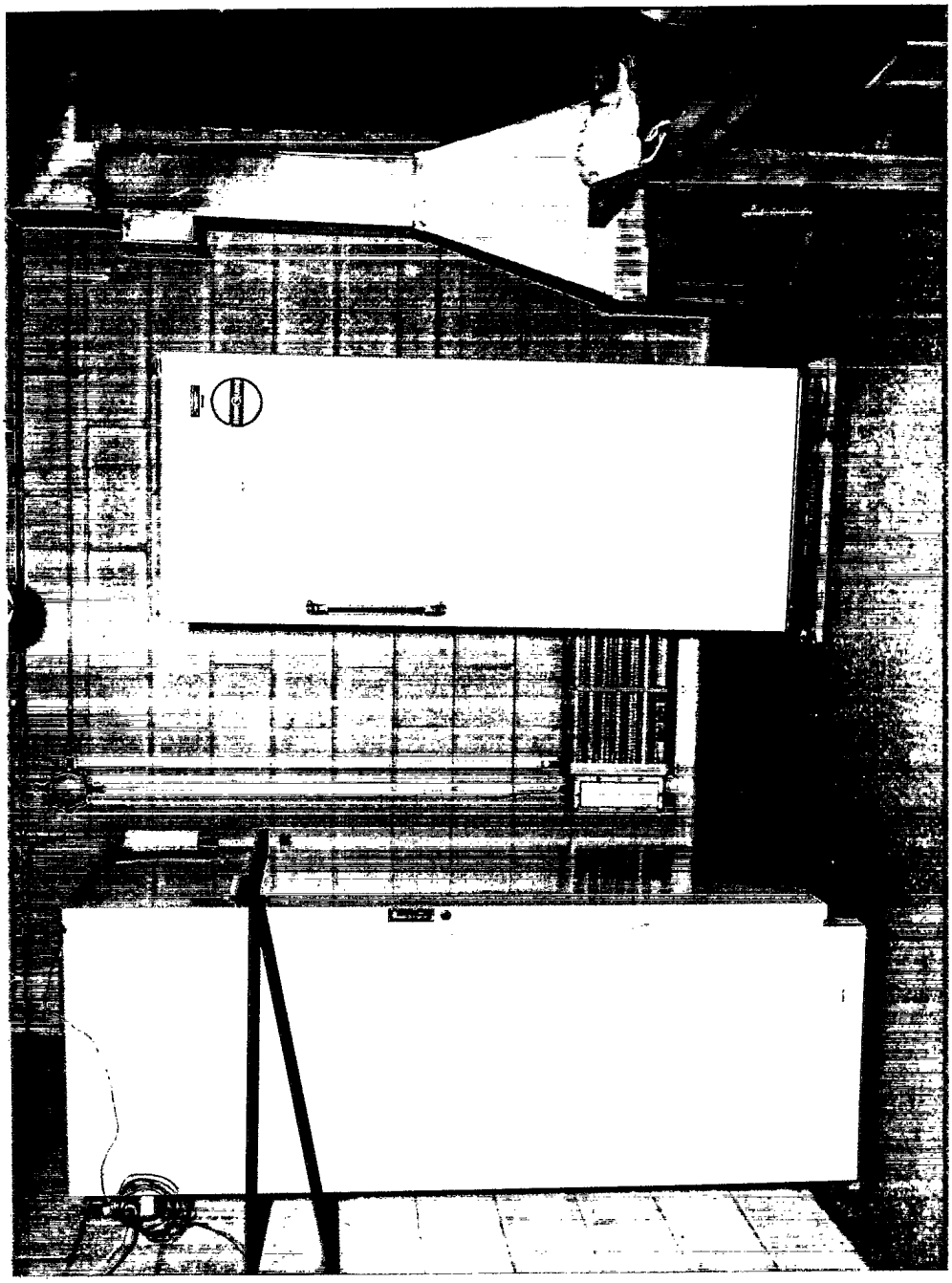


Figure 8: Photograph of the contents of the front room of Building 17.

Figure 9: Photograph of all safety devices.

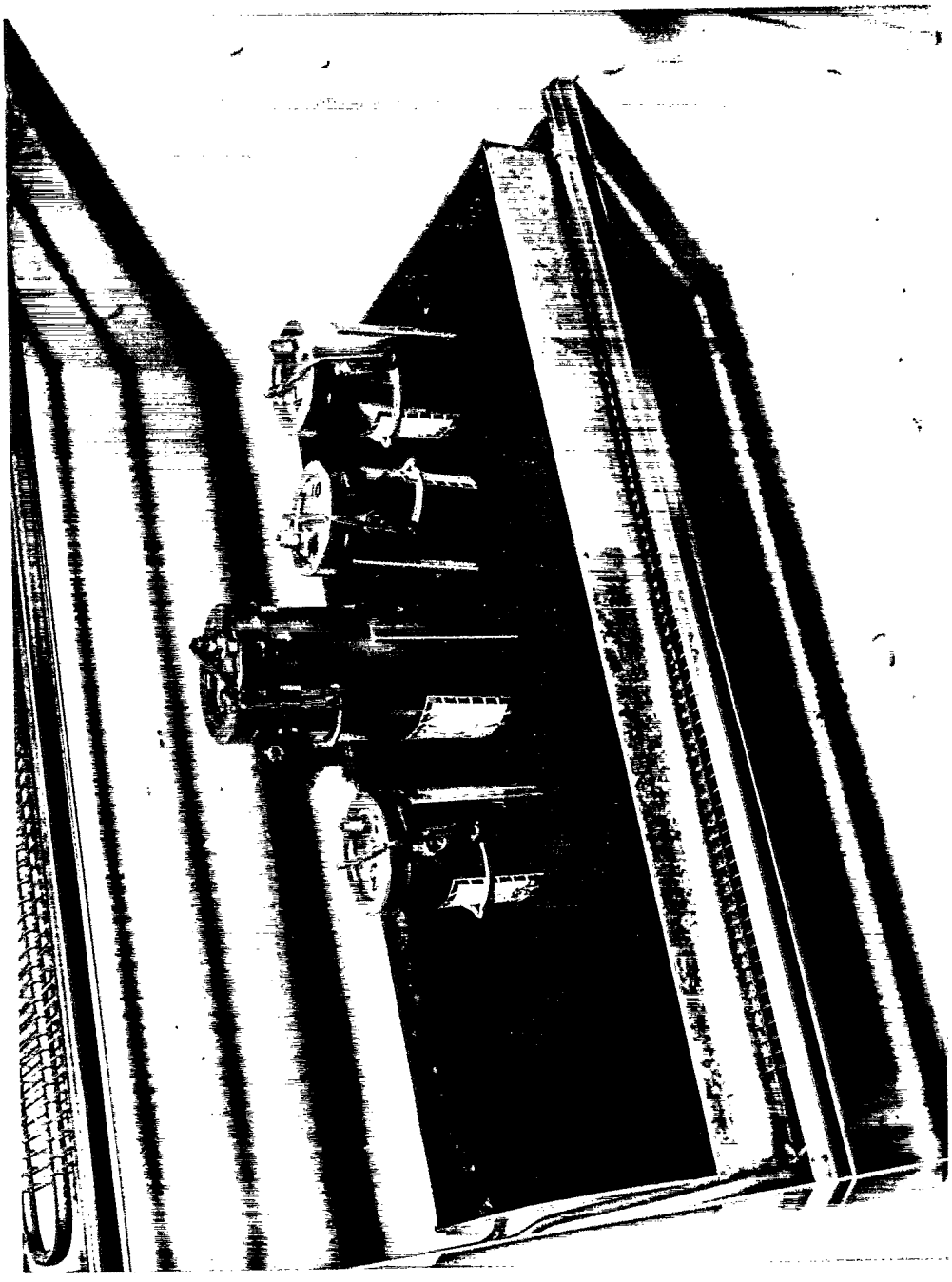


Figure 10: Photograph showing how CW agents were stored.

Figure 11: Rear section of Building 17.

APPENDIX 1

1. DREO Project Registration and EARP Decision Form
2. DREO Environmental Screening Form

DREO PROJECT REGISTRATION AND EARP DECISION FORM

1. Division Protective Sciences	2. Section Physical Protection	3. Name of Initiator Dr. S. Liang
4. Project No. (if applicable)	5. Task No. (if applicable)	6. Contract No. (if applicable)
7. Location PSD Facilities, Defence Research Establishment Ottawa 3701 Carling Avenue, Ottawa, Ontario		

8. Project Title Decommissioning of All Facilities/Buildings Occupied by PSD

9. Study Conducted

Yes ☐ No ☒

- ☒ Initial Screening - Using Class Assessment?
- ☐ Initial Environmental Evaluation (IEE)
- ☐ Initial Impact Statement (EIS)

10. Assessment Decision

- ☐ Code 1 - Automatic Exclusion (Proceed) - Exclusion List Item No: ☐
- ☒ Code 2 - Insignificant Adverse Effects (Proceed)
- ☐ Code 3 - Adverse Effects Mitigable (Proceed)
- ☐ Code 4 - Effects Unknown (IEE Required)
- ☐ Code 5 - Mitigation Unknown (IEE Required)
- ☐ Code 6 - Significant Adverse Effects (Panel Review Required)
- ☐ Code 7 - Significant Public Concern (Panel Review Required)
- ☐ Code 8 - Automatic Referral (Panel Review Required)
- ☐ Code 9 - Unacceptable Effects (Project Abandoned)

11. OPI (Directorate/Division/Section)

	Name, Rank, Position	Phone No.	Date
Recommended by (Screening Officer)	S. Liang - DS-04	998-9746	29/09/93
Approved by (Director)	B. Harrison - DS-06	998-2195	

30/9/93

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DREO ENVIRONMENTAL SCREENING FORM

12. PROJECT DESCRIPTION

General

To decommission all facilities/buildings currently occupied by PSD.

Project Rationale

PSD is moving to DRES and all the facilities/buildings PSD currently holds will no longer be required.

Activities

The objective of this decommissioning project is to remove, and if necessary to decontaminate everything which has come in contact with chemical warfare (CW) agents. Thus all activities pertaining to this decommissioning include:

1. Check for residual CW agents;
2. Decontaminate and clean up of all residual CW agents in all buildings/facilities as required.
3. Prepare a report detailing all activities.

Secondary activities pertaining to this decommissioning includes:

1. Removal of fumehoods, filters and associated ductings.
2. Clean up of chemical and chemical waste of non-CW origin.
3. Label facilities which may contain asbestos and PCB (polychlorinated biphenyls).
4. Prepare a report detailing all secondary activities.

13. DESCRIPTION OF EXISTING ENVIRONMENT

Location

Buildings 4, 5, 5B, 9, 17 and 73.

Zoning & Present Use

Building 17 was used for CW agent storage, and all agents have been removed since March 1993. Building 5B contains laboratories, some of which were used for CW agents synthesis, handling and disposal, the rest were used for routine wet chemistry and analytical work. Building 9 contains various heavy equipment to manufacture paper and equipment to analyze paper and fabrics. The basement of Building 5 contains the Polymer Research Laboratory inside which are presses, mills, injection mould equipment, where rubbers and plastics can be manufactured. Room 201 in Building 5 is the only laboratory remaining on this floor. Building 73 is used for transient storage of wastes from the time they are collected until they are picked up by licensed contractors (usually not more than 3 days). Rooms 118, 119, 120, 123, 125 in Building 4 are used as offices and technical evaluation laboratory.

General Description

DREO is located in a complex managed by the Department of Communications (DOC) on the Ottawa Rive at Shirley's Bay, west of Ottawa. DOC maintains the Communications Research Centre (CRC) at this site and DREO is a tenant of CRC. Protective Sciences Division (PSD) is the only division in DREO who deals with a lot of chemicals and occupies several buildings on site. Building 17 is an isolated building with its own fence and alarm system for security reasons. Building 5B is a secure wing off Building 5. It is 100% contained with its own make-up air. Building 9 was built like a pilot plant in which laboratory and pilot scale production of paper can be made. Building 5 had been renovated in the mid-80's to become offices except Room 201 (used for general storage of chemicals), and the Polymer Research Laboratory in the basement. Building 73 is situated in an isolated area. Building 4 (the part that PSD occupies) contains mainly offices and a small scale evaluation laboratory which uses a very small amount of non-hazardous chemicals (e.g. sodium chloride) and solvents.

Valued Ecosystem Components (VECs)

Decommissioning workers and future accupants of the decommissioned buildings/facilities.

(This form may be reproduced locally)

14. SOURCES OF INFORMATION USED

Literature Consulted

1. CCME National Guidelines for Decommissioning Industrial Sites.
2. Southeastern Region Interim Decommissioning/Cleanup published by Ontario Ministry of Environment.
3. US Federal Register 53 (50), 8504-8507 (1988), article published by the US Department of Health and Human Services, Centers for Disease Control.
4. US Department of Energy, Report No. ANL/ESD/TM-21 (Dec 1992).

Consultations

Acres International Ltd, Calgary, Alberta, under DSS contract W7714-3-9697.

Site Visits

Contractors from Acres International Ltd has the first site visit from 30 August to 01 September 1993.

Maps and Drawings

See attached DREO site map.

Public Meetings

Briefing to DREO Health and Safety Committee Meeting once evry two months starting 05 Aug 93.

Other

15. SCREENING MATRIX

Attached? ☐ Yes

☒ No

16. DESCRIPTION OF POTENTIAL IMPACTS
(Use additional sheets if necessary)

1. Description	Exposure to very small dose of chemical warfare (CW) agents to the clean-up workers.
Significance	Insignificant; there was no record of spill of CW agents in DREO, and all work involving CW agents were carried out inside fumehoods, thus there is no exposure danger to all workers. Furthermore, in case of accident, PSD workers are fully trained in emergency treatment of casualties caused by CW agents, and in decontamination and clean-up of any CW agent spill.
2. Description	Residual CW agents.
Significance	Insignificant; there was no record of any spill inside any building.
3. Description	Generation of waste, from CW agents and other chemicals.
Significance	Insignificant; DREO is a registered Waste Generator in Ontario, all CW agents decontaminated solution and CW agent breakdown products, and all chemicals currently in use in PSD were all registered wastes and disposed of by licensed contractor.
4. Description	Exposure to contaminants other than CW agents, such as waste.
Significance	Insignificant; CW agents decompose in the decontaminating solution which render them harmless. The decontaminating solution itself consists of bleach and alcohol, which is no more hazardous than any other household items. In terms of other chemicals, PSD employees are briefed on all health and safety aspects of the handling, removal and disposal of chemicals in laboratories.
5. Description	
Significance	
6. Description	
Significance	
7. Description	
Significance	
8. Description	
Significance	
9. Description	
Significance	

17. MITIGATION AND MONITORING
(Use additional sheets if necessary)

1.	**Monitoring:**	CW agent monitoring
2.	**Monitoring:**	Health and safety of all workers.
3.	**Monitoring:**	Personal protective equipment have to be available at all times.
4.		
5.		
6.		
7.		
8.		
9.		
10.		

18. CONCLUSIONS

1. Insignificant adverse environmental effects, when all operations are monitored under Item 17 (Mitigation and Monitoring).
2. Proceed.

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ANNEX B

LETTER OF APPROVAL OF THE DECOMMISSIONING PLAN PROVIDED BY ACRES INTERNATIONAL LTD

ACRES

December 3, 1993
P10649.00

3344A

Department of National Defence
Defence Research Establishment Ottawa
Building 29, 3701 Carling Avenue
Ottawa, Ontario
K1A 0K2

Attention: **Mr. B.H. Harrison, Ph.D.**
Director, Protective Sciences Division

Dear Dr. Harrison:

RE: **Decommissioning Plans for Protective Sciences Division Facilities, Part I. Building 17 - Toxic Chemicals Storage Building**
SSC File No. 017SV.W7714-3-9697

The Protective Sciences Division (PSD) has prepared a decommissioning plan for Building 17 at DREO. Acres International Limited (Acres) has reviewed drafts of this plan dated July 1993 and October 1993. This letter reports Acres opinion of the final version of the plan, also dated October 1993.

Decommissioning Guidelines

The Canadian Council of Ministers of the Environment (CCME) has issued "National Guidelines for Decommissioning Industrial Sites" (CCME-TS/WM-TRE013E dated March 1991). These guidelines provide a step-by-step approach to

- determine if contaminants are present;
- develop decommissioning and cleanup guidelines that are compatible with the intended future use by eliminating human health concerns and mitigating environmental effects; and
- address safety and aesthetic factors.

The CCME recommends a phased approach to decommissioning that collects and assesses site-specific data that are used together with cleanup criteria to determine the appropriate level of cleanup or remedial action.

The decommissioning planning approach followed by PSD is consistent with the spirit of the CCME guidelines and generally consistent with the letter of the guidelines. The principal departure from the phased approach recommended by CCME is in Phase II (Reconnaissance Testing Program) and Phase III (Detailed Testing Program). The PSD has prepared a decommissioning plan for Building 17 (Phase IV) without conducting any site-specific Reconnaissance (Phase II) or Detailed (Phase III) testing for contaminants. Hence, the PSD's

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Vancouver, Winnipeg, Toronto, Burlington, Niagara Falls, Halifax, Sydney, St. John's

approach is essentially a variation on the Optional Fast Track Approach suggested by CCME for new or "clean" facilities, which jumps from Phase I (or II) directly to Phase V (Implementation of Decommissioning). Although the PSD's approach is a slight procedural departure from the CCME approach, it is a reasonable way to proceed, for several reasons.

- According to the building assessment in the decommissioning plan, Building 17 is not expected to be contaminated.

- In any event, the PSD has taken the conservative approach of assuming that contamination is present and specifying monitoring and decontamination procedures on that basis in the decommissioning plan.

- In preparing a decommissioning plan before implementing the decommissioning, the PSD is being more rigorous than the CCME Optional Fast Teach Approach.

It should be noted that the CCME guidelines are directed primarily at cleanup of contaminated **lands**. Although the overall process recommended by CCME is applicable to cleanup of a building, such as Building 17, to render it suitable for other uses, not all the details in the CCME guidelines apply to a building cleanup.

Regulatory Compliance

(The following is a technical judgment, not a legal opinion)

Most of the federal, provincial and municipal environmental laws and regulations that might pertain to building decommissioning are concerned with contamination of the **environment**. Residual contamination in Building 17 is not in "the environment" per se and, if decommissioning operations are carried out properly in accordance with the decommissioning plan, would not be released into the environment. Hence, compliance with environmental laws and regulations is an issue principally in four areas

- accidental release of contamination into the environment during decommissioning

- disposal of wastes from decommissioning activities

- health and safety during decommissioning and thereafter

- Environmental Assessment and Review Process for the decommissioning.

The decommissioning plan for Building 17 addresses environmental releases of contamination indirectly, through reference to a number of DREO safety manuals and PSD standard operating procedures. The reporting requirements of the Canadian and Ontario Environmental Protection Acts are being addressed in a separate emergency response plan for decommissioning operations that is currently under preparation.

Wastes generated for disposal during decommissioning will be similar to the wastes already approved for disposal from DREO under Ontario regulations. Hence, adherence to the existing procedures should ensure compliance.

Decommissioning activities in Building 17 will fall within the scope of the ongoing routine activities of the personnel involved. Hence, compliance with the established DREO health and safety program should ensure regulatory compliance in this area as well. The decommissioning plan specifies how zero or undetectable CW agent will be achieved by the cleanup, thus protecting future users of the building.

The decommissioning plan for Building 17 includes the documentation needed for compliance with the Environmental Assessment and Review Process.

As Building 17 will still be on federal lands after decommissioning, concerns about changes in municipal zoning requirements do not apply.

Acres Comments on Previous Drafts

All of Acres substantive comments on the two previous drafts of the decommissioning plan for Building 17 have been adequately addressed in the final version of the plan.

Conclusion

The decommissioning plan for Building 17 is a sound planning document. When used with the safety manuals and standard operating procedures referenced therein, it should provide adequate guidance to the decommissioning exercise for meeting the objective of ensuring that "Building 17 is suitable and aesthetically acceptable for general use in the future with no residual environmental or health and safety liability for DND related to CW agent storage inside the building."

Yours very truly,

J.W. Tanner, M.Eng., C.Chem.
Manager, Environmental Projects

JWT/ab

cc: J.M Robinson
SSC Science Contracting Officer

ANNEX C

AIR-SAMPLING OF FUMEHOODS, DUCTINGS AND EQUIPMENT IN PROTECTIVE SCIENCES DIVISION (PSD)

by N. Gibson

1.0 Introduction

In support of the decommissioning project of PSD laboratories at DREO, air samples from fumehoods, associated ductings, fan-motor assemblies and equipment in all the laboratories in Building 5B and Room 201 in Building 5A were monitored for GD, GB and HD (soman, sarin and sulfur-mustard respectively).

A series 3000 MINICAMS system, developed by CMS Research Corporation, Alabama, USA was used in the monitoring task. This system is an automated air-monitoring and alarm system consists of three functional parts: (1) air sampling by a pump and then collected using solid adsorbent; (ii) separation using a temperature controlled gas chromatography column, and (iii) the contaminants in air were detected using a flame photometric detector. The system is controlled by a personal computer that provides the flexibility suitable for the operation of MINICAMS accessories such as the stream selection system, the sample selection system and data analyses. A schematic of this instrument is shown in Figure E-1. Since this instrument is a commercial product advertised for the monitoring of chemical warfare (CW) agents, the description of each working component is minimal.

2.0 Analytical Procedure

Analyses of air samples for residual CW agents in laboratory, fumehoods and ductings were performed on the MINICAMS system. This air sample was collected from the laboratory environment by a reciprocating pump operating at 14 min. The contaminants in the air were then collected on a cooled NAYESEP solvent bed (for phosphorus compounds such as GB and GD) and TENAX sorbent (for sulfur compounds - mustards). The collected contaminant was desorbed from the sorbent bed by heating to above 200°C. The samples were then drawn into a capillary column where each component of the air contaminant was separated by gas chromatography. Each component was detected, identified and analyzed with a flame photometric detector (FPD). This detector is a very sensitive and specific detector used in analyzing phosphorus and sulfur compounds. The FPD utilized an oxygen-hydrogen flame to ionize all the CW agents (which are organic compounds) in the air sample, and a photomultiplier tube is used to detect the molecular

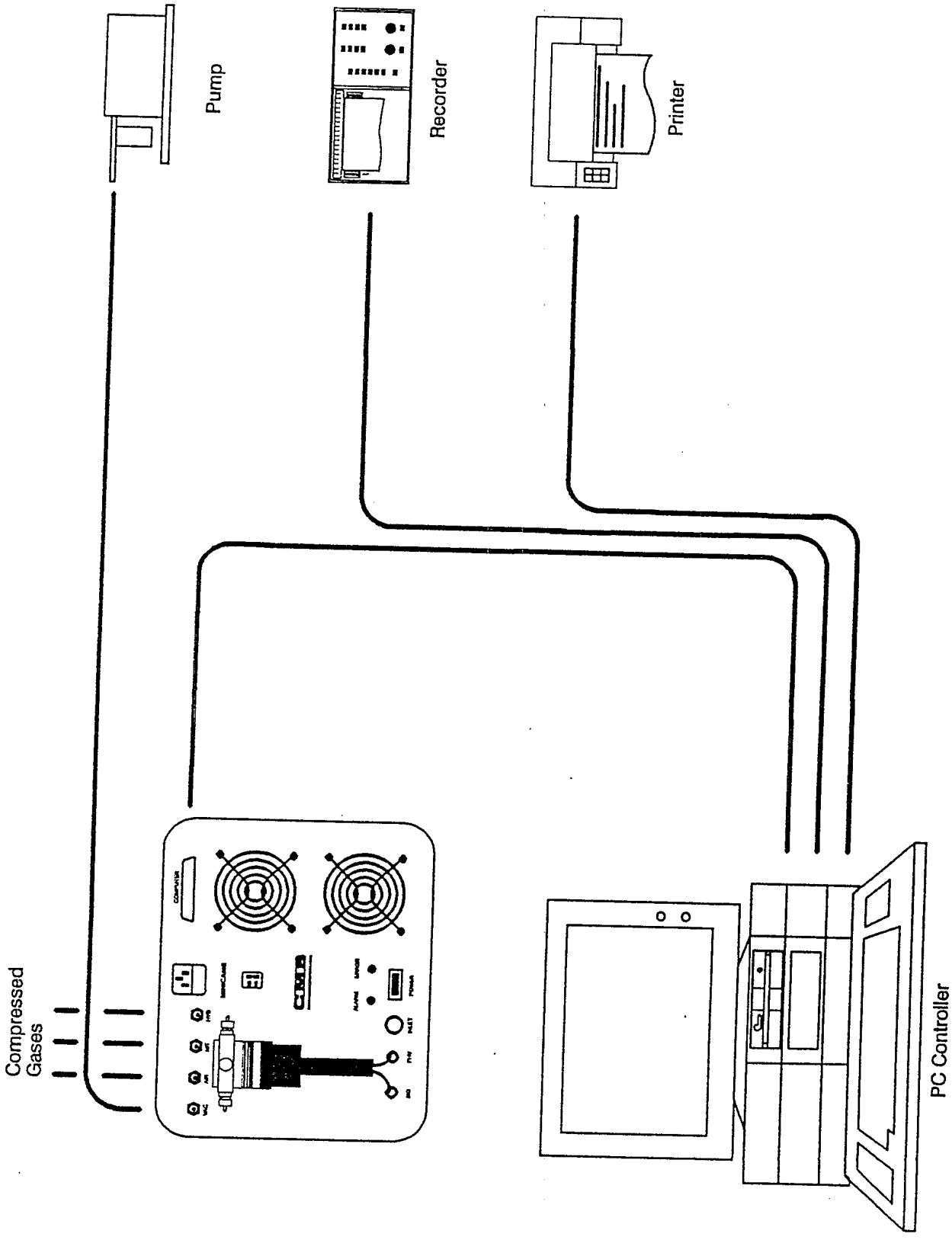

Figure 1. Major components of the laboratory system

emission from HPO species (arising from GB and GD) and S_2 species (arising from HD). Selectively for phosphorus and sulfur in the photomultiplier tube is obtained by using the appropriate interference filter which monitors the phosphorus emission at 526 nm and sulfur at 394 nm (as shown in Figure C-2).

The detection limit for phosphorus compounds (i.e. GB and GD) is 0.002 ng/L and 0.2 ng/L for sulfur compounds (such as HD).

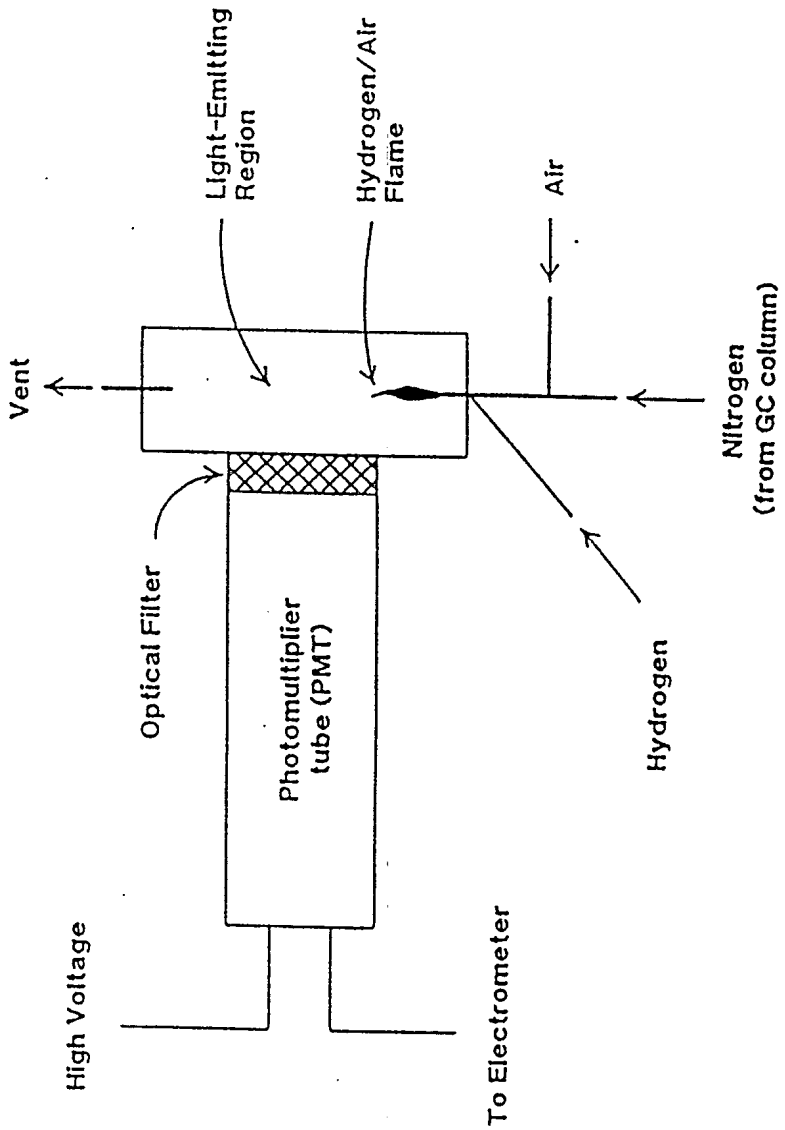

Figure 1. Detection of agent in a flame-photometric detector.

ANNEX D

SWAB SAMPLING

Swab samples were taken on the floor and on equipment in Building 17, to ensure that there is a total absence of chemical warfare agents, namely GB, GD and HD. This task was performed by a contractor according to standard US EPA (Environmental Protection Agency) protocols. It is important to note that not only were analyses carried out for chemical warfare agents, but also for their decomposition products, such as methylphosphonic acid (MPA) and thiodiglycol (TDG). In the total absence of evidence of GB, GD and HD, and these decomposition products using these standard protocols, one can safely ascertain that the area or the equipment was not contaminated.

1.0 Swab Sampling Protocol

1.1 Calibration

Prior to sample analysis a 5 point calibration curve was constructed for each GB, GD, the TBDMS derivative of methyl phosphonic acid (MPA), HD, and the TBDMS derivative of thiodiglycol (TDG). MPA and TDG are decomposition products arising from GD (and GD) and HD respectively. However they cannot be chromatographed in their free forms, therefore MPA had to be silylated with TBDMS in this analysis. The standards ranged in concentration from the instrumental detection limit to 1-2 orders of magnitude above this concentration. Each day the analyses were performed, a single point check of the calibration was performed for HD (a sulphur mode species), and GD (a phosphorous mode species).

1.2 Sample Collection

swab area:	100 cm^2
swab description:	10 cm x 10 cm cotton gauze pad soaked with 10 mL acetonitrile (distilled in glass)

The swab area was thoroughly wiped with the swab, and then the swab was placed in a EPA approved 40 mL vial. The vial was then capped, labelled and stored at room temperature until analysis. The swab was manipulated with a pair of forceps cleaned by a solvent rinse.

1.3 Sample Preparation

The sample preparation procedure is based on work done by G. Purdon, J. Pagotto and R. Miller at DREO in 1985 (DREO report 910, DREO technical note 85-5, DREO report 936).

1. Filter the sample by gravity through a Whatman #1 filter paper or equivalent. Wash the swab and vial with five 5 mL aliquots of acetonitrile (distilled in glass). All filtrate was collected in a 100 mL round bottom flask.

2. Evaporate the sample to approximately 5 mL using a rotary evaporator with the sample vessel immersed in a 20°C bath.

3. Transfer the sample by pipette to a 50 mL round bottom flask with five 2 mL aliquots of acetonitrile (distilled in glass).

4. Evaporate the sample to approximately 1.0 mL using a rotary evaporator with the sample vessel immersed in a 20°C bath.

5. Transfer the sample by pipette to a 3 mL Reacti-Vial with three 2/3 mL aliquots of acetonitrile (distilled in glass).

6. Blow down the sample volume to 0.7 to 08 mL with zero grade nitrogen.

7. Cap the vial and add 200 μL of MTBSTFA (silylation reagent) to the sample.

8. Make sample volume up to 1.0 mL with acetonitrile (distilled in glass).

9. Allow reaction to proceed at 60°C for 2 hours.

10. Transfer the sample by pipette to an autosampler vial and analyze by GC/FPD for sulphur and phosphorous.

The agents GB and GD hydrolyse rapidly. Therefore, these agents were only recovered in reduced quantities in the swab sample recovery experiments. The amount of GB and GD detected decreased over time as these compounds hydrolyze. These compounds are not expected to be present on the swab samples due to this tendency to hydrolyze. Upon hydrolysis, these compounds form MPA and analogues of MPA.

Recoveries of the MPA during these experiments were inconsistent when present in quantities less than 0.25 ng. Due to the requirement to have all the lab work completed by May 11, we were unable to investigate the source of the loss in greater detail or perform recovery studies at higher concentrations. MPA is merely reported as being present if detected. When present, the quantity is in excess of 0.25 ng in the swab sample.

HD and TDG were recovered from the swab samples at the 80-85% level. The reported quantities are the amounts detected, they are not corrected for recovery data.

1.4 GC Analysis

Equipment: Varian 3400 Star gas chromatograph
Varian 8200 autosampler
Varian 4270 integrator

Column: J&W Scientific DB-5, 30 m x 0.53 mm
70°C isothermal for 1 minute
Ramp to 300°C at 15°C per minute
Hold at 300°C for 3.67 minutes (8.67 for some samples).

Injector: Flash vaporization glass liner
300°C isothermal
Varian 8200 Autosampler standard injection mode

- solvent flush injection
- 1.0 µL acetonitrile
- 0.5 µL air
- 1.0 µL sample
- 0.8 µL air

Detector: Flame photometric detector
325°C isothermal

Carrier: Chromatographic grade helium
20 mL per minute measured at 70248C

TABLE D-1

Detection Limits for the Varian 3400 Gas Chromatograph

Compound	Detection Limit (ng)
HD	1.3
GB	0.001
GD	0.001
methyl phosphonic acid	0.01
thiodiglycol	2

TABLE D-2

Recovery Experiment Results

Compound (quantity)[1]	% Recovery
HD (5.3 ng)	80 - 85
GB (0.0045 ng)	dependent on dryness of sample
GD (0.0087 ng)	dependent on dryness of sample
methyl phosphonic acid (0.057 ng)	not detectable below 0.25 ng
thiodiglycol (18 ng)	80 - 85

[1] Quantity reported is what would be present in a 1 μL injection, this is 1000 times less than what was spiked onto the swab.

ANNEX E

LETTER OF VERIFICATION THAT THERE IS NO RESIDUAL CW AGENT IN DREO PROVIDED BY FARRINGTON-LOCKWOOD CO. LTD.

FARRINGTON
LOCKWOOD
COMPANY LIMITED

100 Terence Matthews Crescent
Kanata, ON, CANADA K2M 1P7
Telephone 613-591-0754
FAX 613-591-3580

7 April 1994

Dr. S. Liang
Defence Research Establishment, Ottawa
3701 Carling Ave.
Ottawa, Ontario
K1A 0K2

Re: Contract W7714-3-9758

Dr. S. Liang:

During the course of contract W7714-3-9758 analyses were performed at various points in the fume extraction systems of building 5B, and in the laboratory portion of building 17. The MINICAMS agent monitoring system (a system based on the technique of gas chromatography) was employed in the analysis for airborne contaminants, and a Varian 3400 gas chromatograph equipped with a sulphur and phosphorous specific flame photometric detector (FPD) was employed for analysis of swab samples collected from surfaces of ducts, fumehoods and floors (building 17 only).

The technique of gas chromatography (GC) separates mixtures of compounds based on their boiling point and their affinity for the analytical column material. Thus each compound will reside on the column for a specific period of time. Standards are used to establish this residence time on the column and the sensitivity of the detector to a specific compound. As such, the absence of a peak at the pre-defined time indicates that the compound of interest is not present at or above the detection limit of the analytical hardware. However, the presence of a peak is not definitive proof that the compound is present; compounds with similar affinities for the column can have the same residence time on the column. The GC technique, coupled with a selective detector such as the FPD, is a powerful screening tool. If positive confirmation of the presence of a compound is required, a more sophisticated analytical method such as Gas Chromatography/ Mass Spectroscopy must be employed.

Of the approximately 200 samples collected and analyzed in the course of this contract only one sample had any peaks coincident with the agents of primary interest (GB, GD, and HD). The swab sample collected at the baffle of system RT-12, in the penthouse of building 5B, contained a compound giving rise to a peak with an area corresponding to approximately 3 ng of HD. This value of 3 ng is near the detection limit for HD and below the level where reliable quantification can be expected. The identity of the compound responsible for the peak is not clearly sulphur containing, as is described in the final report. There were other peaks observed, particularly in the phosphorous mode analysis of the swab samples. The identity of these peaks is unknown. Identification of these materials is beyond the scope of this contract.

A complete account of the findings of the analyses is given in the final report entitled, "MONITORING OF RESIDUAL ORGANOPHOSPHOROUS AND ORGANOSULPHUR COMPOUNDS IN PROTECTIVE SCIENCES DIVISION BUILDINGS/FACILITIES AT DEFENCE RESEARCH ESTABLISHMENT OTTAWA".

Jim Anderson,

James Anderson

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This report describes the decommissioning of Building 17, a storage facility for toxic chemicals. The decommissioning process, from its planning stage to the final stage of a clean empty building has been detailed. The planning phase addressed the health and safety concerns and the achievable level of cleanliness of Building 17. The actual decommissioning then followed, paying particular attention to monitoring of chemicals and the verification that none exists at the detection limit of the equipment employed.

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