

File

31 MAY 1979

Mr. Davidson/
72630

Report of the Army Science Board Ad Hoc Subcommittee on Safety of Propellant and Explosives Production at the Radford Army Ammunition Plant

The attached proposed memorandum for the DAS was developed as requested by Dr. Pierre as the aftermath of a 29 May 1979 meeting on the above subject with Secretary Alexander and Dr. DePoy. By separate action letters of commendation for each member of the Ad Hoc Subcommittee proposed for signature by Secretary Alexander, have been initiated as well as letters, prepared for Dr. Pierre's signature, to GEN Guthrie and the Secretary of the Navy commending representatives of those organizations for their support of the study.

Dr. Pierre's signature on the attached proposed memorandum to the DAS.

None required.

(Signed) Arthur Douglas

**ARTHUR DAUGLAS
Colonel, GS
Assistant Deputy for
Materiel Acquisition**

*CF: Lt Sweeney
4 June 79*

Arthur Douglas

1 JUN 1979

MEMORANDUM FOR DIRECTOR OF THE ARMY STAFF

SUBJECT: Report of the Army Science Board Ad Hoc Subcommittee on Safety of Propellant and Explosives Production at the Radford Army Ammunition Plant

As you recall, an Army Science Board Ad Hoc Subcommittee was designated to investigate the safety of propellant and explosives production at the Radford Army Ammunition Plant. This action was the aftermath of the second significant 1970 explosive accident at the plant, which occurred last fall.

The attached report was presented to, and approved by, Secretary Alexander on 29 May 1979. Although all of the recommendations contained in the report were approved in general, the Secretary specifically directed that immediate implementing actions be initiated with respect to the following recommendations contained on pages 5 and 6 in the report.

a. Recommendation (1), page 5; expansion and additional training of Government safety office personnel at Radford.

b. Recommendation (3), page 6; development of (1) a method to highlight, and bring to the attention of appropriate personnel, interruptions of continuous processes, and (2) a program to conduct periodic hazard analyses of these processes so as to evaluate operating experience.

c. Recommendation (4), page 6; development of a BA procedure for expeditiously processing production projects to correct conditions identified and authenticated as process safety deficiencies.

d. Recommendation (7), page 6; the appointment of a security specialist on any future Boards of Investigation of explosive incidents who is qualified to evaluate the possibility of sabotage.

Concerning additional safety personnel requirements, it is requested that an expanded but expeditious study be undertaken covering both Government and contractor personnel at all ammunition manufacturing facilities. The

**SUBJECT: Report of the Army Science Board Ad Hoc Subcommittee on
Safety of Propellant and Explosives Production at the
Redford Army Ammunition Plant**

**study should identify the additional personnel and costs required as well
as including recommended courses of action for providing these sources,
such as internal reprogramming from lower priority activities.**

**I would appreciate information at an early date on the implementing actions
that have been initiated and their estimated completion date.**

[(Signed) Percy A. Pierre

**Incl
as**

**Percy A. Pierre
Assistant Secretary of the Army
(Research, Development and Acquisition)**

Mr. Davidson/72630/fm/31May79

**SUBJECT: Report of the Army Science Board Ad Hoc Subcommittee on
Safety of Propellant and Explosives Production at the
Radford Army Ammunition Plant**

**Study should identify the additional personnel and costs required as well
as including recommended courses of action for providing these sources,
such as internal reprogramming from lower priority activities.**

**I would appreciate information at an early date on the implementing actions
that have been initiated and their estimated completion date.**

((Signed) Percy A. Pierre

**Incl
as**

**Percy A. Pierre
Assistant Secretary of the Army
(Research, Development and Acquisition)**

Mr. Davidson/72630/En/31May79



DEPARTMENT OF THE ARMY
ARMY SCIENCE BOARD
OFFICE OF THE ASSISTANT SECRETARY
WASHINGTON, D.C. 20310

30 March 1979

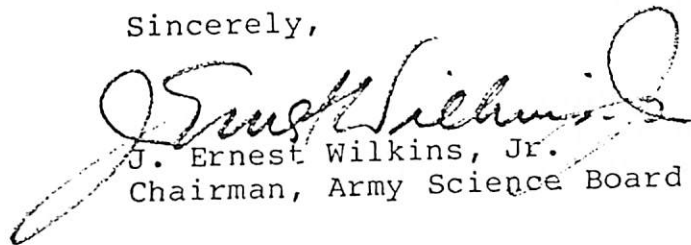
Honorable Percy A. Pierre
Assistant Secretary of the Army
(Research, Development, and Acquisition)
Department of the Army
Washington, D.C. 20310

Dear Secretary Pierre:

Respectfully submitted herewith is the report of the Army Science Board Ad Hoc Subcommittee on the Safety of Propellant and Explosives Production at the Radford Army Ammunition Plant. Included in the report are responses to the questions posed by you in your letter of 11 December 1978, as well as some recommendations for actions which we feel the Army should undertake.

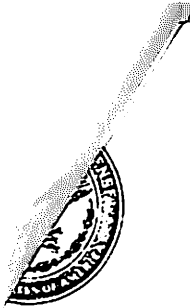
We will be happy to amplify further any of our findings, as well as look into other aspects of this matter, as you may desire.

Sincerely,



J. Ernest Wilkins, Jr.
Chairman, Army Science Board

Encl.
As stated



DEPARTMENT OF THE ARMY
ARMY SCIENCE BOARD
OFFICE OF THE ASSISTANT SECRETARY
WASHINGTON, D.C. 20310

30 March 1979

From: Chairman, ASB Ad Hoc Subcommittee on the Safety of
Propellant and Explosives Production at the Radford
Army Ammunition Plant

To: Assistant Secretary of the Army (Research, Development
and Acquisition)

Via: Chairman, Army Science Board

Subj: Report of the Ad Hoc Subcommittee

In response to your letter of 11 December 1978, we have reviewed the recent explosive incidents at the Radford Army Ammunition Plant, Radford, Virginia, for the purpose of investigating and submitting findings, conclusions, and recommendations with respect to the safety of design, construction, operation, and maintenance of the plant. In our efforts, we have reviewed the reports of the Boards of Investigation of the recent incidents, as well as many Army safety instructions, selected hazard analyses, and sample operating procedures for the Radford plant. We have held discussions with a wide variety of people as outlined in the attachment to this report.

In general, we have found that the Radford plant is well managed and well operated. There are a few areas, however, in which we feel improvements could be made, which are discussed in later sections of this report.

Our findings relative to the specific items included in our charter are as follows:

a. Evaluate the design, construction, operation, and maintenance of the Radford Plant, the organization of its work force, and the systems and procedures employed there in the production of propellants and explosives.

Finding. With respect to the design and construction of the plant, most of the facilities are old, but these appear to be adequate and properly utilized for the types of propellants and explosives that are now being processed. It is significant to note that the severe accidents that have occurred in

e plant, including the TNT accident in 1974, have all occurred on new, continuous processes, rather than the older facilities used for batch operations. In many of the new facilities, there are an alarming number of problems and shortcomings which appear to us to be a result of a lack of communication between the Corps of Engineers and the plant personnel during the final design and construction phases. As a result, the operating contractor's maintenance personnel had been diverted from their normal duties to correct these deficiencies. Since 1976, the Project Manager for Munitions Production Base Modernization and Expansion has established a configuration management program to monitor and control design modifications, which may remedy this problem in current and future construction.

The plant appears to be well maintained, and the RAAP policy of scheduling regular down days for maintenance appears to be functioning properly.

A striking phenomenon in the RAAP organization is the advanced age of the employees. It appears that the policies utilized in reducing the work force from peak periods to peacetime levels of operation tend to cut off the younger personnel and to concentrate the older employees. In a few years, the RAAP organization will be facing mass retirement of these older employees, and it is feared that much aggregate experience may be lost before it can be passed on to younger workers entering the organization.

The systems and procedures employed at Radford in nearly all the production processes appear to be quite adequate, and we could not identify any major shortcomings in these areas. In a later section of this report, we do suggest some changes in procedures for monitoring the new continuous production processes.

b. Determine whether there is any correlation among the three explosive incidents occurring there within 1978.

Finding. Disregarding the burning ground incident, which we do not feel to have been of a sufficiently serious nature to deserve further attention, at the higher levels within the Army, we believe there is a very general type of correlation between the two other 1978 incidents, and with the 1974 TNT incident as well. These three incidents all occurred in new, continuous processes. All three incidents in the continuous processes appeared to occur when blockage or interruption of the continuous process took place.

In the TNT production, there had been a holdup by "white compound" building up in a line between vessels. Rather than dumping the nitrator to clean out the "white compound," which would have meant a downtime of 8 to 12 hours, it became routine to "rod" the line to clear it. This operation was done with the agitator still turning and eventually resulted in the explosive incident. In the nitroglycerin process, problems had been recognized in the transfer operation, and funding had been requested over a period of several years to make modifications. Finally, in the continuous nitrocellulose process, at least twice a pusher in the centrifuge had stalled, the space between the pusher and inlet funnel had clogged completely, and the centrifuge had continued to run. After the centrifuge was stopped, the space between the pusher and the inlet funnel was found to be packed with acid-wet nitrocellulose. Also, seven fume-offs had occurred in one of the centrifuges on the two shifts immediately prior to the explosion. It was in this centrifuge that the explosion occurred.

c. Evaluate the safety of the production process as conducted at the Radford plant and in its major components.

Finding. The General Manager at RAAP has prime responsibility for the operating contractor's safety program, and in turn, each department head is responsible for the implementation and effectiveness of the safety program in his area. A safety department is responsible for the administration and coordination of the program and reports directly to the General Manager. The safety program includes regular inspection of equipment, facilities, and operations, and appears to be thorough and professional.

The safety program is well documented with proper delineation of authority and responsibilities. Technical operating procedures are detailed, usable, and accurate. A procedure is in use to review and approve changes in procedures.

The Government Safety Office, on the other hand, is understaffed and overcommitted. The office consists of only three men. The Safety Manager appears to be well qualified, with over 35 years experience and attendance at many safety courses and seminars. Two safety specialists have four- and one-year safety experience, respectively, and have not

attended all the DARCOM safety courses. (Their scheduled attendance at courses in FY 1979 was cancelled owing to a lack of travel funds.)

The Government Safety Manager has not been able to monitor adequately and personally the safety program of the operating contractor. The majority of his efforts have been directed to external audits, safety supervision of the extensive Corps of Engineers construction program, and staff safety reviews of program documentation. As a result, he was able to make only infrequent reviews of plant facilities.

A review of the Government Safety Officer's records and report files for recent years indicates that there were no Government Safety Office inspections made on explosives operations from September 1977 through March 1978, samplings of explosives operations were made on a total of 13 days during April, May, July, and August 1978, and no inspections were made from September 1977 through December 1978. During the two years prior to September 1977, safety inspections of explosives operations were far more frequent and of broader scope.

To augment its program, the Government uses Quality Assurance personnel to assist in monitoring the operating contractor's safety procedures.

d. Determine the safety of the production process as conducted at the Radford Plant and in its major components.

Finding. It is the opinion of the Subcommittee that the overall frequency of accidents occurring at RAAP is not excessive, although the severity tends to be high when workers are exposed to the hazards of working with fire and explosive sensitive materials. Prior to 1978, the safety record at RAAP was excellent. Even with the 1978 incidents, there have been only 12 lost-time accidents since January, 1977, of which nine have been industrial type accidents and three (all connected with the same incident) have been explosive related.

In view of the problems with continuous processes as discussed previously, the Ad Hoc Subcommittee found that there was no formal system for in-process review. Operating personnel had experienced interruptions in the process resulting from equipment malfunctions or conditions of a

severity not anticipated. Corrective actions appeared to consist of treating the isolated symptom rather than examining the process itself to determine the causative factors. There was no indication that a hazard analysis had been conducted subsequent to the initial startup, either to evaluate operating experiences gained or to determine the implications of the repeated in-process interruptions. In the case of the nitroglycerin explosion, the problem with the transfer system had been identified; however, there were no procedures to fund expeditiously the required construction.

e. Investigate the attitude of employees, their representative organizations, and the surrounding community toward the Radford plant and the manufacturing processes conducted there.

Finding. In our contacts with many of the employees and with a representative of their union, we felt that the general attitudes regarding safety and the plant were quite good. We also met with several citizens from the local community. Without exception, they strongly supported the plant and emphasized its economic importance to the area.

f. Provide advice through the Army Science Board to the Secretary of the Army on the above matters.

On the basis of its review, the Subcommittee recommends the following:

(1) The Government Safety Office at Radford be expanded with at least one additional professional safety manager. The two assigned Government safety specialists should receive formal safety training such as the appropriate portions of resident instruction in the Safety Specialist Course at the DARCOM Field Safety Activity. Quality Assurance personnel should attend, as a minimum, the two-week course at the DARCOM FSA in munition safety.

(2) A comprehensive program of inspection of explosives operations and facilities by the Government Safety Office be developed.

(3) A method be developed to highlight interruptions of continuous processes to process engineering and safety personnel as well as to plant management. A program should be developed

to conduct periodic hazard analyses of continuous processes to evaluate operating experience. Equipment malfunctions and recurring interruptions in the processes should be evaluated to ascertain if correction or modifications of the processes are required.

(4) A Department of the Army procedure be developed for expeditious processing of projects to correct conditions identified and authenticated as process safety deficiencies. The Subcommittee feels that the new DARCOM system for identifying and supporting "projects to eliminate authenticated hazards to life" is a valuable step in this direction.

(5) Consideration be given to modifying the operating contract at Radford to provide a safety incentive to the contractor, with a documented and periodic evaluation of the contractor's safety performance.

(6) An analysis be made of the age of employees at RAAP and their estimated time remaining to retirement be evaluated, and attempts be made to retain younger people in the organization. This would possibly enhance the safety of operations over the near term, and would almost certainly give younger personnel the benefit of the experience of the older employees to prevent possible increases in the accident rates in later years.

(7) Although not directly related to the specific items in the charter, we additionally recommend that the appointment of a security specialist be made to the Boards of Investigation of all explosives incidents. It appears to us that a thorough investigation of the possibility of sabotage in an incident is made by the FBI only if there is evidence that sabotage occurred. In the past, some Boards have included such a specialist, but others have not.

In summary, we find no major shortcomings in the safety of the design, construction, operation, and maintenance of the Radford plant. In fact, we feel that the plant is well managed and well operated. Notwithstanding our overall impressions, we feel that some improvements can be made in the operations and procedures, as discussed above.

We hope that these findings and recommendations will be beneficial to the Army. We will be happy to discuss them further with you, or to look into other aspects of the RAAP safety program if you desire.

It should be noted that the work of this Ad Hoc Subcommittee of the Army Science Board was very greatly aided by the appointment of COL Philip G. Kelley, Jr., Chairman of the Department of Defense Explosives Safety Board to the Subcommittee. His outstanding experience and knowledge in the area of explosives safety have been invaluable to us in this effort. In addition, he made two of his engineers, Messrs. James T. Drake and James M. Hawes, available to conduct a survey of Radford which was of great importance. Mr. Ray A. Miller of the Naval Weapons Center, China Lake, California, assisted the Subcommittee and made very significant contributions. We also had valuable assistance from Messrs. Albert Camp, A. J. Perk, and Walter Carr from the Naval Ordnance Station, Indian Head, Maryland. Finally, we wish to acknowledge the outstanding cooperation and support of LTC Watts and his staff at Radford, the Hercules organization, COL Thorne of ARRCOM, and Mr. Davidson of your office.

Respectfully submitted,

Phil E. DePoy
Phil E. DePoy
Chairman, ASB Ad Hoc Subcommittee

ATTACHMENT

Meetings/Visits of Ad Hoc Subcommittee on the Safety of
Propellant and Explosives Production at the
Radford Army Ammunition Plant

27 November 1978 - Subcommittee Meeting, Pentagon, Washington,
D.C.

- Briefing by LTC Watts, Review of Operations
Accidents.

3-5 January 1979 - Subcommittee Visit to RAAP.

- Briefings by COR and Hercules staffs.
- Tour of plant facilities.
- Discussions with COL Durel and Dr. Matsuguma of the
Board of Investigation for Nitrocellulose Incident.
- Discussion with Mr. Rutzinski, FBI.

22-26 January 1979 - Explosives Safety Management Survey at
RAAP by Messrs. J. T. Drake and J. M. Hawes,
DDESB, accompanied by COL Kelley.

13-14 February 1979 - Visit to RAAP by Messrs. Ray Miller, Naval
Weapons Center, and A. J. Perk and Walter
Carr, Naval Ordnance Station, Indian Head,
accompanied by COL Kelley.

14 February 1979 - Briefing by Messrs. Drake and Hawes, DDESB,
to Dr. DePoy and Dr. Wilkins.

1 March 1979 - Subcommittee visit to Aerospace Division,
Hercules.

- Discussions with Mr. D. D. Welder,
President, and Mr. R. G. Sailer, Vice.
President, GOCO and Plant Operations

13 March 1979 - Subcommittee Meeting, Pentagon, Washington,
D. C.

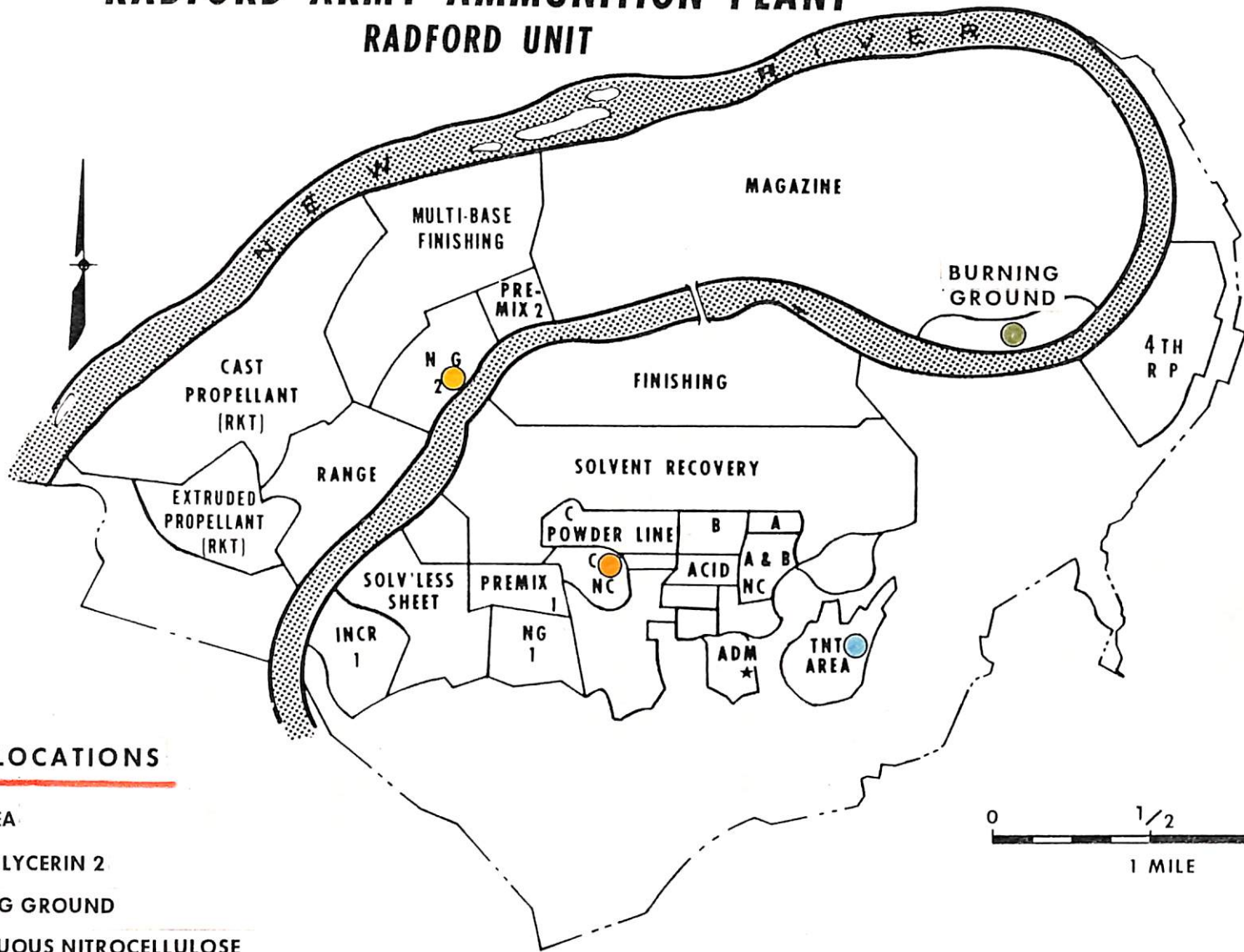
- Briefings on "Hazards to Life" projects and GOCO
contracting procedures.

27 March 1979 - Visit to Naval Ordnance Station, Indian Head,
by Dr. DePoy and COL Kelley.

March 1979 - Visit to RAAP by Dr. DePoy and COL Kelley.

- Discussions with employees and several Radford citizens.
- Meeting with Mr. Quesenberry, President OCAW

RADFORD ARMY AMMUNITION PLANT RADFORD UNIT





COLLEGE OF ENGINEERING
DEPARTMENT OF APPLIED SCIENCE DAVIS-LIVERMORE

HERTZ HALL
POST OFFICE BOX 808, L-794
LIVERMORE, CALIFORNIA 94550

July 3, 1979

J. Ernest Wilkins, Jr.
Chairman
Army Science Board
Department of the Army
Office of the Assistant Secretary
Washington, D.C. 20310

Dear Ernie:

The report on Radford is good -- diagrams would make the narrative clearer, but their absence isn't crippling. Your recommendation 6 on page 6 could be strengthened, however.

As stated, the facility has a cadre of employees of nearly the same age. Their retirements will drain experience and the slug of new hires will have fewer teachers. Why not suggest that, if the mean time to retirement is T years, up to $1/T$ be granted early retirement each year and then hired as "paid annuitants". (If $1/T$ is too large a number, a lesser fraction could be used.)

The paid annuitants don't count against the OMB full time ceiling, so that new hires can be brought aboard. The retired employees will be making no more gross pay than before, but their take-home pay increases. The additional payroll cost to the facility is an investment: it's a way to train the new people that'll minimize the tuition charged by the school of experience.

Sincerely,

A handwritten signature in cursive script, appearing to read "Wilson K. Talley".

Wilson K. Talley, Professor
Department of Applied Science

WKT/lh