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MONTHLY STATUS AND PROGRESS REPORT

FOR AUGUST, 1949

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A Report Submitted

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V. BROOKHAVEN NATIONAL LABORATORY

The Brookhaven National Laboratory is now developing a reporting procedure for future use which is designed to give a comprehensive picture of the Laboratory's activities. This report for August, contains a description of the BNL well-drilling program and the results of geological studies. A summary of the Reactor Complex construction status and activities of the Department of Reactor Science and Engineering are also included.

Geological Studies

As part of the Laboratory's radiation protection program the Geology Survey Group has been conducting an extensive program of drilling wells and test holes in the central part of Long Island. This network will provide the water level measurements, underflow and adsorption data, and other geological information essential to a detailed knowledge of subsurface conditions in the neighborhood of the BNL.

Sixty-two observation wells are being measured every two weeks, and five continuous recorders are in operation. Complete chemical analyses of sixty-two water samples have been received from Washington. The gross natural radioactivity from eleven samples is very low, with one exception at some distance from Brookhaven.

A 10-inch well to bedrock north of the reactor complex shows that the Lloyd sand aquifer in this area has a much higher clay content than is found in western Long Island; water can be obtained from it only with difficulty. In order to test the tightness of the Raritan clay seal over the Lloyd, a 4-inch well was drilled 1000 feet from the 10-inch well, and it was found, during pumping of the larger well, that there is no direct communication between the Lloyd and the overlying aquifers at this point.

With the well-drilling program virtually completed, the geologic staff is concentrating on experimental work, the monitoring of strategically located wells and the gathering of data on underflow, adsorption, ion exchange, and water level fluctuations, Some preliminary work was done on direct measurements of flow rates; one rate recorded was only four inches per day. The method developed for measuring flow rate involved the addition of methanol to the concentrated ammonium chloride solution. The methanol reduces the specific gravity of the ammonium chloride tracer solution to 1.0. Thus, the tracer does not tend to sink, and can be followed for much longer periods of time than was previously possible.

Some of the studies to be pursued in the immediate future are as follows: hydrologic studies (including pumping tests), recharging experiments, studies to determine indices of dilution, direct flow measurements employing tracers, the routinization of water sampling and monitoring programs, further resistivity work, and seismic studies to extend data obtained from the two deep wells regarding the configuration of the bedrock beneath the Lloyd sand.

Two months ago the Assistant Director of the U. S. Geological Survey, the Chief of the Ground Water Division, and the representatives of the Engineering Division of AEC visited the Laboratory to review the work accomplished here. Arrangements were made for the USGS to finance that part of the BNL work which is of primary interest to the Survey.

Reactor Science and Engineering

The Department of Reactor Science and Engineering, with a present staff of 142, was established last January 1, 1949. It is made up of the personnel from the former Nuclear Reactor Project and the Engineering Department. The new Department is divided into functional units, Reactor Operations, Hot Laboratory Operations, and Research. The present activities of these units are described in the following sections.

Reactor Complex Construction. With the exception of the Hot Laboratory, which is now approximately 85% finished, construction on the reactor complex is substantially complete. The pile start-up date depends upon the results of an extensive investigation concerning design and fabrication of the Reactor structure. This investigation will not be completed until approximately November 1. The operations staff is now occupying the control portion of the Reactor Building and equipment is being installed in the Reactor Laboratories Building. This work is expected to be completed before the Reactor is in routine operation. The H. K. Ferguson Company is turning over to the Brookhaven National Laboratory the fan house, cooling towers, stack, and pump house, all of which have passed satisfactory performance tests.

The Hot Laboratory, which consists of a "hot" section 150 ft. x 70 ft., and a "cold" section 200 ft. x 70 ft., is also expected to be ready for its staff by the early Fall. However, the hot cells and the semi-hot cells bench have not yet been constructed, and plumbing, electrical, and heating systems have not been installed. The waste tank farm, and the holdup and waste treatment area, are about 95% complete.

Operations for Reactor Use. The Physics Department is cooperating in a project to observe and determine the energy of the beta-rays produced in neutron decay; a cloud chamber is under construction, while its shutter and total-reflection neutron collimator is being designed.

Neutron collimating equipment is being prepared for experiments to determine the spin and moment properties of the neutron.

As soon as the Brookhaven Reactor goes into operation, isotopes produced by it will considerably enlarge the activities of the Isotope

Production and Distribution Group, which has processed over seventy orders for radioisotopes and labelled compounds for the various scientific departments of the Laboratory within the past six months. Most of these items were obtained from the Isotopes Division at Oak Ridge.

Testing and Research. Much theoretical work is being done in studying problems which will arise during the period of initial operation, in the phase between criticality and high level operation. Much can be learned concerning routine operating characteristics, by making careful comparisons between theoretical predictions and experimental performance.

Measurements have been made on the quality of the graphite moderator and it is found to be comparable to that used in other operating reactors. Standardization work has been done on several neutron sources, by comparing them with those at the Argonne National Laboratory.

A study will be made to define, and perhaps extend, a safe upper limit for the neutron flux, which had been established at about 5×10^{12} n/cm^2/sec. Other studies will be made on the solid state properties of graphite, and on some properties of uranium metal under reactor operating conditions.

Much work continues on the structural problems of the airhandling systems; the causes of the initial failures have been carefully analyzed, and the conclusions drawn from these studies have contributed greatly to the revisions in design and fabrication.

A laboratory is being prepared for the fabrication, in furnaces, of single crystals of both organic and inorganic materials.

The Reactor Chemistry Laboratory is now in operation. To date most of its work has been devoted to assembling special apparatus such as a high vacuum line of fluorine resistant materials, fluorine handling equipment, furnaces with controls for carrying out reactions with special gases, and a high-vacuum line of conventional design. Use of this equipment is expected to furnish much basic information on the reactions of fluorine compounds.

A careful evaluation of the properties of the reactor shield will be made. Since this is the first shield of its type to be built, precise information on its performance will be of great importance. The shield is perforated by one 12 inch square hole, which will accommodate large experimental apparatus, and by a number of 4 inch square holes, which will be capable of releasing collimated neutron beams. It is planned that several other atomic energy laboratories will join Brookhaven in a collaborative program of study on shielding problems. The shielding properties of various materials and composites will be measured.

Early studies on the waste disposal problems indicated the necessity for an extensive waste handling, storage, and treatment system.

A concentration process, to accomplish a reduction in the volume of stored liquid wastes, is being developed. Pilot plant scale runs have been made, and the design of the present system, with some improvements, appears to be practical. The problems of the permanent disposal of concentrated liquid wastes, and the concentration of radioactive isotopes in biological systems representative of sewage treatment plants, are under study.

VI. [redacted]

An account is given of the participation of the Medical Division n the start-up of beryllium operations at Luckey, Ohio. Several field trips f special interest are described.

Start-Up at Luckey

By late 1948, several considerations suggested the need of a new facility for fulfillment of AEC beryllium requirements. Briefly, these may be outlined as follows:

1. Neighborhood cases of illness in the vicinity of beryllium-producing plants had indicated that extraordinary measures were necessary to cut down the amount of beryllium in plant effluents. This would be at considerable expense and at the risk that, even with improved control, a small number of neighborhood cases might turn up in densely populated area. It seemed advisable from this point of view to have a new facility in a sparsely populated region. In addition, a new facility could have adequate control built into it at a minimum expense.

2. A fire had occurred in the Lorain plant of The Brush Beryllium Company rendering it unfit for further production without substantial expenditures for restoration.

3. A new process had been developed which held promise of producing beryllium at about one-half the cost of processes that were then in use.

4. It was anticipated that the Commission's need for beryllium would increase and that therefore further production capacity would have to be made available.

It was accordingly decided early in 1949 to build a completely new production plant on the site of the stand-by magnesium plant then owned by the War Assets Administration just outside of Luckey, Ohio. By starting from scratch, the AEC was able to take advantage of the points already cited by building a new plant to be operated by The Brush Beryllium Company and located in an isolated area with a very low population density.

In the course of plant design, frequent conferences were held between engineers of the Medical Division and those of the Brush Beryllium Company to devise materials handling procedures and equipment, process equipment and ventilation facilities which would enable full scale plant operations with air concentrations not exceeding the limit set by the Medical Division for safe working conditions. A procedure was set up whereby the Medical Division would take part in preliminary design discussions and would approve the final drawings before the beginning of construction. On completion of the installation, after inspection reveals that it is satisfactory, the Medical Division is to be notified and Industrial Hygiene personnel will visit the plant to survey the plant atmosphere.

Operations will be started and the process continued for a sufficient period to enable a complete evaluation of the employee exposure, and will then be shut down. After analytical results are obtained, the exposures will be estimated and the plant will be advised to operate if adequate control is obtained. If this is found not to be the case, modifications will be recommended.

Consistent with this procedure, the first steps in the ore processing were inspected on August 2, and approval was given to commence operation of the following equipment: 1) drum unloading apparatus, 2) feed weighing apparatus, 3) ore pre-heater, 4) electric ore furnace, 5) frit bucket and 6) miscellaneous materials handling equipment. Samples were taken at a sufficient number of locations to give an estimate of the maximum possible exposure to personnel during this portion of the operation. Six air samples which were taken show a maximum of 6.15 ug/m^3 of air. The highest sample was taken directly behind the furnace door at a time when the furnace was plugged and fuming. A similar sample taken during normal operation showed 0.3 ug/m^3. This compares with similar samples which were taken during the previous plant operations at Lorain which showed something over 200 ug/m^3. The following table gives further comparisons of the improvements brought about by incorporating good design into the plant:

Sample Location	Air Concentration (ug/m^3)	Air Concentration Corresponding Operation At Lorain (ug/m^3)
General air in front of furnace while operating.	0.04	450
Breathing zone of furnace operator while pouring.	0.09	1350
Loading drums onto skip hoist.	2.0	400

It can be seen from these figures that the reduction in air beryllium concentration was in the order of approximately 1000fold and that the average concentration in the area is well below the 2 ug/m^3 figure which has been set as a maximum average for industrial atmospheres. Accordingly, approval was given to begin full scale production operations in the beryl fritting department. This department will continue operations until Sept. 10.

On Sept. 6 the second operational step, that of sulfating the beryl frit, will be started. On that day, a visit has been scheduled for one of the engineers of the Medical Division to visit Luckey and make a similar study of the sulfating operations which will be followed by a complete analysis of the handling and frit operations so that a weighed daily exposure of personnel this department may be obtained for the record. This is the procedure which will be followed as each department of the plant is put into full-scale operation.

Field Work

The Medical Division, as part of its routine work, carries on radiation surveys, safety and fire protection inspections, industrial hygiene investigations of various types, and sanitary engineering studies. These are generally not included in the monthly report except when they are of unusual interest or significance. During the month of August, several non-routine field strips were made which are briefly mentioned as an example of the variety of problems with which the staff has to deal competently:

1. The Navy Ordnance Depot at Earle, New Jersey, has agreed to cooperate with this office in the disposal of slightly contaminated wastes by dumping at sea. Contaminated material will be drummed or will be packed loosely in the case of large units, loaded on trucks at Middlesex, and monitored. There will be periodic shipments from Middlesex to the Navy Depot where the material will be unloaded by the Navy civilian personnel and Middlesex labor, if needed, for storage in an outdoor area. After sufficient accumulation, the Navy will load the material on an LST (deck-load) and it will be dumped manually 100 miles out at sea where the water is approximately 500 fathoms deep. A representative of the Radiation Section instructed the Navy in proper methods for safeguarding these operations.

2. A mercury spill in the Pupin Building at Columbia University was reported to this office and at their request, a survey was made to determine the extent of contamination. The area was thoroughly surveyed and several spots of high contamination were found. Recommendations were made for a floor cleaning program and for fixing the non-removable mercury with wettable sulphur and water.

3. A fire inspection was made at the Metals Selling Corp., Putnam, Connecticut, where approximately 120 pounds of magnesium is stored. It was found that the fire protection was entirely unsatisfactory and it is believed that if a fire were started, it would result in the complete destruction of the plant and of the magnesium. Accordingly, the somewhat novel recommendation was made that the magnesium be removed from storage and placed in the open if it cannot be shipped or stored in a fireproof building.