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MINUTES OF INTERPROJECT COORDINATION MEETING ON
RADIATION SURVEY INSTRUMENTS
Held September 14-15, 1944 at Metallurgical Laboratory
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(Minutes issued from District Engineer's Office)
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714353

Present: U.S.E.D.: Major H. L. Friedell
Dr. P. C. Aebersold (Chairman)

Rochester: Mr. W. F. Pale
Lt. R. Tybout

Hanford: Mr. S. J. Bugbee

Clinton: Mr. E. Wollan
Mr. Ray

Columbia: Mr. L. T. Rainwater
Mr. W. W. Havens

Metallurgy: Messrs. W. P. Jesse, F. Shonka,
R. J. Stephenson, J. C. Stearns,
H. C. Vernon, J. E. Rose, and
Lt. D. L. Collins

PURPOSES

Mr. Aebersold stated the purpose of the meeting as follows:

"To decide on means of getting for all groups concerned a sufficient number of the most satisfactory health and survey radiation instruments in the most expedient and efficient manner."

The aims of the meeting were:

"1. To establish the measuring requirements of the health survey and monitoring instruments needed.

2. To review the instruments available and select the types for the various requirements.

3. Investigate the procurability of instruments for the over-all project needs.

4. Obtain inter-project coordination on tests and development of instruments.

5. Outline developments still needed -- direction of research on radiation survey instruments."

COORDINATION BETWEEN INSTRUMENT GROUPS:

It was also stated that although increased coordination is being effected between the various groups interested in radiation instruments by more rapid and direct exchanges of pertinent reports and by visits of personnel between groups for specific

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purposes, there are economies still to be gained in equipment, time, and personnel, as well as expediency in accomplishing project aims, by further coordination.

In order to aid further in attaining coordination between the various groups Mr. Aebersold suggested that preliminary reports on the development and testing of radiation instruments be written and sent to his office from which they would be circulated to the instrument sections. The suggestion was made that final reports, giving more complete details of construction and performance, should be written with less delay. A small committee should be formed, possibly one man from each of the projects, which would be responsible for interproject coordination on radiation instruments and which could meet occasionally to review the status of radiation instrumentation. Also one man familiar with radiation instruments should be selected to visit regularly (every four to six weeks) all the instrument laboratories and by that means to improve the dissemination of instrument knowledge as well as to integrate the needs and developments.

A discussion was held on these suggestions and they were warmly received but no formal action was taken. It was stated that the effectiveness of this endeavor would be considerably increased if the radiation instrument section of Y could be represented. This apparently is not possible at the moment but there is room for hope. Major Friedell suggested that Lt. Collins would be a very good person to circulate between the instrumentation groups of the projects. This was agreed as an excellent choice but action was deferred until the matter could be cleared through official channels.

MEDICAL TOLERANCES:

A discussion was centered around the problem of medical tolerances. Major Friedell stated that the tolerances which needed to be established must be left for final agreement by the medical groups. The two problems are:

1. Tolerances for alpha, beta, gamma, and neutron radiations.
2. The chemical toxicity of various radioactive materials.

(This includes not only the amount of material but also chemical composition, solubility, etc. The criterion for these materials is generally how much is suspended in the air being breathed rather than on a surface, that is, air monitoring of these toxic materials is more important in general for the medical needs than surface monitoring).

Mr. Wollan suggested the medical group put out a report on tolerance on the basis of the information available at the moment and then add to this when more definite information is available. Further discussion centered around whether tolerance per day should be changed to average tolerance per month so that a person could take more on one day and less on another.

REVIEW OF INSTRUMENTS:

General:

The discussion then turned to a review of the various instruments now available and their uses. These were given as:

1. Portable ionization chamber and counter instruments.
2. Continuous radiation monitoring installations.
3. Instruments for survey and monitoring of dust.
4. Instruments for measurement of contamination of personnel.
5. Surface contamination survey instruments.
6. Neutron radiation selective instruments.

The physical principles on which these instruments are based are:

A. Electorstatic indicators.
B. Vacuum tube circuits
C. Counters (Geiger-Mueller, Proportional Counter, Linear Amplifier).

These were rated for survey purposes by Major Friedell in the following manner:

Criterion	Ratings		
	High	Medium	Low
1. Sensitivity	C	B	A
2. Simplicity of construction	A	B	C
3. Feasibility of construction.	B	A	C
4. Practicability			
(a) Durability	A	B	C
(b) Skill for handling	A	C	
for reading	B		
(c) Ease of obtaining reading	B	C	A

Further criteria were given by Mr. Ray as:

Readability and sensitivity:	calibration, linearity, range, readable increment.
Usability:	types of radiation measured; size, weight, response time, and warm up time.
Dependability:	faulty readings, microphonics, geotrophic, holding calibration abusability.
Maintenance:	battery replacement, both ease and frequency.
Repair:	frequency, availability of parts, skill required.
Features:	number of controls, zero set, handles, cover, selective window.
Construction:	commercial availability.
Needs:	many for routine use or a few for exacting uses.

Electrostatic Instruments:

The electrostatic instruments were then described by Mr. Wollan.

(a) Lauritsen or Landsverk-Wollan quartz fiber electroscopes. (The latter is a modification of the former and avoids the difficulty of the fiber winding itself around the support. A further difficulty with the Lauritsen electroscope is that at the present time it is not commercially available.) (See Report CP-I-1930 on the L&W electroscope.)

(b) Victoreen r-meter electrometer (string type fiber). Used with 'Minometer'.

(c) Lindemann or Derschem type electrometers (torsion fiber plus quadrants). Can be used at a sensitivity of 1 millivolt per division but are not portable type of instruments.

Electrometer Vacuum Tube Circuits:

The vacuum tube type of circuits were then discussed. Mr. Shonka described Pluto the alpha ray surface monitoring meter, which has a sensitivity of about 30,000 alpha's per minute full scale. (See reports M-CP-1699 and M-1374). Objections to drift and change of sensitivity of Pluto were discussed. (Memoranda by Mr. Ray on these points are to be circulated.)

Mr. Rainwater described a two tube (959) linear amplifier used at Columbia. Copies of the circuit are available. A report is about to be released on this instrument.

Mr. Ray described the 'Paint Pail' ionization chamber used at Clinton Laboratories, which, though a somewhat insensitive circuit, is very stable and more than sensitive enough for the large ionization chamber used. It uses two 959 tubes balanced in the branches of a bridge circuit. A preliminary report by Mr. Ray on this instrument is to be circulated.

Lt. Collins described the Victoreen portable ionization meter in which the sensitivity is changed by changing the ionization chamber and sealed-in tube combination. The Beckman-Molloy portable ionization meter was briefly mentioned. The latter appears to be good but very limited in production (largely due to difficulty in the production of the special type high resistances required). At present all the Beckman instruments have gone to W, but it is planned soon to furnish the Metallurgical Laboratory group with several for comparative tests. The group at W will be in the best position to report on the usefulness and performance in the field of the Beckman instrument compared with the others. Until the results of such comparisons are known no recommendation can be made concerning a standard beta and gamma ionization-chamber-type survey meter for the whole project.

Mr. Bale described a one tube linear amplifier using a 1LN5 tube made by National Union Company (this company's tubes of this type appear the most satisfactory.) In order to increase the sensitivity, Mr. Bale attached a condenser with a grounded vane in the input circuit. This allows charge to be collected for a length of time and then discharged through the amplifier to give

a ballistic reading. The instrument can also be used for drift or direct reading measurements, thus giving a wide range of sensitivities. It is a fine quantitative instrument, but could not be quickly put into mass production and would not be suitable for unskilled operators. It is planned to make a small number of these instruments and furnish each group with at least one for testing its suitability for the needs of the group.

Dr. Bale also described a portable FP-54 instrument which he has constructed and used satisfactorily. This has much sensitivity and stability as well as range coverage. The main difficulties are in the high drain of the FP-54,,necessitating heavier batteries and shorter battery life. It would also not be as rugged and as easy to produce in large quantities as some of the other instruments. Both the FP-54 and 1LN5 types of instruments were provided with interchangeable chambers for alpha, beta, and gamma measurements and a wide range coverage. For the use of the more skilled radiation measuring personnel these Bale instruments were adjudged to be excellent quantitative instruments with quite a wide range of application.

Mr. Shonka then described a four tube linear amplifier using A.C. which has great stability together with considerable sensitivity. This is in process of development. It is intended mainly for stationary or semi-portable arrangements.

A summary of the electrometer type tubes and the circuits discussed is as follows:

Filament Current	Tube	Used In
Low drain 10 ma	Victoreen	Victoreen instruments
" " 40 ma	959	Pluto, Paint Pail, Columbia circuits
" " 40 ma	1LN5	Bale "vane" instrument
" " 40 ma	32 (special)	Beckman Portable Meter
High drain 90 ma	FP-54	Bale portable type or stationary set-ups.
" " 90-100 ma	954	A.C.powered units, fixed or semi-portable
" " 125 ma	6AK5	Shonka amplifier (A.C. powered units)

Mr. Bale agreed to make available reports on his instruments and Lt. Collins and Mr. Ray are to write a report on the Victoreen portable instruments.

It was pointed out that the only tubes developed specifically as electrometer tubes are the Victoreen (VE-124B) and the FP-54, that the others happened to be available and showed in some cases suitable characteristics. It was further noted that although some of the tubes have been used only in certain applications or arrangements this is in general not a necessary condition. The Victoreen tube, for example, should be tried in circuits other than the one used by Victoreen. (These tubes are being furnished the various groups for such purposes). The important

thing is to develop and standardize upon an electrometer tube circuit which will measure according to measuring specifications throughout the necessary range of d.c. currents for portable survey devices. The physical arrangements and types of ionization chambers incorporated in the device can be adapted to suit the specific needs.

It was requested that those who need any of the Victoreen instruments or the Landsverk-Wollan instruments are to write to the chairman. These should be available in reasonable time.

Counter Instruments:

The counter circuits were then described. Lt. Collins showed several models of a light portable beta and gamma sensitive counter instrument. This device will detect 0.001 r/8 hr. Using either the direct-reading meter (or earphones on some models) it is a useful instrument for quickly locating beta or gamma active material and also for scanning in subtolerance regions. A first run of about 75 of these instruments is being produced by the Hallicrafters Company. Some modifications will be desirable if future runs are necessary. The possibility of replacing the multivibrator counter voltage unit with a light compact battery is being tried. Although not provided with a cable attachment for use of the counter as a probe, this feature is easily added. The limitations of the counter instrument are that it is for sub-tolerance to tolerance dosages, its response is quite dependent on the type of radiation, and the GM tubes have a short life at high counting rates.

Mr. Bale also presented a portable beta and gamma counter instrument. This has the added feature of allowing the operator to take the counter out of the set and use it several feet away from the set with a cable attachment. The full scale response on the direct reading meter was 60 mr/8 hr. It is a more polished instrument than the device in large scale production described by Lt. Collins.

Neutron Detection Instruments

Slow neutrons may be detected by the gamma rays produced by their absorption in a large block of paraffin. Using a Lauritsen type of electroscope with and without Cd an estimate of the slow neutron density may be obtained. The slow neutrons are detected by the capture gamma rays. Slow neutrons are also detected by counting the alpha particles released from boron under slow neutron bombardment. Although counters filled with BF_3 gas have been widely used for this purpose, counters lined with boron by new techniques are proving more satisfactory. The meaning of boron counter responses in biological applications is obscure. Measurement of the gamma rays from slow neutron capture in paraffin is a more meaningful quantity biologically.

Mr. Wollan and Mr. Ray described an instrument for fast neutron measurements consisting of two similar ionization chambers, one filled with methane at 27 lbs./in^2 and the other with argon at 40 lbs./in^2, connected so as to give zero total current for gamma rays. Fast neutrons may be detected by the differential

reading caused by hydrogen recoils in the methane chamber. The difficulties of using this double chamber for a small collimated beam were discussed.

A single chamber filled with hydrogen at high pressure was discussed as a suitable means of measuring tolerance doses for fast neutrons in the presence of gamma rays.

SUMMARY OF SURVEY INSTRUMENTS:

The available survey instruments and methods were summarized as follows:

Beta and Gamma Survey:	
"Yes or no" instrument:	Victoreen, 0-20 or 0-50 mr/hr type.
Quantitative instrument:	Lauritsen or Landsverk-Wollan electrometer. Using timer in L-W: 0-200 and 0-2000 mr/hr Using stop watch: all ranges
General:	Pale "vane" instrument: all ranges
Rapid Search:	G-M set (with phones): 10mr/hr and lower
Fixed instrument:	Integrating Victoreen meter Integron with alarm at 100 mr/8 hr.
Alpha Survey:	
"Yes or no" instrument:	Pluto 10,000 c/m detected.
Quantitative:	Pale "vane" instrument or FP-54 amplifier with suitable probe.
Personnel monitoring instrument:	Pulse amplifiers connected in parallel, proportional counters, FP-54 amplifier and chamber.
Air monitoring:	Precipitron type device Filter paper --Sneezy instrument with tolerance alarm system. (more research in progress)

Neutron Survey:

Fast: Landsverk-Wollan electrometer with single chamber filled with hydrogen at high pressure.
Methane-Argon differential chamber and Lindemann electrometer. (research needed)
BF_3-filled counter with differences caused by use of Cd and paraffin.
Hydrogen linear amplifier or proportional counters.

Slow: Differences caused by use of Cd and paraffin around ionization chamber.
BF_3-filled and boron-lined counters.

Personnel Monitoring: SECRET

Gamma: Film
Pocket chambers (Victoreen)
Pocket electroscopes.

Beta & Gamma: Finger counter (for finger protection measurements when handling active materials)

CONCLUSIONS: (with reference to previously listed aims of meeting)

1. Measuring Requirements:

It is essential that the medical authorities agree upon practicable measuring requirements for the health survey and monitoring instruments for each radiation problem. Combinations of sensitivity, stability, accuracy, range, and portability are often requested which from the instrumentation standpoint are at present incompatible with rapid production and simple operability. Furthermore the rapidity desired in obtaining the reading will necessitate a compromise with accuracy and sensitivity. Acceptable combinations of the above mentioned factors should be decided upon for each survey purpose so that the instrument groups will not be continually chasing a will-o-the-wisp ideal. For most survey purposes it was suggested that consideration be given to an accuracy and range requirement of 10% over dosages from 1/10 to 10 times tolerance.

2. Review of Instruments:

The survey instruments developed in the various laboratories were reviewed. No single instrument incorporates physical features and measuring characteristics ideal for all uses that arise in dealing with any particular radiation, nor can such be expected. A number of instruments are available, however, which within the limits of the type of instrument, serve their purpose fairly satisfactorily. Project-wide adoption of some of these is in progress, but in some cases further experience from varied field usage is necessary before final recommendations or final models can be agreed upon. For certain usages there is still no entirely satisfactory instrument, in which case coordination between the groups is in order in developing as generally suitable an instrument as possible. One goal, soon attainable, would be agreement on the best tubes, circuits, mechanical layout, etc., for basic devices to meet certain measuring requirements. Variations of the basic devices could then be made for special measuring conditions, such as special ion chambers, special counters, probes, restricted ranges, etc. In making comparative evaluations of instruments a distinction should be made between (a) the simple, nonversatile instruments intended for use by average plant technicians to give a 'yes or no' answer on whether the radiation level is above tolerance (or whether the amount of active material is worth removing) and (b) the quantitative, more all-purpose instruments intended for use by trained radiation technicaians in making accurate determinations or in doing special experiments.

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3. Procurability:

Procurability is a problem mainly in the case of instruments intended for general use in plants, the 'yes-or-no' or simply-operated, limited-purpose instruments, which it is desired to have produced in large numbers. The project instrumentation groups can generally cope with the needs for the smaller number of the more quantitative, versatile type, or of the special purpose, instruments. In the case of large scale production, coordination is needed between the groups in meeting the over-all project needs as regards suitableness for the average purpose, sufficient quantity, and appropriate scheduling. Coordination between groups in the case of laboratory production is desirable in order to ensure that the best instrument is being produced for the purpose. It is also well to integrate the project needs for certain critical items (tubes, resistors, etc.) used in survey instrument construction.

Portable radiation survey instruments that are being produced by commercial manufacturers are: (A) By the Victoreen Company: (1) ionization chamber - condenser type units for use in conjunction with a string electrometer; suitable for integrating with fair accuracy penetrating radiations, each unit covering a limited range but units being available to cover practically all ranges; (2) Victoreen electrometer tube instrument, suitable for gamma and penetrating beta radiations, giving direct readings of intensities in a quite limited range but provisions being made for changing of the tube and chamber combinations for different ranges (Model 247 has three ranges incorporated in it, while Model 196 has a single range that can be changed); these units are at present of limited accuracy and stability which classes them as qualitative ("yes-or-no") instruments. (B) By the Beckman Instrument Company: an electrometer tube device similar in range and radiation response to the Victoreen electrometer tube device but employing a basically different circuit; it has promise of greater stability and accuracy but production is limited and adequate field testing has not yet been possible. (C) By the Hallicrafter's Company: (upon arrangements for production of a sufficient number) (1) "Pluto", the alpha particle survey instrument with a full scale response of 30,000 alphas per minute; this unit does not have stability and accuracy but is satisfactory for quick qualitative determinations; latest production run will have units provided with adapters to which special snout chambers can be attached; (2) Portable beta counter set (Model 5); it has direct reading meter, possibility of incorporating earphones, and possible added counter in a probe arrangement; it is very satisfactory for rapid search for beta or gamma active material; later production models can be improved by use of a better counter HV supply.

In addition the Metallurgical Laboratory instrumentation group is preparing to go into quantity production of the Landsverk-Wollan electroscope. The Lauritsen electroscope was previously in quantity production by the Henson Company of Pasadena but it is doubtful if such production is being continued. It is planned to

have Dr. Bale's "vane" instrument produced in sufficient quantity to furnish the needs of the U.S.E.D. Medical Group and to give each instrument group one for testing.

To coordinate the demands for the radiation survey instruments listed above as being in quantity production, it was suggested that all requests for these instruments go to the Chicago Area Engineer with copies for Dr. W. P. Jesse and Dr. P. C. Aebersold.

4. Coordination of Instrument Experience and Development:

In addition to integrating the demands for production of instruments and critical parts, coordination between the groups is desirable in gathering all available data on the testing and development of instruments so as to further better instrumentation and minimize duplication of effort. The means existing at present for such coordination are: (1) direct exchange of reports between respective Information Divisions of the project(as well as through Dr. Wensel's office), (2) visits of qualified personnel to other instrument groups when authorized by the Area Engineer, (3) correspondence through offices of the Area Engineer or the Information Division.

Further coordination efforts deemed advisable are: (1) the sending of data on instrument tests, preliminary reports on instrument development, and memoranda pertinent to the over-all instrument problem to Dr. P. C. Aebersold, The District Engineer's Office, for examination in regard to further dissemination; (2) selection of one or two persons from each instrument group to be representatives for the over-all project coordination, said persons to be kept informed of the development and status of radiation instrumentation by correspondence,reports, or occasional meetings; (3) visitation to some of the instrument groups by Lt. Collins periodically (approx. every 6 weeks) both to dispense and pick up information on the performance and development of instruments. It was pointed out that the prompt writing up of information into reports, either in preliminary or final form, is very desirable inasmuch as written details and data are of much value in promoting the coordination.

5. Further Development:

There will, of course, be continued development of special instruments for particular applications and improvement of all the instruments, but for overall project purposes it was indicated that effort should be expended toward: (1) a more satisfactory gamma-beta survey instrument of the electrometer tube type (as indicated from collected criticisms of the Victoreen and Beckman instruments); (2) a more stable, more versatile "Pluto" or alpha survey instrument (possibly a more sensitive device with resistors for less sensitive use, not necessarily having changeable ranges on outside of instrument); (3) a "Super-Pluto" or portable alpha counter instrument (capable of locating less than a milligram of normal or low enrichment tuballoy); (4) a decision as to the relative merits of the Precipitron and "Sneezy" type

air-born alpha contamination measuring devices. SECRET

Some of the instruments and the measuring requirements discussed were not only for health monitoring purposes but for the extremely important purpose of monitoring losses of valuable material. Satisfactory models of items (2) and (3) above are needed as much or more for monitoring of losses as for health measurements, although the two are closely related.

(Minutes by R. J. Stevenson & P. C. Aebersold)

Distribution:
See List attached.

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