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原子力施設における事故の文献集

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原子力施設における事故の文献集

要　旨

Nuclear Science Abstract 第1巻（1948年）から第18巻（1964年）に集録されている原子力関係の事故に関する報文のうち，主として身体に関するものと，原子力施設における事故に関するものを集めた．この文献集に集められた報文数は120編で，NSA に書かれているアブストラクトを，掲載順に並べた．アブストラクトの内容から索引項目を作り，事故対策と事故報告の2つに大別し，これらの中でさらに分類して Subject Index を作成し，巻末に付けた．

1965年5月

日本原子力研究所，東海研究所
職員診療所　小村佑吉，小林弘雄
保健物理安全管理部　赤石　準，飯島敏哲

Bibliography on "Accidents in Nuclear Facilities"

Summary

The bibliography contains 120 abstracts from the Nuclear Science Abstracts, Vol. 1 (1948) to Vol. 18 (1964), dealing with personal exposures to radiations or radiation accidents occurring in nuclear facilities. The abstracts are arranged in the numerical order adopted by NSA. The Subject index is devided in two groups, namely, emergency planning, and accidents, each group being further divided into smaller classes; these clasifications were done by referring to the abstracts only. The index is in the end of the bibliography, arranged alphabetically.

May 1965

Yukichi Kobayashi, Hiroo Kobayashi
Medical Service
Jun Akaishi, Toshitetsu Iijima
Division of Health Physics and Safety
Tokai Research Establishment, Japan Atomic Energy Research Institute

目　　次

Contents

1. まえがき

原子炉の運転，アイソトープの生産などの進展にともない，作業者の身体汚染や被曝の問題はより深く考慮すべきであろう．現在では，原子力施設におけるいろいろな放射線事故者の処置について完全な方針はまだ達成されてはいない．そして外国などで時折起る事故はそのこと自体が研究の対象となっている．人体の汚染や被曝がこのような現状であることから，今までに起った諸外国の事故について知ることがこの問題を研究する最初のステップとして必要であると考え，この文献集を作成した．この文献集が放射線防護や事故者の処置などの方面の仕事にたずさわる方々にとって，少しでも役立つことを願っている．

集録の基準とその範囲は Nuclear Science Abstract，第1巻（1948年）より第18巻（1964年）までの，主として Disaster（初期の NSA では Reactor Safety）の項にあげられていたものの中で関係あると思われたものを集めた．

集録した報文は，第1として，身体汚染事故に関係するもの，第2としてこれに関係する事故報告および施設や作業者の事故防護，処置などに関係するものである．作業者の汚染や被曝を起さない場合でも，原子炉などの事故報告はそのほとんどを取り上げてあるが，事故における一般人への問題を取扱っている報文はそのほとんどを除外した．また原爆戦争における防護，処置およびこれらの活動のための組織などについての報文は除外した．医学的な報文は上記の原爆戦争に関係するものを除いて，なるべく取入れるようにつとめた．

索引項目を巻末につけた．項目は「事故対策」と「事故報告および評価」の2つに分け，前者には事故時における防護対策，方法についての報文が入れられており，また後者には実際の事故についての報文と事故評価などに関する報文が入れられている．一般公衆に関する報文で，この文献集に取り上げたものは「その他」の項目に入れられている．

この索引は NSA の索引項目を参考にして，抄録の内容とてらし合せて作ったものである．したがって，この文献集の索引項目は抄録の内容のみから引き出したものであるため，原報文の内容を必ずしも正確にはとらえていないことがある．また索引項目の分類において適正を欠くものがあると思う．これらの点については今後機会があれば改正したいと考えているが，ここに利用者諸氏に注意を喚起するとともに，お許しを乞う次第である．

この文献の作成に当って，保建物理安全管理部柴沼三千代氏の援助を得た．ここにお礼を申し上げる．

2. 抄　　　録

1. **Method for Evaluating Radiation Hazards from a Nuclear Incident.** J. J. Fitzgerald, H. Hurwitz, Jr., and L. Tonks (Knolls Atomic Power Lab., U. S. A.) KAPL-1045, 53 p (1954)

A method to evaluate the radiation hazards from a nuclear incident is discussed in this report. Several new formulas for the determination of the integrated dose from external and internal radiation, and the fallout of activity from the fission-products cloud are developed in the appendixes. (NSA 8-3657)

2. **Emergency Crew Training and Medical Decontamination Facility at the Livermore Research Laboratory,** G. A. Blanc, W. A. Clark, and G. T. Saunders (Livermore Research Lab., Calif. Research and Development Co., U. S. A.) LRL-142, 17 p (1954)

The formation, training, and operation of the emergency crew, (disaster squad), of the Rivermore Research Laboratory are described. In addition, the medical decontamination facilities, designed to adequately provide emergency care in the case of radiocontaminated injuries, are described. (NSA 8-5104)

3. **The Accident at the NRX Reacter on December 12, 1952.** W. B. Lewis (Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont., Canada) DR-32 (AECL-232), 14 p (1953)

Because of a complex concurrence of mechanical defects in the shut-off-rod system and operating errors which alone would have caused serious trouble, a power surge occurred in the NRX reactor during preparations for experiments at low power. Some of the cooling arrangements at the time were adequate only for low power operation. Consequently some of the natural-uranium metal melted and repured the alminum sheathing and tubes which separated the heavy-water, air, and cooling-water systems. As a result some 10, 000 curies of fission products from long-irradiated uranium were carried by a flood of 1, 000, 000 gal of cooling water into the basement. Fused masses of highly irradiated uranium and uranium oxide were left inside the calandria, and the core vessel of the reactor and tubes of the reactor and tubes of the calandria, were severely damaged. In such a high-flux reactor where the transient xenon poison may effect the reactivity by 40 milli-k (mk), the shut-off rods have to cover a reactivity range of about 70 mk. As one lesson from the accident it appears preferable to withdraw the first or safe guard bank of shut-off rods soon after shutting down, instead of making this first step op the actual start-up. (NSA 10-375)

4. **Administration of Nuclear Safety at Hanford.** R. L. Dikeman (Hanford Atomic Products Operation, Richland, Wash., U. S. A.) HW-42331, 12 p (1956)

Nuclear safety considerations arise in the Hanford Atomic Products Operation in the areas of fuel element fabrication, high power reactor design and operation, chemical processing plant operation, research reactor operations, and, on occasion, in critical experiments. The nuclear safety aspect of all production operations at Hanford is the joint responsibility of the Engineering and Manufacturing Depertments. These responsibilities are clearly delegated within the respective departments to the appropriate levels in the line organizations. (NSA 10-3980)

5. **A Summary of Accidents and Incidents Involving Radiation in Atomic Energy Activities, June 1945 through December 1955.** DANIEL F. HAYES (Div. of Organization and Personnel, Safety and Fire Protection Branch, AEC., U. S. A.) TID-5360, 79 p (1956)

Criticality incidents, reactor incidents, contamination incidents, fires and explosions involving radioactive material, and miscellaneous accidents involving radiation which occurred from June 1945 through Dec. 1955 are described. Safety measures resulting from review of the accidents are included. (NSA 10-9967)

6. **Estimation of Whole-Body Radiation Doses in Accidental Fission Bursts.** JOSEPH G. HOFFMAN and LOUIS H. HEMPELMANN (Roswell Park Memorial Inst., Buffalo, N. Y. and School of medicine, Univ. of Rochester, N. Y., U. S. A.) *Am. J. Roentgenol., Radium Therapy and Nuclear Med.*, **77**, 144-60 (1957)

In two nuclear accidents involving uncontrolled fission reactions 9 persons were inadvertently exposed to complex ionizing radiations Whole body doses are computed on the assumption that serum ^{24}Na slow-neutron-induced activity provides a measure of fast-neutron intensity. The selfdosage in the human body due to gamma radiation from slow neutron captuer in hydrogen is computed on the basis that the serum ^{24}Na activity gives a measure of slow-neutron density. Measurements of gamma ray intensities about a mock-up man filled with ^{24}Na in water are described. The assay of induced ^{24}Na in the sera of humans by a measurement of gamma ray intensity at the anterior diaphragm is discussed. Slow-neutron-induced activities although measurable are found to be negligible insofar as radiation dosage is concerned. In decreasing order of magnitude the dose components are: fast neutrons, hydrogen capture gamma rays. ^{14}N captures, and prompt gamma rays. Doses are expressed in average rep throughout the body, integral dose, terms of incident r delivered by 1 Mev gamma and soft roentgen rays, and the serum ^{24}Na induced activities. (NSA 11-3301).

7. **M. W. Kellogg Co. Radiation Incident on March 13, 1957.** *Nucleonics*, **15**, 42-43 (1957)

This statement by the General Manager of the AEC concerns the background and facts relating to an incident involving ^{192}Ir at the South Houston plant of the Nuclear Products Div. of the M. W. Kellogg Co. in March 1957. (NSA 12-2699)

8. **Windscale.** *Nuclear Eng.*, **2**, 510-12 (1957)

As is generally known, the cause of the accident at Windscale on October 10 was the application of an excessive amount of nuclear heating during a release of wigner energy, which caused an exceptional rise in temperature, leading to can failure, uranium oxidation, and finally a fire. Among the fission products released a certain amount of ^{131}I passed through the stack filters in gaseous form. (NSA 12-3288)

9. **The Internal Dose to Various Organs as a Function of Isotopic Composition of the Fission Products in a Specific History of Operation.** JAMES O. ALDERMAN and KENT C. HUMPHERYS. (Air Force Special Weapons Center, Kirtland AFB, N. Mex., U. S. A.) AFSWC-TN-57-22, 63 p(1957).

An evaluation was made of the relative importance of the various isotopes formed in a reactor to the radiation dose which might result from internal deposition following a reacter accident. Tabulated data and graphs are presented for use in making calculation of the internal dose which might be expected in any specific case, regardless of reactor power level and mode of operation. For the case of the reactor with a history of operation used in this report, and neglecting (n, γ) reaction, it is concluded that the external dose resulting from a 10 curie-sec/m^3 exposure in an infinite cloud is 4.2 roentogens, a definite upper limit. The internal hazard is markedly greater than the external hazard from a 10 curie-sec/m^3 exposure to ^{235}U fisson products at times greater than 4 hours after a reactor accident. (NSA 12-12144)

10. **Exposure Criteria for evaluating the Public Consequences of Catastrophic Accidents in Large Nuclear Plants.** F. P. Cowan and J. B. H. Kuper (Brookhaven National Lab., Upton, N. Y., U. S. A.) *Health Phys.*, 1, 76-84 (1958)

Various types of direct exposure to the fission product cloud from a catastrophic reactor accident are analyzed and expressed in terms of an acceptable emergency dose (AED) due to 1 c-sec/m^3 of exposure. The problem of combining these exposures is considered and criteria are suggested for four categories of personal injury. Indirect exposure due to deposition of fission products is also considered and limits are suggested to be associated with evacuation and varying degrees of restriction on the use of land. This paper is a condensation of a more detailed development of exposure criteria included in a study of the consequences of catastrophic reactor accidents carried out by a group at Brookhaven National Laboratory. A very brief summary of the methods and results for the whole study is given in an appendix. (NSA 12-12186)

11. **Exposure Criteria for Estimating the Consequences of a Catastorophe in a Nuclear Plant.** J. B. H. Kuper and F. P. Cowan (Brookhaven National Lab., Upton, N. Y., U. S. A.) A/CONF. 15/P/430 Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic Energy, 1958.

Estimates were made of the injuries to be expected as a result of exposure to a fission product cloud, and of the effects of ground contamination. A hypothetical 500 Mw (thermal) reactor was assumed to have been operating for six months. Two types of accident were postulated, one in which a large fraction of the total fission product inventory was released, and the other involving the escape of the volatile fission products only. Whole body exposures to beta and gamma rays, lung exposure to beta rays, and the exposures of body organs to deposited isotopes as a result of direct exposure to the fission product cloud were estimated. An attempt was made to reduce these to equivalent values of whole body exposure, to combine them, and thereby to obtain an over-all index of biological damage. It was concluded that for the full fission product release an exposure more than 400c-sec/m^3 (as measured at 24 hr after the accident) would likely by fatal, between 90 and 400 c-sec/m^3 illness would be unlikely but these might well be expenses involved in establishing absence of damage, and below 10 c-sec/m^3 no illness or expense would be anticipated. For the volatile fission product release the corresponding numbers are 350, 80 to 350, 10 to 80, and 10c-sec/m^3. Estimates of the effects of contamination on land use are necessarily rather crude, and actions taken would undoubtedly depend on the size and character of the area affected. Again various components of external and internal exposure were considered. They were combined and criteria for evaculation and limitations on the use of land were proposed. It was concluded that for the full fission product release areas contaminated with more than 10^{-2} c (measured at 24 hr) per square meter would have to be evacuated, that between 10^{-3} and 10^{-2}/m^2 severe restrictions on land use and outdoor work would be required, between 10^{-4} and 10^{-3} some corps might have to be destroyed and temporary restrictions on agriculture would be expected, and that below 10^{-4} no restrictions would be necessary. For the volatile fission product release these figures would all be a factor of 10 greater. (NSA 12-14518)

12. **Radiation Exposure to People in the Environs of a Major Production Atomic Energy Plant.** J. W. Healy, B. V. Andersen, H. V. Clukey, and J. K. Soldat. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash., U. S. A.) Prepared for the Second U. N. International Conference on the Peaceful Uses of Atomic 1958.

The permissible dispersal of radioactive wastes from an atomic energy plant is limited by the radiation exposure which may occur to individuals or populations living in the vicinity. This exposure is dependent upon the type of plant, and therefore the form and quantities of wastes discharged, and upon the ecological nature of the plant environs. A review of information available on sources of enviromental exposure to humans from one major complex consisting of both reactors and seperation plants is made to indicate levels of radiation exposures involved. For single-pass, water-cooled reactors, the effluent water-cooled reactors, the effluent water containing both neutron activation products and traces of fission products constitutes the major source of waste release. Dispersal of this water in a major river reduces the concentrations in the plant environs but ecological mechanisms provide concentration factors in plants and animals. The high level liquid wastes from the seperation areas are stored in underground tanks while the lower level liquid wastes are dispersed to the soils of the region where they are retained above the water table. As a result, the only seperations plants wastes reaching a point of public use are the small quantities of fission products contained in the ventilation air and process gases released through stacks after pre-treatment. The concentrations of various isotopes resulting in air, water, and foodstuffs in the vicinity of the plant are reviewed to indicate levels attained. Methods of assessing the overall radiation exposure from these concentrations are indicated. The total exposure is estimated and compared with natural background, contributions from fallout, and national limits. (NSA 12-14523)

13. **Accidental Radiation Excurtion at the Y-12 Plant June 16, 1958. Final Report.** (Union Carbide Nuclear Co., Y-12 Plant, Oak Ridge, Tenn., U. S. A) Y-1234, 119 p (1958)

The radiation accident which occured at the Y-12 Plant on June 16, 1958, is discussed. To the extent that information is available, it describes the circumstances leading to the accident, attempts to reconstruct the nuclear reactivity conditions, and reviews the dosimetric means and results which were used to help determine the exposure of affected employees. (NSA 12-15284)

14. **Long-range Travel of the Radioactive Cloud from the Accident at Windscale.** N. G. Stewart and R. N. Crooks (AERE, Harwell, Berks., Eng.) *Nature*, **182**, 627-628 (1958)

The path was determined for the radioactive cloud from the accident on Oct. 10, 1957, at Windscale No. 1 Atomic Pile. The influence of meteorological conditions is discussed. The concentration of iodine-131 in the air was measured at a number of sampling points. Data are tabulated on iodine-131 dosage levels at various locations in Great Britain and throughout Europe. (NSA 12-16144)

15. **Deposition on Radioactivity in North-West England from the Accident at Windscale.** A. C. Chamberlain (AERE, Harwell, Berks., Eng.) and H. J. Dunster (U. K. AEA. Risley, Eng.) *Nature*, **182**, 629-630 (1958)

Measurements were made of the deposition of radioactivity in north-west England following the accident at Windscale No. 1 Atomic Pile on Oct. 10, 1957. The influence of meteorological conditions is discussed. Data are tabulated on the concentration of various nuclides relative to iodine-131 found in filter paper and grass samples. Data on radiation dosage are included. (NSA 12-16145)

16. **Nuclear-Critical Accident at the Los Alamos Scientific Laboratory on December 30, 1958.** H. C. Paxton, R. D. Baker, W. J. Maraman and Roy Reider (Los Alamos Scientific Lab., N. Mex., U. S. A.) LAMS-2293, 34 p (1959)

The nuclear-critical accident that occurred in the plutonium processing plant at the Los Alamos Scientific Laboratory on December 30, 1958, resulted from an unusual and complex set of circumstances. Reconstruction of the steps that preceded the accident and analysis of the materials involved give a reasonably specific picture of the conditions at the time of the radiation burst. (NSA 13-7657)

17. **Reactor Safety. A Literature Search.** R. J. Smith (comp.) (Technical Information Service Extention, AEC, U. S. A.) TID-3525, 20 p (1959)

Included are references to 118 unclassified AEC research and development reports and 56 unclassified non AEC reports. These references are presented on reactor systems, materials, and operation designed to provide maximum safety for the reactor, reactor personnel, and environs. Information is included concerning incidents and conditions of operation considered hazardous. (NSA 13-8247)

18. **Yugoslavian Criticality Accident, October 15, 1958.** *Nucleonics*, **17**, (No. 4), 106; 154-6 (1959)

A zero-power reactor built for reactor-design experiments and an accident involving the reactor are described. In the detailed description of the facility it is pointed out that the reactor can be started without switching on the flux recorder. This lack of an interlock system and the fact monitors and the that monitors and safety circuits were turned off made possible the accident of Oct. 15, 1958. An uncontrolled rise of heavy water resulted in a supercriticality which was detected only when operating personnel smelled ozone. Of the eight persons involved, six were flown to the Curie Foundation, Paris, for treatment. One died, and five recovered to Yugoslavia. Calculations are given neutrons was 388 rems and from gamma radiation, 295 rems. (NSA 13-11081)

19. **Accidental Radiation Excursion at the Oak Ridge Y-12 Plant. I. Description and Physics of the Accident.** Dixon Callihan and Joseph T. Thomas (Oak Ridge National Lab., Tenn., U. S. A.) *Health Phys.*, **1**, 363-72 (1959)

An aqueous solution of enriched uranium inadvertently flowed into a 55 gal drum in a process area in Oak Ridge in June 1958, establishing a prompt-critical neutron chain reaction in which about 10^{18} fissions occurred before the system finally became subcritical by the addition of water. The solution contained about 2.5 kg of ^{235}U. Records of the radiation field show the power excursion to have continued about 20 min during which the reaction oscillated a number of times. This paper describes the accident and presents a reactor-physics analysis yielding reactivities in an unperturbed system as great as 1.3 per cent which were above zero for a time consistant with observations. A plausible sequence of events during the excursion is enumerated. The emergency and health physics procedures and the medical observations of exposed personnel will be given in subsequent papers of this series. (NSA 13-11763)

20. **Public Relations following AEC Accidents.** MORSE SALISBURY (Division of Information Services, AEC, U. S. A.) TID-7569. p 4-9 (1958)

Accidents in nuclear plants involving radioactive materials are cited as to the effect of these accidents on the surrounding population. Ways are discussed of informing the public of the nature of accidents in nuclear plants. (NSA 13-15231)

21. **Study of Six Cases of Accidental Acute Whole-body Irradiation.** H. JAMMET, B. MATHE, B. PENDIC, J. F. DUPLAN, B. MAUPIN, R. LATARJET, D. KALIC, L. SCHWARZENBERG, Z. DJUKIC, and J. VIGNE. Translated by THOMAS L. SHIPMAN (Los Alamos Scientific Lab.) from *Rev. franc. études Clin., et biol.*, **4**, 210-25 30 p, (1959) AEC-tr-3774

On October 15. 1958, at the Vinca, Yugoslavia, center of nuclear studies, six persons were irradiated by neutrons and gamma rays from a nuclear reaction. Everything indicated that the doses received approached or surpassed those normally regarded as lethal. On the following day the patients were sent to Paris and hospitalized in the radiopathology service of the Curie Foundation. The exact evaluation of the radiation doses received presented difficult problems. It proved necessary to correlate the clinical course with the physical findings in order to determine the course of therapy. This depended on the radiation doses received. Furthermore, the patients appeared to be in different dose ranges, one with a sublethal dose, four with doses in the lethal range, and the last with a supra-lethal dose. This distribution provided an exceptional opotunity for theoretical study. We were guided solely by the medical requirements which frequently were far removed from the rigid considerations of biologic experimentations. The patients with the lowest dose received nothing but standard treatment, the other five received transfusions of hematopoietic cells. Four of these cases actually survived in satisfactory condition. The most highly irradiated man died of gastro-intestional complication on the 32-nd day after irradiation, although the bone marrow transplant indicated his hematologic recovery. These cases are reported here as studies showing successively the dosimetry, the clinical course, and the therapy. (NSA 13-18807)

22. **Contamination of the NRU Reactor in May 1958.** J. W. GREENWOOD (Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont. Canada) AECL-850, 52 p, (1959)

In May 1958 a piece of irradiated uranium fuel burned in the main room of the NRU Reactor building. The building was severely contaminated, and the reactor was shut down for several months for decontamination activities. Despite the potential hazards, no harm came to personnel and the reactor suffered only minor damage. Investigations were conducted to determine what lessons could be learned to prevent similar incidents in the future. Events leading up to the incident are briefly stated, and the problems faced in putting the reactor and its building back into operation are described. (NSA 13-19673)

23. **Immediated Evaluation of Doses from External Radiation and from Internal Contaminations in the Event of a Radiation Accident.** KARL Z. MORGAN (Oak Ridge National Lab., Tenn., U. S. A.) TID-7577 (p 46-82) Symposium on Technical Methods in Health Physics., Risö, Denmark, May 25-28, 1959.

Two types of radiation exposure during accidents include exposure to external sources and exposure from internal sources. The first and most important consideration in radiation accidents is the prevention of such accidents. Appropriate training programs, the proper design and operation of buildings and facilities, and the effective functioning of an adequate health physics program cannot prevent all radiation accidents, but they can reduce the probability of their occurance and can minimize their sequences. The second important consideration is early warning and immediate action when an accident happens. There is no doubt that the prompt exit of personnel during the Y-12 accident on June 16, 1958, and during the Argonne accident on June 2, 1952, prevented more serious consequences; and had there been similar retreat from the scene of the first two serious Los Alamos accidents (August 21, 1945, and May 21, 1946), there is reason to believe the human exposures would have been materially reduced, and perhaps the two facilities could have been prevented. An important part of the prompt action during the period of a radiation accident is the immediate identification of the individuals who received high exposures. Several features of personnel monitoring meters enable one to make this identification. The third step in an accident is a careful estimate of the absorbed dose from the various types of radiasion, i. e., from neutrons, gamma radiation, beta rays, etc., received by each of the accident victims. In addition, information should be obtained on the energy spectra of the radiation, the dose distribution throughout the body, and the dose rate. All these factors furnish information that is useful in determining the seriousness of the exposure and in deciding on the subsequent medical treatment. The absorbed dose information is obtained from personnel monitoring meters, from area meters, from activation of Na-24 P-32 in the body, and from a study of the radiation source and the flight path of each of exposure victims. The fourth and last step in a radiation accident is that of re-entry and cleanup. Sometimes these steps must be taken quickly but with considerable caution and forethought. Eor example, a critical assembly that resulted in the accident may go critical again with the slightest provocation, or in the case of a radium spill, cutting off or isolating part of the ventilation system may prevent serious human exposure and contamination resulting in a great financial loss. (NSA 13-20053)

24. **Radiation Accidents : Dosimetric Aspects of Neutron and γ-Ray Exposures.** G. S. Hurst and R. H. Ritchie, eds. (Oak Ridge National Lab., Tenn., U. S. A.) ORNL-2748 (Pt. A), 114 p (1959).

A system of dosimetry for persons involved in accidental criticality excursions is presented as part A of a two part report. The information is arranged to be useful as a reference for those responsible for implementing the system. Part A also contains a review and re-evaluation of the dosimetry of previous accidents and a synopsis of part B. Part A and B together form a complete analysis of dosimetric and medical imformation pertinent to acute exposures of humans to mixed radiations. (NSA 14-1716)

25. **Planning for a Radiation Accident.** Eugene L. Saenger (University of Cincinnati, U. S. A.) *Am. Ind. Hyg. Assoc. J.*, **20**, 482-487 (1959)

With careful organization and training of both plant and community health facilities the confusion of radiation accidents can be significantly decreased. Radional approaches to potential radiation accidents are described and discussed. (NSA 14-4485)

26. **High-Level Spill at the Hilac.** Nelson B. Garden and Carroll Dailey. (California. Univ., Berkeley. Lawrence Radiation Lab., U. S. A.) UCRL-8919, 40 p (1959).

On July 3, 1959, an incident occurred in the Hilac Building when the turning of the wrong valve resulted in pressurizing a helium cooling box, with a resultant blowout of a thin foil. The burst of He gas disintegrated experimental foils made up with 10^{11} dpm of ^{244}Cm. The resulant activity was quickly dispersed as airborne particulates throughout the building. The 27 people in the building were evacuated within 10 minutes under surveillance of the Health Chemistry personnel; wherever clothing proved to be contaminated it was removed, and in cases where nose swipes were pertinent they were taken. Although an assumption of a combination of the worst conditions could conceivably have resulted in 1 man's inhaling between 2 and 4 times the calculated allowable inhalation for short bursts, evaluation from air analysis and medical tests indicate that it is unlikely that anyone actually did receive this amount. The building was closed during decontamination procedures, which required about 30 people for 3 weeks in direct decontamination work and 30 people for 3 weeks in indirect wrok. The cost of labor, material, and other charges related to the spill amounted to about $ 30, 500 without overhead; equipment loss was held to less than $ 2, 000. The lost time of operation of the Hilac has been evaluated at $ 26, 000, so that the total loss from the incident amounts to roughly $ 58, 500, The primary cause of the accident was determined to be an error by the experimenter. Steps where taken to help insure against any recurrence of an uncontained radiation spill at the Hilac, and to decrease the danger of exposure to personnel in the event that a spill should occur in the future. (NSA 14-5504)

27. **Nuclear Incident at the Idaho Chemical Processing Plant on October 16, 1959.** WILLIAM L. GINKEL, C. WAYNE BILLS, AUBREY O. DODD, KLEM K. KENNEDY and FRED H. TINGEY(Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho, U. S. A.) IDO-10035, 97 p (1960)

A nuclear incident involving uranium process solution occurred at the Idaho Chemical Processing Plant, National Reactor Testing Station, on October 16, 1959. A report is presented in which the events leading to the incident are discussed and the consequences of the nuclear excursion are described including radioactive contamination and personnel exposures. The findings and recommendations of the committee are given and additional data on operation background, health physics, and material balance aspects of the incident are reported. (NSA 14-11830)

28. **A Compendium of Information for Use in Controlling Radiation Emergencies, Including Lecture Notes from a Training Session at Idaho Falls, Idaho, February 12-14, 1958.** ALLEN BRODSKY and G. VICTOR BEARD, Comps. and Eds. (Office of Health & Safety, AEC, U. S. A.) TID-8206, 102 p (1960).

Information is summarized which may be needed by trained personnel in exercising rapid and professional judgment during the period immediately following an unexpected radiological incident. Past experiences in radiation accidents are reviewed. The shipment of radioactive materials and the control of fires during radiation emergencies are discussed. The results of fuel element burn tests are reviewed and monitoring activities are described. (NSA 14-12802)

29. **Radiation Accidents.** EUGENE L. SAENGER(University of Cincinnati, Coll. of Medicine, U. S. A.) *Am. J Roentgenol., Radium Therapy Nuclear Med.*, **84**, 715-728 (1960)

The likelihood of serious radiation accidents is increased due to the rapid growth of nuclear technology in science, industry, and national defense. This paper reviews briefly the possible causes of various types of radiation accidents. Suitable emergency programs are described. The acute radiation syndrome is discussed both from clinical and laboratory aspects. Recent advances in therapy are described. (NSA 14-24400)

30. **Dosimetry Applications.** J. A. AUXIER, J. C. ASHLEY, *et al.* (Oak Ridge National Lab., Tenn., U. S. A.) RUNL-2994 p 233-241 (1960)

Studies to determine the shieding afforded by residences against radiation fall-out were continued. The activation of blood sodium by neutrons was evaluated for dosimetric purposes, and monitoring systems for nuclear accidents were improved. A comprehensive experiment was conducted at the Boris Kidric Institute in Vinca, Yugoslavia, to determine the radiation exposures of the six persons exposed an accident in 1958. (NSA 15-422)

31. **Nuclear Accident Survey.** J. SPENCER BURKETT. *Nuclear Power*, **5**, (No. 54) 77-80 (1960).

An extensive survey of reported serious radiation accidents is presented together with tables showing the casualty list of USAEC (1943 to 1958), possible power-reacter accidents classified according to reactor type, and actual accidents (both reactors and critical assemblies) over the world. The accidents discussed in detail are: (1) Canada. 30-Mw NRX reactor (Dec. 1952, contamination of coolant) and 200-Mw NRX reactor (May. 1958, reactor contamination). (2) France. EL-2 and EL-3 D$_2$O research reactors (minor and routine accidents). (3) Yugoslavia. Vinca accident (Oct. 1958, irradiation of six persons, with one death). (4) United Kingdom. Windscale (Oct. 1957). Power excursions, processing-plant accidents, and noncritical accidents are also treated, and it is concluded that correct training in handling radioactive sources and anticipation of accidents through plans for early warning, evacuation, health physics, and decontamination are necessary. (NSA 15-2304)

32. **SL-1 Explosion Kills 3; Cause and Significance Still Nuclear.** *Nucleonics*, **19**, 17-23 (1961)

The SL-1 reactor accident of Jan. 3, 1961 is described; and the emergency organization, public reaction, significance, and the containment of the radiation are described. AEC established three advisory groups to determine the following: Accident cause, decontamination and other site operations, and future disposition of the SL-1. Public and press reaction has been mild. The Army reactor program is unaffected. AEC initiated an immediate safety survey. (NSA 15-10421)

33. **Dosimetric Investigation of the Radiation Accident, Vinca, Yugoslania.** G. S. HURST, R. H. RITCHIE, F. W. SANDERS, P. W. REINHARDT, J. A. AUXIER, E. B. WAGNER, A. D. CALLIHAN, K. Z. MORGAN, and J. W. SMITH (International Atomic Energy Agency, Vienna) To/HS/22, 71 p, (1960).

The radiation accident at the Boris Kindric Institute, Vinca, Yugoslavia, on Oct. 15, 1958, resulted in heavy exposure of six scientists to mixture of neutrons and γ radiation during a subcritical experiment with a zero power reactor. The reactor was constructed with natural uranium rods suspended in a large tank which could be filled to various depths with heavy water. A team from the Oak Ridge National Laboratory, Teen., made measurements of the radiation dose received by the exposed persons. The methods of dosimetry were essentially those used in connection with the Oak Ridge Y-12 accident and are based on the ratio of ^{24}Na to ^{23}Na in the body or blood system. To accomplish the measurements the zero power reactor was operated in two different power ranges. Date are presented from computions of γ dose leakage; studies of ^{24}Na activation in man-shaped phantoms; an intercomparison of French and American ^{24}Na calibration; measurements of the neutron flux distribution in the Vinca reactor room; and neutron measurements with a tissueequivalent phantom. Individual doses were calculated as ranging from 207 to 436 rad units. Photographs and drowings are included of the equipment and experimental facilities. Results of measurements are presented graphically. (NSA 15-11367)

34. **Organization of a Radiation Hazard Emergency Response Capablity.** A. J. Breslin, W. B. Harris, and A. A. Weintraub (U. S. Atomic Energy Commission, Health and Safety Lab., N. Y., U. S. A.) *Am. Ind. Hyg. Assoc. J.*, **22**, 59-63 (1961)

The U. S. Atomic Energy Commission in cooperation with the Department of Defense maintains a nationwide organization of radiation safety teams to provide emergency technical assistance to state and local officials in the event that an accident with public health significance occurs during the utilization, handling, or transportation of radioative materials. The capability to handle such accidents is not yet adequately developed at the state and municipal levels. The basic mission of the teams is to provide rapid hazard evaluation and recommendations for control. Important requirements for the satisfactory performance of this mission are effective liaison with civil authorities, expeditious team mobilization and transportartion, use of professional radiation safety personnel, and field equipment suitable for rapid and approximate measurements. (NSA 15-11375)

35. **AEC'S Pittman Report on the SL-1 Accident.** Frank Pittman (AEC, U. S. A.) *Nucleonics*, **19**, (No. 3) 62-69 (1961)

The facts pertinent to the SL-1 reactor accident of January 3, 1961 (9 : 01 p. m.), are reviwed, e. g., the reactor history, post-accident evidence, and radiation levels. It is tentatively postulated that movement of the central rod was the cause of the accident, although boron corrosion on the side platers with consequent poison loss could also have set of the accident ; some of the possible causes of such rod off the accident ; some of the possible causes of such rod movement are discussed. The operations involved in the connection of control rod drives (the operations that was being undertaken at the time of the accident) and the extent of burnable poison side damage are treated in detail. Part of the interim report of the Board of Inquiry regarding the possiblility of the accident being initiated by central rod movement is presented. (NSA 15-12497)

36. **Incidents de Fonctionnements a EL-2 et-3 Entre 1. 1.** P. Balligand (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucleaires, Saclay, France) CEA-1397, 22 p (1960)

The two most important accidents, costing 50 days out of operation for EL-3 and 43 days for EL-2 were due to the melting of a fuel rod through a cooling defect in a cell ; the behavior of the fuel could not otherwise be considered responsible. (NSA 15-14024)

37. **Acute Radiation Death Resulting from an Accidental Nuclear Critical Excursion.** *J. Occupational Med.*, **3**, Spec. Suppl., p 146-192 (1961)

An accidental critical excursion took place in the plutonium recovery plant of the Los Alamos Scientific Laboratory on Dec. 30, 1958. The average whole-body dose in the lethal case was estimated at between 3900 and 4900 rads, with the incident dose to the upper abdomen calculated to be approximately 12000 rads of neutrons plus gamma radiation. Two other workers received total doses of approximately 130 and 35 rads, respectively, most of which was gamma radiation. The critical excursion took place in a tank of solution from which plutonium was being recovered, and the number of fissions was calculated to be $\sim 1.5 \times 10^{17}$ the accident and subsequent events are recounted. The clinical case of the fatality is reviewed in detail. Data are included from routine chemical and pathological studies and special biochemical studies, whole-body counts, and gamma spectral measurements, dosimetric calculations, and health physics studies of area radiation dose varied widely in different parts of the body and even in different parts of the same organ. Results of clinical studies, covering the 14 months following the accident, are presented for the two workers who were exposed to non-lethal doses. Analysis of blood data led to the conclusion that changes following exposures in excess of 100 rads are characteristic and of clinical significance, whereas doses below 50 rads produce blood changes which are too slight to be of any diagnostic value. 58 references. (NSA 15-14154)

38. **The United States Naval Radiation Exposure Evaluation Center.** E. R. KING and T. G. MITCHELL (U. S. Navale Hospital, Bethesda, Md., U.S.A.) "RADIOACTIVITY IN MAN", p 129-144 (1961)

Facilities of the U. S. Naval Radiatien Exposure Evaluation Center are described. While the facilities are designed to handle personnel exposed to peacetime accidents or incidents, the planning could be applied to wartime casualty exposure. The facility consists of a receiving word, decontamination and monitoring stations, wards, and clinical and radioassay laboratories. Plans are outlined for an enlarged facility which will include wholebody counting facilities. Clinical investigations and research will also be carried out in the new facilities. (NSA 15-19677)

39. **Nuclear Incidents from Non-controlled Critical Excursions and Therapy of Acute Radiation Syndrome.** SERGIO LIN (Ospedale Maggiore, Trieste). *Minerva nucleare*, **5**, 5-21 (1961).

Nuclear accidents from uncontrolled supercriticality which took place in several nations from 1945 to 1958 are discussed. A survey was made of the characteristics of the equipment involved in these accidents and of their mechanism. These accidents concerned critical assemblies, subcritical reactors, power reactors, and parts of fissionable material processing plants. The symptoms of the acute radiation symdrome were illustrated in relation to the dose cf radiations absorbed and the manner of absorption of ionizing radiations. Recommended therapeutic procedures in acute radiation disease are graphed in three steps: a) general emergency therapy; b) symptomatic therapy; and c) causal therapy. Recent progresses in the chemistry of chelating agents and the most valuable procedures for increasing the excretion of radioactive substances from the human body are discussed. (NSA 15-20634)

40. **Radiation Accidents in Nuclear Technology.** NIEL WALD and GEORGE E. THOMA. "Proceeding of the Thirteenth International Congress on Occupational Health" p 569-572 (New York).

Radiation accidents that have occurred during the past 15 years are reviewed. Thirty-seven individuals were involved in 7 major accidents, 5 of which occurred in the U. S. A. Clinical and laboratory findings are used to differentiate the patients falling into the various grades of clinical injury. Therapeutic procedures employed in the treatment of radiation injuries are outlined. (NSA 15-21019)

41. **SL-1 Accident.** Atomic Energy Commission Investigation Board Report. 173 p. (1961).

The SL-1 accident, January 3, 1961, took the lives of three persons. This report summarizes the current information pertaining to the circumstances surrounding the explosion within the reactor vessel. The evidence strongly indicates a nuclear incident of 50 Mw-sec or more which could credibly be induced by rapid and extensive motion of the central control rod. There is no evidence to show that the actions of the operators on duty were in any way different than those prescribed and which had been carried out without incident many times before. (NSA 15-23102)

42. **The Clinical Evaluation and Management of Radiation Accident Exposure Patients.** E. R. King (National Naval Medical Center, Bethesda, Md., U. S. A.) *Radiology*, ***77***, 77-82 (1961).

A description of a practical approach to the problem of the clinical management of radiation disaster patients is offered. Improtant details involve adequate control of the admission room, as well as determination of the type of exposure and the radiation dose. Most of the treatmet now available is supportive in nature. Good judgemens in caring for such cases is of great importance. (NSA 15-23360)

43. **Aircraft Accidents involving Plutonium Contamination.** Thomas P, Baker, Jr., Bruce B. Boecker, and James L. Dick (Air Force Special Weapons Center, Kirtland AFB, N. Mex., U. S. A.) AFSWC-TN-58-3, 16 p. (1958).

Procedures are presented for the delineation and subsequent control and cleanup of an area contaminated by an aircraft accident involving plutonium containation. The area of concern will be that of an area contaminated by plutonium to 1000 micrograms per square meter and/or 1000 disintegrations per minute per cubic meter of air or greater. This area will be contained within approximately 400 feet radius for one weapon, 550 radius for two weapons, 650 feet radius for three weapons, etc. (NSA 15-26386)

44. **Estimation of Dose Distribution within the Body from Exposures to a Criticality Accident.** W. S. Snyder (Oak Ridge National Lab., Tenn., U. S. A.) "SELECTED TOPICS IN RADIATION DOSIMETRY", p 647-656 (1961)

An adequate system of dosimetry for exposures due to a critical excursion must provide information from which the dose received by the different body organs can be obtained. In order to use proper RBE factors the dose from gamma-rays should be estimated separately from the dose received from protons and heavy recoil atoms. Thus it is essential to know the energy spectrum of neutrons incident on the body, but since the gamma-rays are quite penetrating and have an RBE of 1, it usually suffices to know the air dose of gamma radiation. Under laboratory conditions the air dose of gamma radiation can be measured by an ion chamber and the neutron air dose can be obtained by the use of a specially designed and operated proportional counter. The neutron spectrum can be determined approximately by the use of the Hurst threshold detectors. In the case of critical accidents the neutron spectrum and the gamma dose can be estimated if threshold detectors and metaphosphate glass dosimeters are located near the site. If the exposed person wears a dosimeter belt containing gold, sulfur and glass dosimeters, his orientation can be taken into account. By normalization with fixed dosimeters, this allows for an estimate of the dose distribution within his body. In case some or all of the components of this system are missing, a re-run of the excursion may be necessary. This need not be at the exact power level of the accident, since the data can then be normalized with the sodium activation observed in the blood of the exposed person. The spectrum of neutron and gamma radiation from the critical assembly can also calculated. Monte Carlo calculations are performed to determine the dose distribution in a cylindrical tissue mass equivalent to the trunk of the human body for various neutron energies. Using the data mentioned above, these results make it possible to determine the dose pattern in the body of an exposed person. (NSA 15-26416)

45. **Problems of Personnel Monitoring at a Criticality Accident.** H. F. Henry (Oak Ridge Gaseous Diffusion Plant, Tenn., U. S. A.) *Health Phys.*, **6**, 86-93 (1961).

With respect to personnel monitoring at a criticality incident, the implications of some experimental data are reviewed which show the dependence of the relative positions of an individual, his typical personnel monitoring device, and the excursion which is essentially a unidirectional γ-neutron radiation source. These data show that, for a given exposure, the dose indicated by either a γ-or neutron-sensitive device of the type generally used can vary by factors of at least 3 or 4, due only to the attenuation by the individual's body. Similar data indicate qualitatively the effect of moderation and reflection in affecting the neutron spectrum incident upon the device as compared to that actually incident upon the individual. In view of the uncertainties thus indicated, it is concluded that, although a γ-and neutron-sensitive personnel monitoring device can provide sufficiently accurate data concerning an individual's exposure for record purposes and will be useful for the prompt identification of personnel who have been highly exposed, a monitoring system consisting of blood sodium determinations as calibrated by area type dosimeters is necessary to provide data which are useful in indicating medical treatment. (NSA 15-31065)

46. **Description of the Accident and Subsequent Events.** Thomas L. Shipman (Los Alamos Scientific Lab., N. Mex., U. S. A.) *J. Occupational Med.*, **3**, (No. 3) Special Suppl., 147-149 (1961).

An accidental critical excursion took place in the Pu recovery plant of the Los Alamos Scientific Laboratory on Dec. 30, 1958. One employee received a fatal radiation dose calculated as 12, 000 rads to the upper abdomen and two other emplyees received radiation doses calculated as 130 rads and 35 rads. These figures include dosage from neutrons and gamma radiation. The accident occurred in an area where solutions usually containing less than 0. 1 gm Pu/*l* were processed for recovery of Pu. Events that preceded the excursion are reviewed and the accident and subsequent events are described. (NSA 15-32393)

47. **A summary of Industrial Accidents in USAEC Facilities.** (Office of Operational Safety and Fire Protection Branch, AEC, U. S. A.) TID-5360 (Suppl. 3) 37 p.

The accident experience of the AEC contractor operation for 1959 and 1960 is reported. Incidents involving radioactive materials are described. A table of inadvertent criticality was included to supplement other tables. A tabulation exposure records at values from 0 to 15 r is given. (NSA 16-2062)

48. **Hearings before the Joint Committee on Atomic Energy, Congress of the United States, Eighty-Seventh Congress, First Session on Radiation Safety and Regulation.** June 12, 13, 14, and 15, 1961. 439 p.

Hearings were held before the Joint Committee on Atomic Energy of the Eighty-Seventh Congress of the United States on June 12, 13, 14, and 15, 1961 on the subject of Radiation Safety and Regulation. A number of scientists and engineers presented testimony as to current developments in the field of reactor safety and radiation safety generally. The SL-1 accident at the National Reactor Testing Station in Idaho on Jan. 3, 1961 was discussed. Recent proposals for a revision of the AEC regulatory organization were reviewed. (NSA 16-2087)

49. **Nuclear Safety.** W. B. Cottrell, ed. (Oak Ridge National Lab., Tenn., U. S. A.) *Technical Progress Review*, **3**, (No. 1) 107 p, (1961)

Developments in the field of nuclear safety are reviewed. General safety criteria, accident analysis, instrumentation and control, plant safety features, consequences of activity release, and current events are discussed, (NSA 16-3303)

50. **SL-1 Recovery Operations, January 3-May 20, 1961.** (Combustion Engineering, Inc. Nuclear Div., Idaho Falls, Idaho, U. S. A.) IDO-19301, 322 p. (1961)

Plans for deactivation of the SL-1 facility, which underwent a nuclear excursion on Jan. 3, 1961, are discussed, along with results of the facility area. The condition of the reactor is described in detail. Plans for injecting a boric acid solution the core are disclosed; subsequently, it is decided to leave the core dry and to decontainate and disassemble the reactor. All involved equipment are described. (NSA 16-3832)

51. **A Summary of Industrial Accidents in USAEC Facilities.** (Divison of Operation Safety, AEC, U. S. A.) TID-5360 (Suppl. 3, Rev.) 39 p (1961).

The summary includes descriptions of serious accidents for 1959 and 1960, AEC industrial injury frequency rates, criticality accidents, radiation exposures, accidents involving radioactive materials in AEC activities during 1959 and 1960, and accidents involving fatalities in AEC activities during 1959 and 1960. (NSA 16-5610)

52. **Proceedings of the First Symposium on the Nuclear Accident Dosimetry Program : Techniques and Uses, Held at the Miramar Convention center and the Santa Barbara Laboratory of Edgerton, Germeshausen and Grier, Inc., Santa Barbara, California, October 5-6, 1960.** Edgerton, Germeshausen and Grier, Inc. Santa Barbara, Calif. 204 p.

Proceedings of the Symposium on the Nuclear Accident Dosimetry Program : Techniques and Uses are presented. Topics covered include justification of the general system, desciiptions of gamma and neutron systems, energy-respons calculation of threshould-detector units, radiation leakage calculations for critical assemblies, radiation leakage and ^{24}Na activation, dosimetry of recent radiation accidents, status of UCC film badge, visual chemical indicator for gamma radiation, development of radiation belt, fireproof package forthreshould-detector units, maintenance of capability, accidents, criteria for dosimetry placement, packagings, placement and recovery, calibration and counting of foils, and gamma read-out system and requrements. (NSA 16- 6271)

53. **Criticality Accidents in Vinca, Yugoslavia, and Oak Ridge, Tennessee. Comparison of Radiation Injuries and Results of Therapy.** GOULD A. ANDREWS (Oak Ridge Inst. of Nuclear Studies, Inc., Tenn., U. S. A.) *J. Am. Med. Assoc.*, **179**, 191-197, (1962).

Major accidents involving radiation from nuclear reactors occurred in Oak Ridge, Tenn., and in Vinca, Yugoslavia, in 1958. The 2 accidents were in some ways similar, and both contributed information on the treatment of total-body radiation injury. After the Y-12 accident at Oak Ridge, the 5 exposed men recovered with supportive care. The 6 Yugoslavian radiation victims were moved to Paris, where 1 died, and 5 including 4 who had received bonemarrow injections, recovered. Efforts to evaluate the significance of the marrow treatment have involved consideration of physical measurements of radiation dose, biological evidence of severity of injury, and evidencs for and against success of the marrow graft, but have not proved its value in these cases. A comparison of the 2 accidents helps to give perspective on these problems. (NSA 16-6359)

54. **The Assessment of Acute Radiation Injury.** LOUIS H. HEMPELMANN (Univ. of Rochester, N. Y., U. S. A.) "Diagnoisis and Treatment of Acute Radiation Injury" p 49-66 (1961)

A brief account is presnted of the main clinial features of patients injured in the 1945 and 1946 accidents at the Los Alamos Scientific Laboratory It is concluded that there are no dependable biological indicators of the severity of illness in patients who have been exposed to radiation doses in or near the lethal range. The severity of the illness can be assessed only by comparing the response of the patient with that of the patients previously exposed under similar conditions. The excretion of β-aminoiso-butyric acid taurine and changes in the mitotic indices of bone marrow offer the most reliable indication of the severity of radiation injuries. (NSA 16-8647)

55. **The Zero-energy Reactor Accident at Vinca.** BRANISLAV PENDIC "Diagnoisis and Treatment of Acute Radiation Injury" p 67-81 (1961)

On October 15, 1958, the zero-energy reactor at Vinca, Yugoslavia, became supercritical with the result that 6 men were exposed to irradiation with neutrons and γ rays. The personal dose meters, film badges, and pocket meters worn by the exposed persons were completely saturated. In order to determine the doses of radiation received by the victims, measurements were made of the induced activity of metal objects such as rings, pens, and coins carried by the exposed persons, and of the induced ^{24}Na activity in the irradiated persons made with a 25-channel γ spectrometer. Data are tabulated. The total estimated dose received ranged from 350 to 640 rad. The clinical picture, biochemical findings, hematological changes, hemostatic disturbances, visceral and genital disturbances, and response of the patients to bone marrow transfusions are described. The value of early clinical signs, such as nausea, vomiting, diarrhea, and skin reactions, particularly erythema, in estimates of approximate doses received is discussed. Classical biochemical examinations were of little value in establishing the degree of irradiation. (NSA 16-3648)

56. **A Radiation Fatality Resulting from Massive Overexposure to Neutrons and Gamma Rays.** THOMAS L. SHIPMAN (Los Alamos Scientific Lab., N. Mex., U. S. A.) "Diagnoisis and Treatment of Acute Radiation Injury", p. 113-133 (1961).

On Dec. 30, 1958, an accident occurred at the Los Alamos Scientific Laboratory that resulted in an estimated average whole-body neutron and γ ray dose of 3900 to 4900 rad, with incident dose of 12, 000 rad to the upper abdomen and 10, 400 rad incident dose to the head of an individual. Death from cardiac arrest occurred about 35 hrs after the accident. The circumstances leading to the accident are reviewed and dosimetry methods are discussed. The early symptoms, clinical course, biochemical findings, and pathology are described in detail. (NSA 16-8651)

57. **Potential Radioactive Contamination from Nuclear Installations.** W. G. MARLEY (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). "Supplement to the Report of the FAO Expert Committee on Radioactive Materials in Food and Agriculture". p. 6-17 (1960).

Factors influencing the possibility of the accidental escape of radiactivity from nuclear installations are discussed. The possibility of such radiations being transmitted to humans through the food chain is considered. It is stressed that any measurements for monitoring purposes and any studies that are made to investigate the behavior of radioisotopes in such a way that the radiation dose in human tissue can ultimately be evaluated. (NSA 16-10341)

58. **Two Additional Cases of Acute Radiation Sickness in Man.** G. D. Baisogolv and A. K. Gus'kova. JPRS-13022, 29 p (1961).

Two individuals were exposed to whole-body neutron and γ irradiation during a laboratory accident. Both individuals developed marked symptoms of radiation sickness, differing as to extent and severity. Data on radiation dosages are tabulated. Clinical findings and treatment are described. Results are included of physical examinations 3 yr and 8 months after the accident. (NSA 16-17533)

59. **Radiochemistry can Help Analyze Nuclear Accidents.** William S. Lyon, Sam A. Reynolds, and James S. Eldridge (Oak Ridge Ntional Lab., Tenn., U. S. A.) *Nucleonics*, **20**, (No. 5) 92-95 (1962).

Various radiochemical methods are discussed for detecting and measuring contamination released from nuclear accidents. The methods can identify radioisotopes in the contamination spread to nearby areas and can estimate fluxes at various locations in the accident area. The data obtained help in evaluating the severity of the reaction and often can show how to prevent similar accidents. A list of fission products useful in determing number how of fissions in reactor incidents is presented along with lists of important alpha emitters and long-lived fission products. (NSA 16-17733)

60. **Radiation and Health.** WHO. Geneva, 1962, 44 p.

The International Atomic Energy Agency and the World Health Organization sponsored a scientific meeting on the diagnosis and treatment of acute radiation injury in Oct. 1960. The proceedings of this meeting and a review of a number of recent developments in radiation medicine are presented. Topics discussed include the effects of ionization radiation on health, radiation protection, health hazards from nulear-powerd ships, accidental radiation injury, the management of radiation casualtics, therapeutic uses of radiation injury, and applications of viral and health statistics in genetic and radiation studies. (NSA 16-22489)

61. **Review of Reactor Nuclear Incidents.** H. B. Smets (European Nuclear Energy Agency, Paris). IAEA Reprint SM-24/79, 64 p. (1962)

To be published in the Proceedings of the IAEA symposium on Reactor Safety and Hazards Evaluation Techniques held in Vienna, 14-18 May 1962.

An over-all survey is presented of about seventy nuclear incidents which occurred in connection with the operation of nuclear reactors and critical assemblies. When applicable, the following information is given : (a) location and data of the incident ; (b) nature of the incident ; (c) number of persons involved and extent of exposure : (d) financial losses. The reactor nuclear incidents are divided in the following six categories : 1. Criticality incidents and power excursions ; 2. Fuel element fairlures; 3. Corrosion in the reactor vessel and in the primary circuit ; 4. Contamination due to lack of containment of the coolant ; 5. Contamination of the reactor or reactor hall by experimental equipment ; 6. Reactor operators' external radiation incidents. (NSA 16-23299)

62. **The Role of Meteorology Following the Nuclear Accident in Southeast Idaho.** Norman F. Islitzer (Weather Bureau, Idaho Falls, Idaho, U. S.A.) IDO-19310. 44 p. (1962).

The nuclear accident at the Stationary Low Power Reactor No. 1 (SL-1) on January 3, 1961, presented the most severe test to data of meteorological support capabilities for such an occurrence at the National Reactor Testing Station. The activities of the Weather Bureau in providing responsible officials with the necessary meteorological information and interpretations during the emergency are discussed.

The stahnant weather conditions following the accident provided a maximum potential air pollution episode. Meteorological evaluations of air concentrations and deposits of iodine-131 on the vegetation are presented. A deposition velocity for iodine131 of 0.2 cm sec^{-1} over desert-type vegeta tion was computed. Computed dispersion patterns and emission rates of this isotope from the SL-1 are presented. The computed long-period average air concentrations, based on wind speed and direction statistics, are considerably less than measured values at greater distances from the source. This is apparently due to the confinement of the mountains forming the Snake River Plain. A volumetric-type calculation of air concentra tion appears to be more satisfactory. (NSA 16-29182)

63. Criticality Accident at the Y-12 Plant. Gould A. Andrews, Beecher W. Sitterson, Arthur L. Kretchmar and Marshall Brucer (Oak Ridge Inst. of Nuclear Studies, Tenn.). "Diagnoisis and Treatment of Acute Radiation Injury" p. 27-48 (1961).

On June 16, 1958, a criticality accident occurred at the Y-12 plant in Oak Ridge, Tenn. Five men recived high dose levels of neutron and γ radiation. Dosimetry procedures, clinical observations, and methods of treatment are described. (NSA 16-31997)

64. Review of Some Prompt Critical Accidents. W. R. Stratton (Los Alamos Scientific Lab., N. Mex., U. S. A.) IDO-16791, p 283-288 (1962)

Six prompt critical accidents that have occurred in this country are reviewed. These six represent the different types of incidents of the known 18. Almost all the incidents seem to differ and there is usually not enough information to figure out what happened. (NSA 17-1036)

65. The Value of Frequent Realistic Exercises in Disaster Control. Robert S. Brua and Robert M. Allman (U. S. Air Force, San Francisco, U. S. A.) *Minitary Med.*, **127**, 505-508 (1962)

Training exercises to improve the capability of medical personnel to handle mass casualties are discussed. (NSA 17-1670).

66. Nuclear Reactor Accidents and the Thyroid. *Lancet*, 1, 523 (1962).

After a consideration of the reactor accident at the Windscale No. 1 pile in 1957 (cf. ibid., 2 : 1000 (1957), actions required to safegard the public under such circumstances are proposed. The first danger which must be averted is that resulting from the inhalation of radioactive materials by persons living downwind of the reactor at the time. The accident at Windscale resulted in a release of radioiodine in a far greater proportion than that corresponding to its concentration in normal fission products. This corresponds to the volatility of I relative to other fission products, notably Sr. The Medical Research Conuncil has recommeded that the dose to the thyroid from the absorption of radioiodine under accidental conditions should not exceed 25 rem. Administration of KI to those people whom it would be necessary to evacuate might be a simple and safe means of reducing irradiation of the thyroid. If this were done as an alerting action, the deed for evacuation might be reduced or eliminated. There are theoretical grounds for believing that dose of inorganic iodide of 100 mg would reduce the radiation dose to thyroid by a factor of about 10. In addition Pochin and Burnaby (Health Physics, 7 : 125 (1962)) show that doses of KI containing 200 mg iodide inhibit further thyoid uptake of ^{132}I when the iodide is given several hours after single oral doses of radioiodine. Thus irradiation of thyroid could be appreciably reduced if stable KI were administered as long as 3 to 5 hr after absorption of radioiodine. It is concluded that administration ot small doses of KI as early as possible after an accidental release of fresh fission products would give a considerable degree of protection to persons living in a region downwind from a nuclear reactor. In this way sudden evacuation which might later prove to be unnecessary would be avoided, and valuable time would be gained during which preparation could be made for orderly evacuation. (NSA 17-2849)

67. **Body ^{24}Na Activity as a Measure of Body Dose.** E. R. Ballinger and P. S. Harris (Los Alamos Scientific Lab., N. Mex., U. S. A.) TID-14529 (LADC-5055), 21 p (1962).

Problems of casualty assessment following radiation accidents involving neutron exposure are discussed. A portable rate meter and probe assembly is described which was developed to externally measure induced body activity relative to the incident neutron tissue dose devered. The detector was calibrated for activity from ^{24}Na that has a half life of 14.8 hrs. Screening of suspected exposures can be accomplished in 5 to 60 sec by placing the probe over the lumbar area of the back. The instrument and its use are described in detail. (NSA 17-5775)

68. **Problems of Surgical Treatment for Injuries by Radiation.** A. Morczek and K. Neumeister. JPRS-16072, 10 p (1962) Translated from Deut. Gesundheitsw., 17, 1266-1270.

The treatment of persons injured in radiation accidents is discussed. It is pointed out that the mechanisms of injury from a nuclear weapons explosion are fundamentally the same as in nuclear reactor accidents. Dangers from external irradiation and from the absorption of radioactive materials are reviewed, with emphasis on radioactive contamination of wounds and their surgical treatment. (NSA 17-6325)

69. **Direct Measurement of Inhaled Doses Following Reactor Accidents.** W. M. Pusch (Philips G. m. b. H., Vinna) *Atompraxis*, **8**, 423-430 (1962).

The various possibilities of estimating the internal radiation stress which results from breathing contaminated air following a reactor accident are discussed: (1) an estimate of the internal dose based on the MPC value of the most toxic isotope present; (2) an estimate of the internal dose based on a simplified formula which presupposes that the concentration of the individual isotopes remains constant, or that the concentration is measured repeatedly; (3) an estimate of the thyroid dose caused by ^{131}I, using a measuring system combined with a dust collector, which permits direct reading of the values necessary for the calculation. (NSA 17-6327)

70. **Pathogenesis and Regeneration of Radiation Induced Bone Marrow Injury, and Therapeutic Implications.** T. M. Fliedner, E. P. Cronkite, and V. P. Bond (Brookhaven National Lab., Upton, N. Y., U. S. A.) BNL-6018, 34 (1962).

The hematological data of patients of 4 radiation accidents, Rongelap 1954, Oak Ridge 1958, Vinca 1958, and Lockport 1960, are reviewed. and compared The blood cell curves appear to show three phases. An initial phase at about 8 to 10 days, a phase of transient or abortive regenerations, and a phase of final effective recovery were demonstrated. These phases in the blood are precended and caused by particular events in the bone marrow. Evidence was brought forward that transient rises in leukocytes and reticulocytes associated with a delayed platelet disappearance curve are associated with a marrow capable of spontaneous recovery. In patients with in homogenous total-body irradiation, the transient rise may lead directly to effective recovery. Immediate decline of all blood cell elements without evidence of further, even abortive attempts of marrow regeneration must be considered as evidence for letha bone marrow dose and extremely serious complications may be expected. The clinical implications of these analyses are outlined and the diagnostic possibilities described. (NSA 17-7906)

71. **Influence of Continuing Clinical Observations on Dose estimates One Year afters a Radiation Accident.** M. Ingram, J. W. Howland, C. L. Hansen Jr., H. Mermagen, and C. R. Angel (Univ. of Rochester, N. Y. U. S. A.) *Health Physics,* **8**, 519-522 (1962).

Delayed manifestations of x-ray injury in the most severely injured casualty in the Lockport Incident include effects on the nervous system, vascular system, testes, and skin. Only one of the most seriously injured men has shown prominent late effects. Health of the others corresponds to their respective conditions before exposure. Earlier estimates of dose may be modified in some of the cases on the basis of retrospective analysis of the clinical courses. Clinical data are summarized and modified dose estimates discussed. (NSA 17-8449)

72. **Elements of Emergency Planning for Coping with a Serious Radiation Accident.** A. R. Keene, C. M. Unruh, G. E. Backman, and L. A. Carter (General Electric Co. Hanford Atomic Products Operation, Richland, Wash., U. S. A.) HW-SA-2609, 22 p (1962)

Procedures are outlined for coping with serious radiation accidents. It is pointed out that accidents can occur in spite of careful facility design and conservative operating procedures and that advance planning should be done to handle the most severe accident that is credible without regard to the probability of its occurrence. Since the actual conditions encountered after an accident will differ from those in a postulated accident, plans should be kept general and flexible. (NSA 17-10855)

73. **Acute Radiation Death Resulting from an Accidental Nuclear Critical Excursion. IX. Summary.** Thomas L. Shipman (Los Alamos Scientific Lab., N. Mex., U. S. A.) *J. Occupational Med.*, **3**, 191-192 (1961).

Major facts of a nuclear criticality accident, which resulted in the death of 1 man (K) and substantial exposures to 2 others, are recapitulated. The critical excursion took place in a tank of solution from which Pu was being recovered, and the number of fissions was calculated to be 1.5×10^{17}. The average whole-body dose to K was estimated to be between 3900 and 4900 rads, with the incident dose to the upper abdomencalculated to be 12000 rads, neutrons plus gamma. Two other workers, neither of whom showed any signs or symptoms of injury other than alterations in their blood counts, received total doses of approximately 130 and 35 rads, respectively, most of this being gamma radiation. K went promptly into shock and was unconscious within a few minutes of the accident. He was brought out of shock, but died 35 hr after the accident. Marked changes were observed in the hemopoietic and urinary systems, heart, gastrointestinal tract and bone marrow. Lymphocytes were not found in the curculating blood after the eighth hour, and there was virtually completre urinary shut down despite administration of large amounts of fluids. A surprisingly large percentage of the material was recovered from the pulmonary lymph nodes. K's dose varied widely in different parts of the body and even in different parts of the same organ, Such as the heart and stomach. From data on the other 2, it apperars that the changes following exposures in excess of 100 rads are characteristic and of clinical significance, whereas doses below 50 rads produce blood changes too slight to be of any diagnostic value. (NSA 17-10874)

74. **Medical Procedures for Radiation Accidents.** *Med.*

J. Australia, 1, 256-258 (1962).

An outline of recommended steps to be taken in event of contamination accidents is given. The sequence of measures to be carried out are : deterimine whether radioactive contamination is present, taking necessary precautions such as wearing protective clothing ; remove the contaminated or exposed person to a safe area without entering the radiation field, if possible; keep all nonessential persons away to avoid spread of the contaminants; give first aid immediately but do not attend to minor injuries before decontamination; collect all available evidence on the extent and nature of contamination or external exposure; decontaminate the subject as far as possible before removal to hospital or other medical station where major injuries may require further decontamination, save all clothing, dressings, blood, vomitus, and excreta for subsequent analysis; attempt to alleviate psychologic trauma of the subject by sedation and reassurance, before admission to hospital. A stepwise procedure for decontamination of the subject is also described. In most cases decontaminations is best carried out by the subject himself. Various kinds of radiation exposure are discussed as well as the immediate and long-term harmful effects. (NSA 17-10876)

75. **Radiation Accidents.** ARLENE M. PUTT (Uni. of Arizona School of Nursing, Tucson, U. S. A.) *Nursing Outlook*, 9, 350-351 (1961).

A plan for handling radiation accidents in hospitals is outlined. All rooms used in examination and treatment of radioactive persons must be surveyed by the hospital radiation officer, before being used for other accident cases. Following emergency treatment, the patient is transported to the clinical radioisotope unit. If he has sustained surface contamination only, he is decontaminated by scrubbing with soap and water before he is admitted for observation. If the radioactive contaminant was ingested or inhaled, he is admitted to a private room in which personnel who care for him must observe specific controls. This includes working at a distance from the patient whenever possible, staying at the bedside for no longer than the time specified, and checking of linen and excreta for radiation. The precautions are reviewed daily and changed as deemed safe. As the radiation hazard decreases, the time personnel are permitted with the patient increases. The patient is isolated until he is no longer a source of a significant amount of radiation, at which time he is released from isolation by the radiation control officer. (NSA 17-12513)

76. **Emergency Actions in Radiation Accidents.** D. M. DAVIS. *Nuclear Safety*, 4, (No. 2) p. 26-29

Several definitions of a radiation emergency are given, and several improvements that should be made in emergency procedures are outlined. The AEC experience in radiation accidents and its methods for coping with them are described. Personnel dosimetry, exposures of rescue teams, and radiation surveying of large areas are discussed. (NSA 17-13726)

77. **Solvent Extraction Method for Zr-97. Use for Evaluating Critical Nuclear Incidents.** WILLIAM J. MAECK, S. FREDRIC MARSH, and JAMES E. REIN (Phillips Petroleum Co., Idaho Falls, Idaho, U. S. A.) *Anal. Chem.*, 35, 292-294 (1963).

On the basis of experience with three incidents in which large levels of fission products were present prior to the incidents, three fission product nuclides, ^{99}Mo, ^{143}Ce, and ^{97}Zr, are recommended as monitors. A method is descibed for ^{97}Zr based on TTA extraction of zirconium activity followed by milking and counting of the ^{97}Nb daughter activity. Relative standard deviation is 1.1%. (NSA 17-14162)

78. Acute Radiation Injuries in Disaster Situations. John J. Lang (Public Health Service Hospital, New Orleans, U. S. A.) and Raymond T. Moore. *Public Health Rept.* (U. S.), **78**, 17-21 (1963)

The treatment of radiation injuries in a disaster situation injuries is discussed. It is pointed out that no new symptoms or signs are present that have not been observed in ordinary clinical practice. This is not a mystery disease. Little can be done for patients in the immediate period after exposure, except for reassurance, sedation, and possibly, minimal fuid replancement. Patients who show radiation-induced skin erythema or conjunctivitis during the prodromal period usually will not survive under austere disaster circumstances. A drop in the absolute lymphocyte count to very low levels during the first few days after exposure also indicates poor prognosis. Appearance of definite central nervous system signs usually indicates a fatal course. Recurrence of diarrhea after the fourth day also usually means the patient is unlikely to survive. If infections and bleeding precede epilation, the course is more severe. Treatment will be essentially symptomatic and replacement in character, consistant with available resources. Fallout contamination can be removed without significant hazard to decontamination personnel. A detergent and water shower with thorough scrubbing is the method of choice. However, in most situations, removal of clothing and firm wiping or brushing of the body will have to be relied upon, since adequate water supplies may not be available. Work techniques in the decontamination area should be strictly controlled to prevent spread of contamination to clean areas. (NSA 17-14569)

79. Measurement of Radiation Dose after a Reactor Accident Finn Devik. *Nord. Med.*, ***66***, 1320-1321 (1961)

Calculation of the radiation doses (207 to 436 r) received by 6 workers exposed during the Vinca (Yugoslabia) reactor accident is discussed. (NSA 17-17930)

80. A Method for Immediate Detection of High Level Neutron Exporsure by Measurement of Na-24 in Humans. R. H. Wilson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash., U. S. A.) HW-73891 (Rev.), 11 p (1962).

A procedure is described for the quick identification of persons exposed to neutrons by direct body survey. Neutrons are captured by natural ^{23}Na contained in the body to produce ^{24}Na, which decay by β emission to ^{24}Mg. Gamma rays with energies of 1.37 and 2.75 are emitted and may be detected outside of the body by a portable GM-type radiation survey instrument placed against the abdominal area. A general relationship was developed between body weight, count rate, and dose that gives a good estimate of the neutron dose received. (NSA 17-18323).

81. The Health Physics Aspects of the SL-1 Accident. John R. Horan and William P. Gammaill (Idaho Operations Office, AEC, Idaho Falls, Idaho). *Health Phys.*, **9**, 177-186 (1963).

With so few accidents in the atomic energy industry, new concepts and procedure of interest to the Health Physics profession will result from a critical analysis of each major radiation accident. A brief description of the reactor, its purpose, and operating history prior to the accident is followed by a comprehensive treatment of the health physics activities. Emergency personnel working under adverse conditions in radiation fields, ranging up to 800 r/hr, received whole body exposure doses up to 27 r. Many unique problems were associated with the recovery and decontamination of the bodies. Environmental monitoring revealed that the airborne radioactive material was essentially all iodine-131 and was well below the

Radioactivity Concentration Guide value for the off site population. Analysis of soil and air samples indicated that the reactor building was quite effective in containing the fission products during and following the excursion. Included are deta on direct radiation levels experiences in the vicinity of SL-1 and the rate of decay of the primary source. The major lessons learned from the accident are summarized. (NSA 17-18417)

82. **Summary Report of Accidental Nuclear Excursion, Recuplex Operation, 234-5 Facility.** C. H. Zangar (Richland Operation Office, AEC, U. S. A.) TID-18431, 25 p (1962)

A description of occurrences associated with an accidental nuclear excursion in a 60-1 glass tank (k-9) of the Hanford Recuplex facility is Presented. This facility is a multipurpose Pu recovery operation for processing wastes. The plant and processes are described along with excursion of the emergency plan. Measures which could have been used to avoid the accident are discussed. (NSA 17-20244)

83. **Nuclear Safety in Fallout Situations.** Gordon M. Dunning. *Nuclear Safety*, 4, (No. 3) p. 69-77 (1963)

A review is given of three fallout incidents in which countermeasures were taken. These incidents were: (1) the multimegaton shot BRAVO in Bikini Atoll, after which some islanders were evacuated; (2) the 32-kt HARRY shot at the Nevada Test Site, after which the inhabitants of St. George, Utah, were asked to remain indoors for 2 hr; and (3) the increase in ^{131}I in milk in Salt Lake City after the SEDAN shot, in which case the milk industry took steps to reduce the ^{131}I content. The reasons for each countermeasure are outlined. It is shown that the actions undertaken on the milk in Salt Lake City were in large measure unneccessary, as the Federation Radiation Council figures prompting the actions are very conservative and were to serve only as guides. (NSA 17-23580)

84. **SL-1 Final Report.** J. R. Buchanan. *Nuclear Safety*, 4, (No. 3) p 83-86 (1963)

The final report issued by the AEC's Board of Investigation on Sept. 5, 1962, is discussed. The accomplishments of the three recovery phases are described. Some statements made to the Board by Combustion Engineering, Inc., and Argonne National Laboratory are given. It was concluded by the Bord that the direct cause of the incident was manual withdrawal of the central-rod blade beyond the specified limit and that the actual reason for the withdrawal is not known. (NSA 17-23582)

85. **Pre-planning for Nuclear Accidents.** J. M. White and J. Neil (Atomic Energy of Canada Ltd., Chalk River, Ont., Canada) *Health Phys.*, **9**, 507-509 (1963).

The improvements in emergency planning and equipment at Chalk River which have occurred during the last 15 years are discussed. Reference is made to how well emergency plans operated during the two major accidents which occurred. The existing procedures which deal with emergencies are discussed and some of the emergency equipment designed and built at Chalk River by the Radiation and Industrial Safety group is described. (NSA 17-25492)

86. **Problems on the Causal Relationship between Damage and Nuclear Incidents.** (Comit. Nazl. Energia. Nucl.) Giuseppe Belli. *Notiziario*, **9**, 49-51 (1963).

Problems related to the cause-effect relationship between nuclear incidents and damages are described from a legal viewpoint. (NSA 17-26950)

87. Iodide to Reduce Risks of Reactor Accidents. *Brit. Med. J.*, **1**, 628 (1963).

Possible ways of reducing radioiodine uptake of local populations following a nuclear reactor accident are discussed. The amount of radioiodine released into the atmosphere after the Windscale reactor incident was considerable. Since approximately half of any iodine inhaled or ingested will become localized in the relatively small volume of the thyroid gland, a short exposure to an even moderately radioactive atmosphere can result in an appreciable dose of radiation to the gland. Various substances are know to reduce the uptake of radioactive iodine by the thyroid, such as derivatives of thiourea, used in the treatment of thyroid disorders. Even the safest of them, however, may cause side-effects, and their administration to a random population, including children, would entail risk of harmful effects. Potassium perchlorate and thiocyanate also inhibit the iodine-concerning mechanism of the thyroid, but the use of these drugs would also entail certain risks. Single doses of 100 mg KI would appear to be reasonably without risk, and although some people are allergic to iodine, iodide is a common component of cough mixtures and other medicaments taken by the population at large. The dose to the thyroid from any radioactive iodine which is subsequently inhaled may be reduced by a factor of about 10 after administration of 100 mg of KI, and this precaution would be useful so long as it is stressed at the same that the best safety precaution is to leave the dangerous, or potentially dangerous, area till all risk has passed and it has been declared safe by a recognized authority. (NSA 17-27607)

88. Medical Aspects of Radiation Accidents. A Handbook for Physiciants, Health Physicists and Industrial Hygienists. EUGENE L. SAENGER, ed. (Cincinnati. Univ. Coll. of Medicine, U. S. A.) 372 p (1963).

Topics discussed include: procedures to be followed the first 12 hr after an accident; Later emergency period; clinical features of the acute radiation syndrome; therapy and long-term follow-up studies; hospital disaster plans for radiation accidents; problems of psychological upset; accidents involving primarily external sources of radiation; accidents involving exposure to radionuclides; reactor and critical assembly accidents; nuclear chain reacting systems; role of civilian authorities and public relations; governmental aid and legal requirements; fire from nuclear materials; nonmilitary nuclear weapon accidents; relation of radiation accidents to mass disaster and large-scale emergency programs; and procedures for purification of water and food. Several useful tables are included also. (17-27632)

89. Reactor Containment Research and Development. N. A. WEIL (Illinois Inst. of Tech., Chicago, U. S. A.) (CONF-39-83) 21 p. From American Nuclear Society 9 th Annual Meeting, Salt Lake City, June 1963.

An outline is given of containment concepts, sources and release rates of energy, responses of containment structures, effects of projectiles, and leakage rates of radioisotopes, with particular regard to major reactor accidents. (NSA 17-34192)

90. Accidental Personnel Exposure to Elemental S-35. A. R. MAASS, T. L. FLANAGAN, D. BLACKBURN, and M, SMYTH (Smith Kline and French Labs, Philadelphia, U. S. A.) *Health Phys.*, **9**, 731-740 (1963).

While an organic chemist was attempting to open a glass ampule containing 1. 27 C of elemental ^{35}S dissolved in 15 m*l* of benzene, the vial exploded, and the operator was contaminated internally and externally with the radioactive material. Utilizing the techniques of dilution of the absorbed radioactive material with non-radioactive sulfur in several of its many utilized forms, as well as the administration of agents that seem likely to increase the rate of excretion of ^{35}S, the major load of detectable ^{35}S was cleared from the body within 5 days. The biological half life of plasma radioactivity was about 19 hr. Approximately 85% of the urinary and 90% of the fecal radioactivity were excreted within 24 hr of the accident. This is in agreement with the classical concept that only a small portion of sulfur introduced in a non-organic form, is retained by the body. Observations in this unusual case are discussed in the light of available literature on ^{35}S. The body burden was estimated to have been 13 ～ 26 μC. There is ampule evidence to suggest that these quantities of radioactive sulfur are unlikely to cause any radiation damadge and, indeed, no adverse effects have been noted during the 3 years since exposure. (NSA 17-36053)

91. **Instrument Requirements for Peacetime Accidents Involving Radioactivity.** A.L. Baietti (Tracerlab, Richmond, Calif., U. S. A) *Health Phys.*, 2, 635-642 (1963).

Conciderațion is given to the instrument requirements for peacetime accidents involving radioactivity. Analysis of the problem is directed at determining the requirements for measuring the radiation field, the contamination level, and personnel exposure. A general description of the charactaristics of the various instrument systems used in these measurements is presented. Recommendations are made on instrumentation development needed to make the measurements necessary for assessing the significance of the radiological environment associated with a peacetime accident involving radioactivity. (NSA 17-36160)

92. **Planning for Care of Injured Radiating Patients.** W. D. Norwood (General Electric Co Hanford Atomic Products Operation, Richland, Wash., U. S. A.) HW-SA-2859 (1962).

The possibility of the occurrence of accidents that would result in injured radioactive employees in an atomic energy installation is discussed. Emergency temporary type facilities that have made available for handling such an event are described. The more permanent type facility recommended for dealing with such an event is also considered. Because of the cost, much thought is required to ensure a reasonably adequate facility at justifiable cost. Plans are discussed for quickly assembling the medical and supporting team required to deal with such a catastrophe. (NSA 17-41020)

93. **Biological Dosimetry of Ionizing Radiation as applied to Triage of Casualties following a Thermonuclear Detonation.** Lawrence T. Odland (Air Force Weapons Lab., Kirtland AFB, N. Mex., U. S. A.) RTD-TDR-63-3049, 25p (1963)

The need for sorting of casualties following a nuclear disaster is discussed. The problem of radiation illness imposed upon conventional traumatic injuries and burns is emphasized. Arguments are presented for the need of a simple yet accurate biological dosimeter to aid medical officers responsible for casualty sorting. Criteria of an ideal biological dosimeter are proposed, and the developments are reviewed. It is pointed out that at present the fall in leukocyte count, especially the lymphocytes, following exposure is the simplest and most practical method of estimating biological injury resulting from ionizing radiation. (NSA 18-447)

94. **Pathogenesis and Regeneration of Radiation Induceed Bone Marrow Injury, and Therapeutic Implications.** Theodor M. Fliedner, Eugene P. Cronkite and Victor P. Bond (Brookhaven National Lab., Upton, N. Y., U. S. A.) *Strahlentherapie, Sonderbaende*, 51, 263-278 (1962)

The hematological data of patients of 4 radiation accidents (Rongelap 1954, Oak Ridge 1958, Vinca 1958, Lockport 1960) are reviwed and compared. The blood cell curves appear to show three phases. These are an initial phase (about 8 to 10 days), a phase of transient or abortive regenerations, and a phase of final effective recovery. These phases in the blood are preceded and caused by particular events in the bone marrow. Evidence was brought forward that transient rises in leukocytes and reticulocytes associated with a marrow capable of spontaneous recovery. In patients with inhomogeneous total-body irradiation, the transient rise may lead directly of effective recovery. Immediate decline of all blood cell elements without evidence of further, even abortive attempts of marrow regeneration must be considerd as evidence for a lethal bone marrow dose and extremely serious complications may be expected. The clinical implications of these analyses are outlined and the diagnostic possibilities described. (NSA 18-1443)

95. **A Summary of Industrial Accidents in USAEC Facilities, 1961-1962.** (Division of Operational Safety. Industrial Safety and Fire Protection Branch, AEC, U. S. A.) TID-5360 (Suppl. 4), 34p (1963)

Information is presented on accidents and incidents occurring during 1961 and 1962 in plants owned and operated by the AEC. Revised reporting requirements established by the AEC in April 1962 are outlined. Data are summarized on radiation exposure of AEC contractor personnel, accidents involving radioactive materials, and accidents involving fatalities. (NSA 18-1957)

96. **A Summary of Incidents Involving USAEC Shipments of Radioactive Material, 1962.** D. E. PATTERSON and A. MEHN (Division of Operational Safety, AEC, U. S. A.) TID-16764 (Suppl. 1), 44p (1963)

Fourteen incidents (described) occurred in the transportation of radioactive materials in 1962. None of the four incidents involving radiation release resulted in any serious consequences or costly cleanup. (NSA 18-1958)

97. **Argonne National Laboratory Radiological Assistance Team.** G. T. LONERGAN and W. H. SMITH (Argonne National Lab., Ill., U. S. A.) ANL 6786, 37p (1963)

The organization, training equipment, and operation of a radiological assistance team are described. The team renders assistance in the event of incidents involving radiological safety or weapons incidents. (NSA 18-6969)

98. **Evacuation of the Injured from a Heavily Irradiated Building.** *Zivilschutz*, **26**, 306-309 (1962)

A description, based on data collected from American technical literature, of the reconnaissance, protective, and rescue measures taken at the Idaho Fall reactor accident January 3, 1961, in which three people died from radiation exposure is presented. Due to the high radiation level (up to 500r/h), there wes numerous difficulties were, however, overcome without a single rescuer suffering any radiation damage. Although of limited application, numerous lessens can be drawn from this incident about the availability of protective equipment and measuring instruments, and the training of rescue workers who may be required to work in high levels of radiation. (NSA 18-6987)

99. **Radiation Emergencies : Types and Mechanisms.** CARL M. UNRUH (General Electric Co. Hanford Atomic Products Operation, Richland, Wash., U. S. A.) HW-SA-3285, 16p (1963)

Radiation emergency planning is discussed for emergencies resulting from the loss of control of radioactive materials such as spills of radioactive materials, fires, explosions, vehicular accidents, and energized equipments. It is pointed out that the extent and involvement in severity and type of radiation exposure, types and number of people exposed, interaction with the public domain, and the duration of each radiation emergency is a function of the source of the radiation and the mechanics of the accident. Each possible course of an accident requires careful examination to assure that emergency planning and the implementation of emergency plans will be effective and timely. (NSA 18-8546)

100. **Emergency Manpower Pool.** E. M. Renton (Atomic Energy of Canada, Ltd., Chalk River, Ont., Canada) 723-37 of "Medical Supervision of Workers Exposed to Ionizing Radiations" (Brussels), Euratom, p. 379-402 (1963)

An emergency manpower rating system for nuclear incidents is outlined. The plan was set up in an attempt to integrate on tabulating cards all medical information, personal data, blood pictures, internal and external radiation exposures. (NSA 18-8585)

101. **The U. S. Atomic Energy Commission and Radiological Emergency Assistance.** F. Raymond Zintz (Atomic Energy Commission, Wash. D. C., U. S. A.) CONF-277-6, 7p (1963)

The AEC supports a nation-wide program of radiological emergency assistance to protect the health and safety of the public while effectuating the development, use, and control of nuclear energy under the provisions of the Atomic Energy Act of 1954 as amended. Radiological assistance is provided in emergencies involving radioactive materials through 8 regional offices that maintain a radiological emergency responce capability available 24 hr a day to supplement the resources of contractors, military organizations, and state and local agencies. The organization and operation of the radiological assistance program is outlined. (NSA 18-14104)

102. **Training Manual for Radiation Monitoring Teams. Vol. 21, No. 28.** J. Richard Briggs (Naval Medical Research Lab., New London, Conn., U. S. A.) MRL-397, 31p (1962)

Basic information and guidance are presented for the training of radiation-monitoring teams made up of candidates with little or no knowlege of atomic or nuclear radiation. As a practical approach to the subject of radiation biology, a brief review of the relevant mathematics and physics is presented. Familiar examples and situations are used to illustrate important aspects and procedures, and finally, specific action and details are set forth as a guide for team action. Radiation monitoring teams are of primary importance in the initial handling of any accident involving radioactive material. The training and skill acquired by such teams may will be the factor of control required in emergencies until more highly trained personnel are available. These teams add immeasurably to the ability of ships and other activities in coping with all phases of control of radioactive contamination, and also in supplementing work done by more highly skilled and trained personnel. (NSA 18-14108)

103. **Evaluation of a Hospital Disaster Plan.** Charles U. Letourneau (Misericordia Hospital, Milwaukee, U. S. A.) *Hosp. Management*, **94**, 44-46 (1962)

Plans prepared for this hospital to be used in civil defense and other emergencies are described. (NSA 18-14136)

104. **Fission-product Release from the NRX 1952 Accident.** W. J. Edwards (Atomic Energy of Canada Ltd., Chalk River, Ont., Canada) CRDC-1177,

12p (1963)

The nature of the fallout observed downwind of the reactor stack following the 1952 accident was considered in terms of resent data on the fission-product emission from oxidizing uranium. The data, assembled from various authors, are interpreted as suggesting that the activity observed locally would be similar to that associated with briefly irradiated uranium and that no particular enhancement in more volatile fission products would be expected. (NSA 18-15604)

105. **Mental Preparedness of Emergency Personnel.** DONALD OKEN CONF-277-8 (From Symposium on Radiation Emergencies in Medicine, Research, and Industry, Chicago, Dec. 1963) 25 p, (1963)

Attention is directed to the phenomenon of anxiety and human behavior under stressful conditions, both mild and severe. It is proposed that almost everyone involved in a major radiation incident would develop some anxiety, a few individuals developing terror or becoming abjectly dazed. Thus all emergency personnel should be prepared to apply therapeutic measures. To combat traumatic disturbances caused by fear of the unknown, the nuclear scientist should provide concrete, tangible, realistic, familiar images of radiation and its effects. Because of the importance of group dynamics, leaders must be chosen with great care. The capacity to withstand stresses faced in the cource of carring out effective function is cited as the most important trait in emergency personnel. A prime outcome of personnel training should be the development of the strong esprit de corps. Training programs designed to provide contact with stressful experience prior to practical work at real disasters are recommended. The roles of adequate inofrmation on radiation and knowlege of accident prevention techniques are emphasized. (NSA 18-16270)

106. **Radiological Emergency Procedures for the Nonspecialist.** KARL F. OERLEIN (Defense Atomic Support Agency, Wash. D. C., U. S. A.) Nov. 1963. 42p (GPO)

The hazards of nuclear radiation are compared to other hazards of modern daily living. The most essential steps to take in case of an accident involving radioactive materials are outlined for the imformation and guidance of the layman who may find himself involved in such an accident. (NSA 18-20273)

107. **Irradiation Doses Resulting from a Criticality Accident.** W. SCHUELLER (European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium) NP-13724 (ETR-150), 18p(1963)

Estimates were made of the neutron and γ radiation doses that would result from a criticality accident in a fissile material solution. Irradiation doses from a criticality accident were determind for an unshielded system and behind a standerd concrete shieled of different thicknesses. It was determined that an aveage criticality accident in a solution system will yield about 10^{17} fissions, although the maximum credible burst may be as high as 3×10^{18} fissions; 10^{17} fissions will cause a lethal dose of about 8000 rem adjacent to the unshielded reactor, or 0.3 rem behind 150cm of concrete shield. The dose from the maximum credible accident are 30 times as large. A semi-lethal dose (400 rem) must be expected from an average accident if the shield is less than 40 cm, and from the maximum accident for the shields below 85cm. (NSA 18-27723)

108. **Theoretical Possibilities and Consequences in Major Accidents in Uranium-233 and Plutonium-239 Fuel Fablication and Radioisotope-processing Facilities.** C. E. GUTHRIE and J. P. NICHOLS (Oak Ridge National Lab., Tenn., U. S. A.) *Trans. Am. Nucl. Soc.*, **7**, 135 (1964)

(No abstract) (NSA 18-27744)

109. **Medical Supervision of Personnel Exposured to Ionizing Radiation. (In Italian)** E. BARTALINI and I. DUCCI *Med. Lavoro,* **54**, 302-312 (1963)

A brief account is given of the available methods of inspecting personnel exposed to ionizing radiations. Criteria are suggested for carring out periodical preventive medical examinations, for measuring the dose received, and for registering data relative to each employee. The units most commonly used in the measurement of ionizing radiations, and the maximum permissible doses are stated. Methods recommended by the EURATOM commission for the determination of the total dose received are described. As regards the individual measurements of dose received, the combined use of an ionizing-chamber dosimeter and of a flimbadge are recommended. The former allows immediate estimation of the degree of exposure, while the latter records data which may be useful also in the case of future disputes. It is recommended to use a separate file for each member of the stuff exposed to the radiations. The need for close and systematic cooperation between the factory medical officer and the responsible technical supervisor whose duty is to note in a special register the total dose of radiations absorbed by each employee, are stressed. (NSA 18-29403)

110. **Clinical Management of Patients Exposed to Radiation Disaster——An Outline.** E. R. KING (Naval Hospital, Bethesda, Md., U.S. A.) *Military Med.* **126**, 693-697 (1961)

Current thinking of how to care for patients involved in peacetime radiation accidents is outlined. Application to wartime conditions is also possible. A table demonstrates the radioactivity present in a nominal size (500 Mw) power reactor after four months of operation with 12 hr of cooling following an excurtion, or run-away. Another table outlines immediate procedures to be carried out once an accident is reported. At the National Naval Medical Center, Bethesda, exposed patients would be evaluated as to their physical condition and external radioactive contamination according to a scheme shown in a third table and other tables outline the criteria used in deciding upon radiation dosage is listed. Another table presennts a description of the possible ways of exposure from which patients may suffer from various types of radiation accidents. The use of marrow grafts and antibiotics is discussed. (NSA 18-29405)

111. **Safety Aspects of U. S. Fuel Reprocessing.** J. A. MCBRIDE (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho, U. S. A.) A/CONF. 28/P/278, 14p (1964) : (Prepared for the United Nations Third International Conference on the Peaseful Uses of Atomic Energy, 1964)

A review is presented of the safety procedures and experience at U.S. fuel reprocessing plants. The probable causes of the five criticality incidents are outlined. It is shown that administrative controls are gradually being replaced by geometrically favorable equipment and nuclear poisons. (NSA 18-31650)

112. **Accidents and Breakdowns at Nuclear Installations.** U. SCHULZE ; Translated by O. S. WHITSTON (U. K. A. E. A. Atomic Energy Research Establishment, Harwell, Berks., Eng.) NP-tr-1153 : from report KFK-68, 63p (1961)

Data are summarized on 60 nuclear accidents reported from eight countries from 1945 through 1961. Only accidents that involved radiation hazards due to breakdowns in reactors, critical assemblies, processing plants, and accelerators are included. Data are included on the nature of the accident, amount of energy liberated, duration of work stoppage, damage to equipment, cost, extent of contamination, and personnel injuries. Bibliographic references are included. (NSA 18-31804)

113. Planning for Radiation Accidents. R. A. LOVE (Brookhaven National Lab., Upton, N. Y., U. S. A.) *Hospitals*, **38**, 50-56 (1964)

A radiation decontamination unit and the equipment and supplies needed for its operation are described. The question of stockpiling blood and other materials for the treatment of the irradiated patient are also discussed. (NSA 18-31811)

114. Radiation Accident. Injury of Fear. W. D. NORWOOD (General Electric Co., Richland, Wash., U. S. A.) *Northwest Med.*, 243-243 (1964) ; (HW-SA-3438)

Since extreme fear is often present in an employee who has had a possible acute exposure to ionizing radiation, the physician should quickly evaluate the condition of the patient by careful attention to the history, signs, and symptoms. This will allow adequate timely treatment, if necessary, and also facilitate prognoisis. Followup studies, to determine the dose of radiation, should be made as an assistance in handling the case and for use in any necessary work limitation. This dose should be added to the cumulative radiation exposure record of the employee. If long delayed effects are considered possible, appropriate medical checks should be made at intervals. (NSA 18-31818)

115. Final Report on the Accident which Occured during a Purification of Plutonium on Ion-exchange Resins June 26, 1962, in the Radiochemical Building of Cenfa (CEN-Fontenay-aux-Roses, France) Translated by E. R. APPLEBY (General Electric Co., Hanford Atomic Products Operation, Richland, Wash.) HW-tr-78, 11p (1963) ; from a publication of the Plutonium Department, Services of Plutonium Chemistry.

Studies were conducted to determine the causes of the accident. The conditions of the accident are described briefly ; they include reused Dowex 1-X-4 anionic resin, high acidity, and extremely long time of contact. Studies of the stability of the resin in HNO_3 concentrations of 7 to 10 N. Recommendations for users of ion exchange resins are presented which include limits on the acidity of the solution, short contact times, and the use of coarse resin particles. (NSA 18-33809)

116. Radiation Accidents and Emergencies. L. H. LANZL and J. H. PINGEL (Argonne National Lab., Ill., U. S. A.) *Science*, **143**, 1352 (1964) (ACRH-21, p45-48)

A symposium on radiation accidents and emergencies in medicine, research, and industry was held in Chicago, Dec. 19 and 20, 1963. A brief summary is presented of the papers presented. While emphasis was placed on local emergencies and small accidents with ionizing radiation, a few papers also dealt with major catastrophes, short of a wartime holocaust. All pertinent aspects of a pure emergency situation were discussed, including accident dosimetry, handling of spills, medical responsibility, mass survey problems, control of post-accident exposures, psychological and legal considerations, and public relations. (NSA 18-33817)

117. Organization of Medical Countermeasures against Radiation Accidents due to Equipment Damage or Breakdown. K. NEUMEISTER JPRS-26021 ; Translated from *Deut. Gesundheitsw.*, No. 28, 1293-1297 (1964)

Measures are outlined for handling radiation accidents in radioisotope laboratories. The handling of disasters such as nuclear weapons explosions or serious reactor accidents is discussed briefly. Emphasis is placed on the organization of medical personnel. (NSA 18-37450)

118. Radiological Emergency Procedures for the Non-

specialist. KARL F. OERLEIN (Defense Atomic Support Agency, Wash. D. C., U. S. A.) May 1964, 40p (GPO)

The biological hazards of nuclear radiation are reviewed. Radiological emergency procedures are outlined for the non-specialist involved in an accident involving radioactive materials. (NSA 18-37468)

119. **The Relationship between Blood Injury and Absorbed Dose in Criticality Accidents.** J. A, DENNIS (Atomic Energy Research Establishment, Harwell, Berks., Eng.) AERE-R-4413 (1964); p. 167-180 of "Biological Effects of Neutron and Proton Irradiations. Vol. I." Vienna, IAEA.

The neutron and gamma doses to individuals exposed in criticality accidents have been recalculated to yield the surface-absorbed dose to the trunk of the body. The relationship is examined between this dose estimate and blood-count profile scores that are based on the scoring system of N. Wald and G. E. Thoma for deviations from the normal of the lymphocyte, neutrophil, and platelet-peripheral blood counts. It is shown that a quantity based on the surface-absorbed gamma dose and the ^{24}Na activity in the blood shows a better prognostic guide for the degree of radiation injury than any of the conventional dose estimates. The relative biological effects data of the heavy-particle recoil doses deduced from these observations are consistent in general with values obtained from experiments on dogs. (NSA 18-38731)

120. **Accidents in Nuclear Energy Operation.** J. R. BUCHANAN *Nuclear Safety*, **5**, 410 (1964)

A summary of data on exposures of AEC and AEC-contractor personnel to penetrating radiation during 1962 is presented. A chronological listing of accidents in nuclear energy operations for the period Aug. 8, 1962, to Nov. 30, 1963, is included. (NSA 18-43859)

3. 項目索引

3.1 事故対策

d. その他

3.2 事故報告および評価

a. 一般

4. 著者索引