AUTHORS AND PAPERS

SETTLED-BED REACTOR

An analysis of a conceptual design for a 1 000-MWe Settled Bed Fast Reactor fueled with UC and PuC spheres and cooled by liquid sodium has been made at BNL to determine its technical and economic feasibility. The study includes a reactor physics analysis, an engineering design and analysis of the thermal and hydraulic characteristics, and a study of the system economics. There appear to be no inherent technical problems for a settled bed fast reactor of this size. Total power generating costs were calculated to be as low as 3.84 mills/kw-hr for fuel leased from the AEC and 4.14 mills/kw-hr for fuel that is privately owned.

This study of the Settled Bed Fast Reactor (SBFR) is a natural extension of the general interests of the Nuclear Engineering Department of BNL, which has for many years been interested in breeder reactors. The SBFR study combines the efforts of a number of disciplines: the authors include four chemical engineers, two mechanical engineers, two metallurgists, and four physicists, all members of the Nuclear Engineering Department, having an average professional experience of more than a dozen years per man, as well as a Long Island Lighting Company engineer who for the past ten years has been a collaborator with BNL. A portion of the team is shown here seated (left to right) Levine, Chernick, Hatch; standing (left to right) Pancer, Susskind, Nugent, Green, Aronson and McNicholas.

FUEL MANAGEMENT FOR A RESEARCH REACTOR

Fuel management and excess reactivity management practices employed at the Livermore Pool Type Reactor (LPTR) have as their goals constant core configuration, nearly constant fuel inventory, and the neutron flux stability desired for research reactors. The original LPTR fuel cycle program, initiated in 1960, has been modified in several respects. The results of 32 cycles of operation have been analyzed with respect to fission fuel content, product mass, thermal utilization and percent burnup. FOOBIE and RHOBURN, computer codes developed by the staff for use in the fuel management program at LPTR, are described.

Ernest E. Hill is presently Chief of the Reactor Safety Branch of the San Francisco Operations Office of the USAEC. From 1955 to 1964, he was Supervisor of the Livermore Pool Type Reactor and Assistant Division Leader of the Neutronics Division at the University of California Lawrence Radiation Laboratory in Livermore. He primary interest has been in the field of reactor fuel management, reactor operations, and reactor safety. He holds a BSME and an MS in Nuclear Engineering, both from the University of California in Berkeley.

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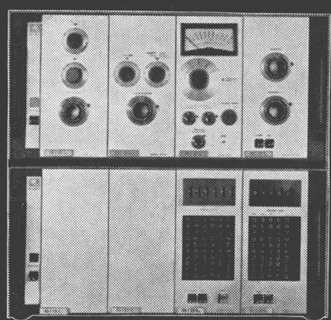

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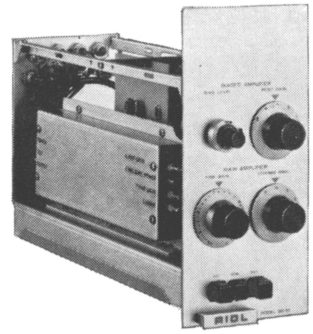

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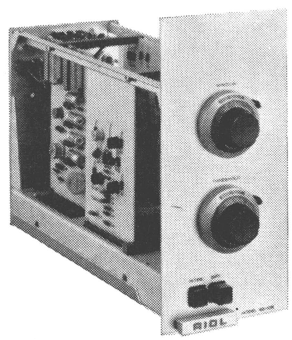

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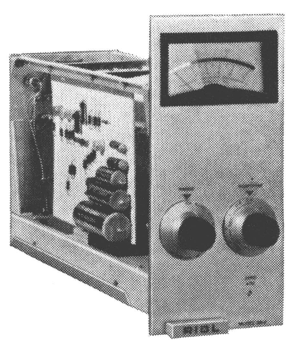

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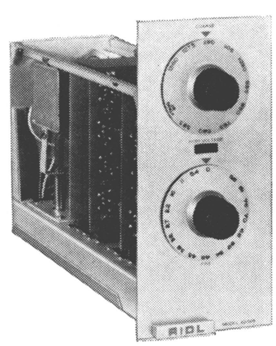

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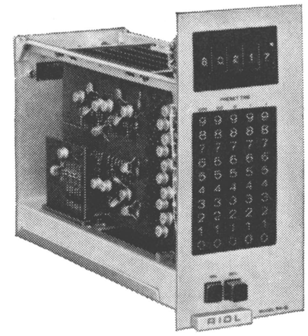

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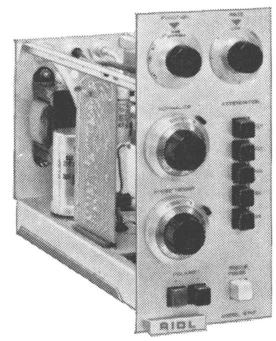

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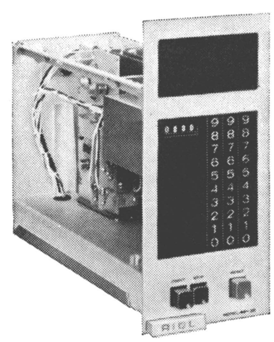

SCALERS. With or without preset count in count capacities from 10^1 to 10^{12}. Accept pulse inputs to 10 mc/sec continuous with pulse-pair resolution less than 10 nanoseconds.

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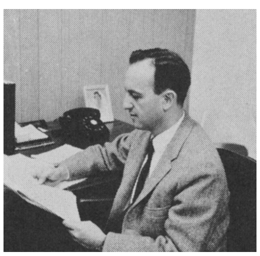
READER SERVICE CARD #50

HEAVY ELEMENT PRODUCTION

Calculations have been made for the buildup of higher nuclides in samples of various heavy element starting materials, at neutron fluxes ranging from 4 x 10^{13} to 1 x 10^{16} n-cm^{-2}-sec^{-1}. Attempts have been made to estimate yields of the heavier fermium isotopes and of 259 Md by means of the nuclear properties predicted from the systematics.

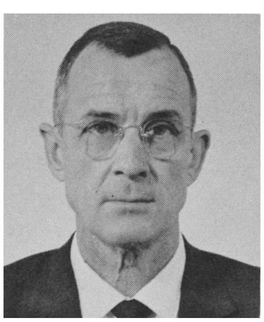
Paul Fields is a codiscoverer of einsteinium (element 99) and fermium (element 100). A senior chemist and group leader of the Heavy Element Chemistry Group at ANL, he has been associated with ANL and its predecessor, the Metallurgical Laboratory, for twenty years. Both he and John Milsted worked at the Nobel Institute of Physics during 1957. Prior to joining the Heavy Element Chemistry Group at ANL five years ago, Milsted spent nine years at Harwell and four at Chalk River. Don Metta, a Scientific Assistant in the group, has been at ANL for fifteen years.



RADIOISOTOPE BIMETAL ENGINE

The old familiar bimetallic disk, commonly used for snap-action thermostatic switches, may be modernized by a proposal to convert it into a remotely operable "engine" which derives its energy from radioisotopic heating. A suggested use for such a device is in producing signals in an underwater acoustic beacon. A theoretical analysis indicates, for example, that 22 kilocuries of ^{90}Sr ought to produce pulses of 10 watt-seconds every 11 seconds.

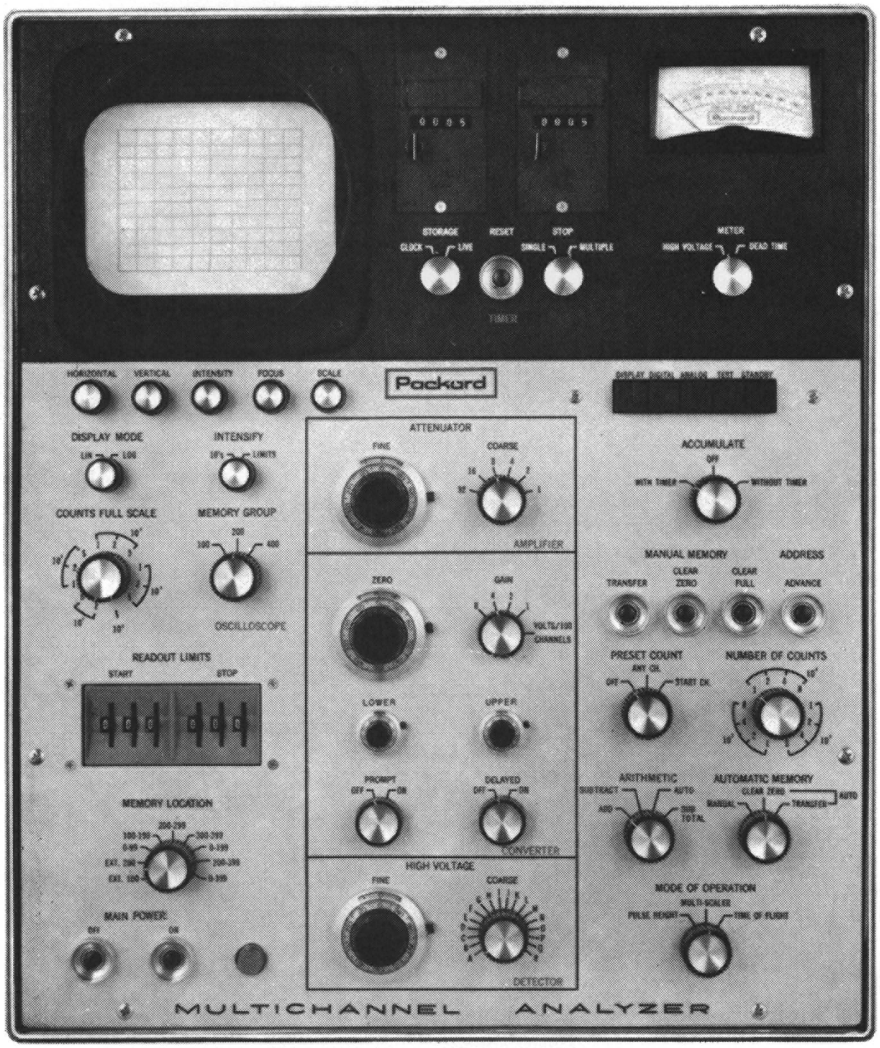
Calvin C. Silverstein has been involved extensively in the study of reactor and isotopic space power plants not only in his present position with Hittman Associates (Baltimore) but also in previous positions with the Martin Company and Atomics International. While at Martin he studied the liquid fluidized-bed reactor concept, and at Cornell Aeronautical Laboratory he explored nuclear applications of porous-wall fluidized beds. He holds a BS degree in mechanical engineering from Newark College of Engineering (1950) and a master's degree in engineering from Princeton (1951), and he attended Orsort (1951-52).



REACTOR PRODUCTION OF ^{109}Cd

The 0.022 Mev X-ray from the decay of ^{109}Cd is suitable for industrial and medical radiography, composition analysis, and mass-density-thickness gaging. Cadmium-109 (1.3 yr half-life) has been recovered from a reactor-irradiated silver target and used to demonstrate the feasibility of using a portable ^{109}Cd X-ray source for radiography. Radiographs made with the source are comparable in quality to those made by conventional X-ray sources, although the exposure time required was somewhat longer. The chief advantage of the proposed system lies in the portability of the source; the unit would weigh only a few pounds.

Howard Russell is a radiochemist at Oak Ridge National Laboratory, where he has worked on the development of methods for the separation and purification of such reactor-produced isotopes as ^{32}P, ^{131}I, ^{35}S, ^{36}Cl, ^{130}Ba-^{140}La, ^{14}C, ^{90}Sr, ^{45}Ca, ^{125}Sb, ^{55},$_{59}FE$, ^{113}Sn, and ^{51}Cr. His work has also included the isolation of pure carrier-free cyclotron-produced nuclides such as ^{57}Co, ^{59}Fe, ^{65}Zr, ^{54}Mn, ^{7}Be, ^{85}Sr, ^{73},^{74}As, and ^{125}I. His B.A. degree in chemistry was won from Lincoln Memorial University (Harrogate, Tennessee) in 1942.



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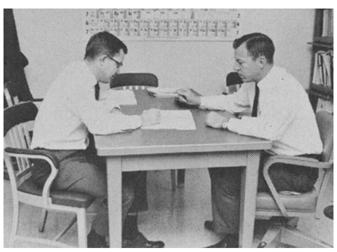
READER SERVICE CARD #51

ELECTRODEPOSITION OF ^{99}Tc METAL
DISTILLATION OF MAGNESIUM

Technetium, unknown in nature until the advent of the nuclear reactor, is nevertheless becoming quite useful for its chemical properties as well as for the radioactive properties of its various isotopes. A few of these uses are suggested in a brief paper which describes a technique for electroplating dense adherent coatings of this element on backings such as copper, gold, silver, or platinum.

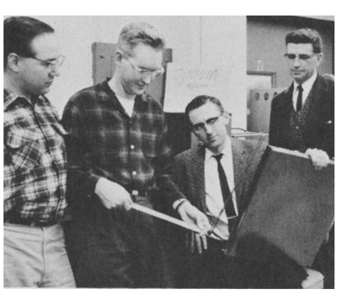
W. D. Box, the author of this paper and of the short note on magnesium distillation which follows it, is a member of the Research and Development Department of the Isotopes Division of Oak Ridge National Laboratory where, since the Fall of 1962, he has been working primarily on fission-product isotope heat sources. He obtained his B.S. degree in Chemistry in 1952 from the University of Louisville (Kentucky) and spent the intervening ten years with the Special Analytical Services Laboratory of Union Carbide's Oak Ridge Gaseous Diffusion Plant.



HASTELLOY-N IRRADIATION EFFECTS

Although the stress-strain relationship of Hastelloy N is not affected by neutron irradiation, ductility is reduced for deformation temperatures in excess of 500°C. This loss of ductility is more significant at test conditions which result in intergranular failure, and it reduces the true tensile strength. Postirradiation annealing of the irradiated alloy does not improve ductility. These data are compatible with experiments suggesting helium generation from the (n,α) reaction of boron as the cause of low ductility. In general the low ductility of irradiated alloys can be described in terms of the present knowledge of intergranular fracture.

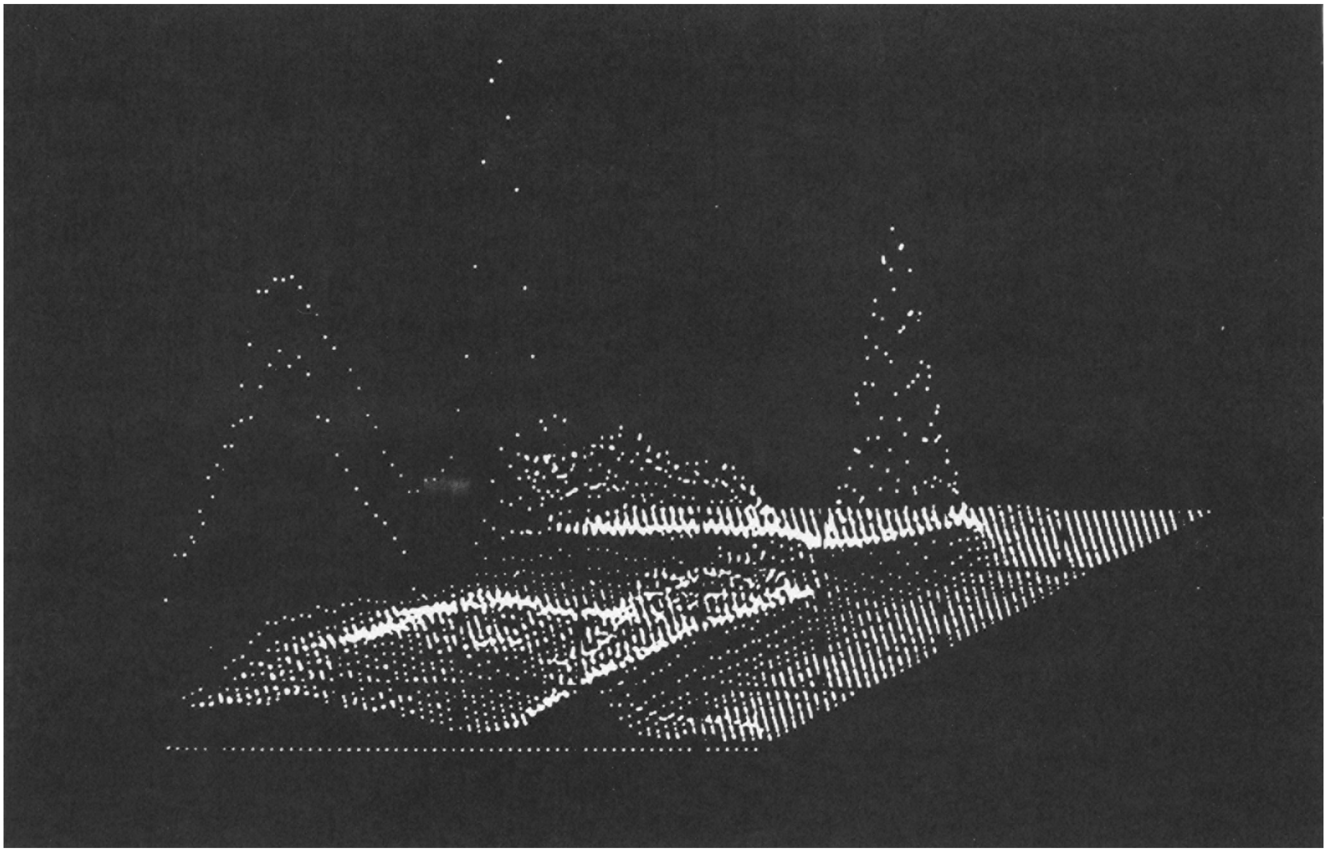
W. R. Martin was graduated from the University of Cincinnati in 1957 with a baccalaureate in Metallurgical Engineering. From 1959 to the present, he has engaged in research on effects of gaseous environments on the creep and short-time tensile properties of iron-base alloys as well as radiation effects on iron-and nickel-base alloys. J. R. Weir holds a BS in Mettalurgical Engineering from the University of Cincinnati (1955) and an MS from the University of Tennessee (1961). He has been associated with research on the mechanical properties of nickel-base alloys and radiation effects on alloys for reactor applications and is presently the Supervisor of the Mechanical Properties Group of the Metals and Ceramics Division at ORNL.



TREAT URANIUM SULFIDE TESTS

Transient nuclear heating experiments have been carried out on gas-bonded, refractory-metal-clad uranium monosulfide specimens in the Transient Reactor Test Facility (TREAT) over a range of temperatures extending to the fuel melting point of 2462°C. Although some fuel slumping was observed, the specimens did not suffer the mechanical damage and fragmentation found for uranium dioxide samples tested earlier. In this respect, the uranium monosulfide behavior is considered to be more satisfactory from a safety standpoint.

L. E. Robinson, C. E. Dickerman and C. August are members of ANL's Reactor Physics Division. For the past few years they have specialized in fast reactor safety studies. C. Mueller has been with this group as a student research aide. R. Carlander, a member of the ANL Metallurgy Division, has concentrated on determination of material changes resulting from reactor exposure. Shown at left are, left to right: August, Dickerman, Carlander and Robinson.



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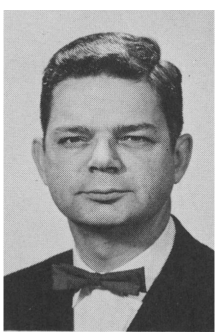
READER SERVICE CARD #52

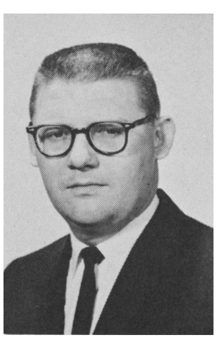
^{233}U-Th FUEL FABRICATION

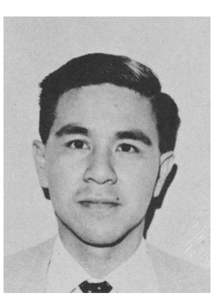
Radiation levels and personnel exposures associated with the operation of the ORNL Kilorod Facility for the fabrication of $^{233}UO_2$-ThO_2 fuel were determined and analyzed. Comparison between the measured activity of ^{208}Tl during a typical sequence of operations and the calculated activity of pure ^{232}U demonstrates the effects of the several fabrication steps. Conceptual design calculations for a semi-continuously operating plant indicate that up to 100 kg/day of mixed oxide containing 200 parts -10^{-6} of ^{232}U can be processed using 5 cm-thick-lead-equivalent shielding.

Don Ferguson is Director of the Chemical Technology Division at ORNL. He has specialized in the development and demonstration of chemical separations processes for reactor fuels and transplutonium elements and of integrated fuel cycles for power reactors since joining the Laboratory in 1946. Bob Brooksbank, with ORNL since 1951, is Section Chief of the Pilot Plant Section of the Chemical Technology Division. He was in charge of the Kilorod Facility and has recently directed other pilot plant programs involving the processing of plutonium and curium and the treatment of low level waste. Jere Nichols, a design engineer in the Chemical Technology Division since 1958, specializes in evaluation of the problems associated with shielding, criticality control, reactor irradiations, and hazards.

DETERMINATION OF ZIRCONIUM







A rapid, accurate method for the determination of the presence of zirconium by activation analysis with radiochemical separation is described. After neutron irradiation, the sample is dissolved and allowed to stand, and the ^{97}Nb daughter of ^{97}Zr is extracted. A high degree of recovery and separation, especially from hafnium and other elements usually associated with zirconium, is obtained. These features, coupled with high sensitivity, are advantageous.

The authors carried out their work as members of the Activation Analysis Group at General Atomic. H. R. Lukens has worked in the fields of radiochemistry, radioisotope applications, and activation analysis since 1948. He has published a number of papers and has coauthored several books in these fields. G. H. Andersen has worked and published in the fields of the bioligical applications of radioisotopes, health physics, chemistry, and activation analysis since 1954. T. C. Choy recently left General Atomic to resume graduate studies after several years experience in the fields of analytical biochemistry and cosmochemistry.