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AEC REPORTS MAJOR ADVANCE IN NUCLEAR EXPLOSIVE PRODUCTION OF HEAVY ELEMENTS

A major advance has been made in the nuclear explosive production of heavy elements, it was announced today by Dr. John S. Foster, Jr., Director of the Atomic Energy Commission's Lawrence Radiation Laboratory, Livermore, operated by the University of California.

Dr. Foster, reporting on the analysis of materials obtained after a completely contained underground nuclear explosion in Nevada on October 9, said the results demonstrate the practicability of using the method to produce significant quantities of isotopes of ultra-heavy synthetic elements.

The measurements show that in a very short time - about one hundred millionth of a second - the explosion pumped up to 17 consecutive neutrons into atoms of natural uranium.

This experiment is the latest in a series started in 1962, and is a part of the United States Atomic Energy Commission's Plowshare Program to apply nuclear explosives to peaceful purposes.

Dr. Foster said the experiment indicates that the custom-designed scientific nuclear explosive can be an important supplement to other American efforts to retain leadership in a major field of science which was created in, and has been dominated for two decades by, the United States.

Studies of the artificial heavy elements have significantly increased knowledge of the stable elements on earth, the fission process, and the origins and history of the earth, the stars and the universe. Some isotopes, such as plutonium-238, curium-242 and curium-244, show promise for powerful, lightweight electrical generators in satellites and spacecraft.

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In the October 9 experiment, code-named PAR, a specially designed nuclear explosive system containing a uranium, U-238, target was detonated at a depth of 1330 feet in the alluvium of the AEC's Nevada Test Site. The explosion had a yield of about 30 kilotons. The explosive was designed to enable the U-238 nuclei present in the target to absorb the maximum number of neutrons. Following capture of the neutrons, the uranium isotopes underwent beta-decay to form heavier elements in the periodic table.

This process was first observed in the initial hydrogen bomb test, MIKE, in the Pacific in 1952. In the debris of MIKE, scientists discovered element 99, einsteinium, and 100, fermium, created by multiple neutron capture by the uranium present. Partly as a result of MIKE, cosmologists now believe that this process occurs in stars and plays an important role in the synthesis of elements in nature.

Analysis of small samples of fused glass, obtained by drilling to the region involved in the explosion of PAR, shows that the explosion yielded a neutron flux approximately three times greater than that of the 1952 MIKE test. The PAR flux was twice as great as has been achieved in previous Plowshare underground experiments.

A major indication of success is the concentration - 1,000 times greater than previously achieved - of californium-254, element 98, in the PAR samples. Observations on the yields of CF-254 and other heavy species are in general agreement in the four laboratories studying PAR samples - Lawrence Radiation Laboratories at Livermore and Berkeley, California; Los Alamos Scientific Laboratory, Los Alamos, New Mexico; and Argonne National Laboratory, Lemont, Illinois.

So far, the scientists have observed elements as heavy as fermium-255, which requires successive captures of 17 neutrons. The scientists are looking in the samples even further up the periodic table for other isotopes, including fermium-257. The discovery of this significant isotope was reported only last month by Livermore scientists

R. W. Hoff, J. E. Evans, and R. W. Lougheed. .f-life that is surprisingly long for such a nt, 80 days. Its discovery supports recent .at relatively long-lived isotopes may exist .ium, element 100, and that nuclear explosives e to make them.

Foster said foreseeable technology in nuclear s development indicates the method can supple- ;lerators and reactors in the discovery, pro- study and practical use of the heavy elements. cular, nuclear explosives may be a means for dis- ; new elements and for producing a spectrum of otopes that are not obtained by other methods.

)r. Foster pointed out nuclear explosives fit into onal program for the production of ultra-heavy ele- in significant quantity. A major facility in this am is the special high neutron-flux reactor which is nder construction at Oak Ridge, Tennessee.

The High Flux Isotope Reactor, HFIR, when completed . produce significant quantities of isotopes of the ients at least up through atomic number 100.

Most of the heavy elements beyond uranium have been :overed initially with accelerators. Microquantities cransplutonium elements have been produced in the AEC's .erials testing reactor in Idaho. And isotopes pro- iced at Idaho, for example, californium-252, have been sed as targets in accelerators for the discovery of ele- ients beyond 100. So far, the discovery of 103 elements .as been verified, and heavier ones are being sought with accelerators at the Lawrence Radiation Laboratory, Berkeley, and in Russia.

Nuclear explosives now promise to extend this effort. For example, californium-252 may become available from the HFIR in sufficient quantities to serve as a target in underground nuclear explosions. The aim would be to make, discover, and study elements in the region of element 105 and higher, which have never been created.

In addition, the instantaneous addition of many neutrons to a nucleus produces a spectrum of isotopes different

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from those to be manufactured in the HFIR - further complementing the basic function of the reactor. New heavy elements have been made in the past by successive captures of neutrons in nuclear reactors. However, this method is very slow by comparison, and the elements formed break down by radioactive decay, alpha particle emission or spontaneous fission, during the process of formation. Rapid production in an explosion does not give these competing processes as much time to occur.

Nuclear explosives cannot, however, do the job of the HFIR, Dr. Foster added.

The PAR device was designed under the direction of Dr. D. W. Dorn, of the Lawrence Radiation Laboratory, Livermore. Studies of the samples taken from the PAR site have been conducted by teams of radiochemists under the direction of Dr. R. W. Hoff at Lawrence Radiation Laboratory, Livermore; Dr. G. A. Cowan at Los Alamos Scientific Laboratory; Dr. Paul Fields at the Argonne National Laboratory; and Dr. Frank Asaro at Lawrence Radiation Laboratory, Berkeley.

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(NOTE TO EDITORS AND CORRESPONDENTS: This information is being issued simultaneously by the Commission's Operations Offices in Las Vegas, Nevada, Berkeley, California, and the University of California.)

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