European
BACKGROUND INFORMATION
Community

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BACKGROUND NOTE

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EUROPEAN COMMUNITY STUDIES GEOLOGIC DEPOSIT OF RADIOACTIVE WASTES

Scientists from 15 countries meeting last month at the European Community's Joint Research Center at Ispra, Italy, to discuss the storage of high-level radioactive wastes in geologic formations have agreed to pool the results of their research and to organize periodic meetings for a further exchange of information.

The Ispra meeting was sponsored jointly by the European Community and the Organization for Economic Cooperation and Development, with the participation of the International Atomic Energy Agency of Vienna. It brought together 43 scientists from the Community nations, the United States, Japan, Sweden, Norway, Finland, Canada, Austria and Switzerland.

Storage of nuclear fission wastes in geological formations has been a primary focus of experimental and theoretical studies in the European Community's program since 1973. The theoretical and chemical work on chemical separation and nuclear transmutation of some heavy elements (e.g. plutonium, curium, americium) has been done at Ispra. These elements produced in nuclear reactors are called actinides and have a very long radioactive life.

The Community is reponsible, under the Euratom treaty, for the basic standards within its nine member nations "for the protection of the health of workers and the general public against the dangers arising from ionizing radiations." These standards were established by the EC Council of Ministers in 1959 and were recently revised.

The Community has budgeted 34.8 million U.A., about $42 million, for nuclear waste management research from 1977 to 1980. The total budget for the four Joint Research Centers is 374.4 U.A., or about $450 million. In addition to Ispra, these are at Karlsruhe, Germany, where research centers on the heavy element, transuranium; Petten, the Netherlands, where high-temperature materials are studied; and Geel, Belgium, where nuclear measurement standards for the Community are set.

The Community also coodinates research in private and national laboratories in the member countries. In the current budget 19.6 million U.A. -- about 40% of the total -- has been earmarked for this contract research.

Deep underground burial is widely considered to be the best solution to the problem of nuclear waste disposal. Stable geologic formations are believed to be safe from earthquakes or other natural catastrophes; the nuclear waste can be reduced in size by reprocessing and conditioned into very stable form (e.g.by vitrification Some studies indicate that long-term deep underground storage of nuclear wastes in carefully selected sites would actually pose less health hazard to man and his environment than that posed by the natural radioactive substances already in the environment.

Just as Europe is more dependent than the United States on the development of nuclear energy, because European energy resources are minimal, so it is more limited in the selection of sites for underground waste disposal.

Finding a solution to the waste management problem is critical, however, since by the year 2000 the waste from an installed electro-nuclear capacity of 500-770 GW(e) will correspond, by assuming modern conditioning techniques, to 1300-1800 m^3 of vitrified high-level waste, containing 11 to 15 tons of transuranium elements. The volume of alpha-contaminated low-level waste is expected to be 90,000 to 126,000 m^3, and the total quantity disposed of by that time will be about 10 times higher.

At least one court in Europe has tied the construction of new nuclear power plants to a solution of the radioactive waste storage problem. A court in the German state of Schleswig-Holstein has ruled that no new power stations can be built unless a plan is included for the safe storage of radioactive wastes.

Part of the Community research program has been to identify probable sites for waste disposal and to speed the research into waste-management procedures by coordinating the studies in member countries. A preliminary list of sites, being prepared under contract by the national geology institutes, is expected to be released later this summer.

Studies are already under way at several sites. At the Asse salt mine east of Wolfenbuettel in Lower Saxony, Germany, for example, an experimental depository for high-level wastes is being developed. Temperature distribution in lined or unlined holes is being studied; tests are being conducted on the mechanical properties of salt under temperature and after irradiation; calculation methods are being developed; the corrosion of hole lining materials is being examined; and the technological problems involved in drilling holes and excavating the caverns. Associated equipment to perform these tasks -- such as transport casks for high-level waste that has been transformed into borosilicate glass, and tools for handling and recovery of the wastes -- is also being developed.

At a salt deposit in the Netherlands, scientists are conducting detailed geologic and hydrologic studies of the area through seismic tests and drilling to a depth of 2,600 meters (nearly 8,000 feet). The facility is expected to be used for disposal of solid radioactive waste in a salt dome, with a cavity for low-level and middle-level waste, and a deep-bore hole depository for high-level wastes. A geophysical study is also being conducted of the salt structure.

Clay formations are being studied in Belgium and in Italy. At the Mol site in northern Belgium, a cavity is being excavated 200 meters (about 600 feet) below ground for disposal of medium-level wastes and for experiments on high-level waste storage. Analyses are being made of the chemical composition of minerals in the clay, the ion-exchange properties of clay, and its mechanical and other physical properties.

In Southern Italy, geological studies are being made of the Trisaia clay formation by drilling and coring and through minerological and geochemical studies of the core.

Hard rock formations are being examined in France, where studies of the migration of radioactive particles are being conducted as well as studies of natural and artificial geochemical barriers.

British scientists are conducting geochemical, hydrological and geophysical studies on various geologic formations they have identified as suitable for waste disposal. Heat transfer experiments are being carried out in the field with electrical heating to simulate the heat generated by decaying radioactive waste. British engineers are also studying the type and size of cavity, the waste containers and the lining of cavity walls in waste storage depositories.

The Community's work at Ispra, where about 100 scientists are involved in waste management research, has been primarily to evaluate the potential hazard of nuclear wastes to man and his environment and to study the chemical separation and nuclear transmutation of actinides.

According to the Ispra tests, which are similar to research on deep geologic formations being conducted in the United States, the likelihood is extremely slim of radioactive particles escaping from an underground storage area until long after the danger of radioactivity is past.

The Ispra scientists reached this conclusion after calculating the rate of geological movement in the stable formations, the rate of decay of waste containers, and the rate of decay in radioactivity of the material to be stored. The Ispra staff is continuing studies on the long-term stability of high-level waste when fired into a borosilicate glass (similar to Pyrex). Comparison of the Ispra results with those obtained by independent tests on glass samples from other European laboratories is expected to allow within the next few years a good knowledge of the long-term radiation resistance of vitrified nuclear wastes.

The Ispra Joint Research Center is also conducting further tests on how the emission of actinides into the biosphere is delayed by clay formations and sandy soils. These abiotic substances have already been shown to delay actinide migration, but much of the data was obtained by laboratory experiments carried out in conditions that could be different from those typical of deep geologic formations.

Since the ecological distribution pattern of actinides will ultimitely control the hazard of radioactive waste to man, the Ispra Research Center is conducting theoretical and experimental studies on how and when the actinides would reach man's environment, and what the likelihood of lethal dose rates would be.

In its research into the chemical separation and nuclear transmutation of actinides, the center has analyzed methods for separating actinides from high-level waste. In recent experiments on waste solutions, more than 99 per cent of the plutonium, americium and curium were separated in one precipitation step. The target goal is a decontamination factor of one in a thousand.

The transmutation of actinides through burning in nuclear reactors, under which their radioactive life can be drastically reduced, thus lessening considerably the problems of storage, has been studied and computer codes to evaluate the buildup of the actinides in different reactors have been set up. Preliminary results show that when actinides are recycled indefinitely in fast-breeder reactors, the total inventory of actinides is no more than 2 per cent.

Through Community-funded contract work, research has been done on reducing the volume of medium-level solid waste stores by immobilizing them in plastic resins. A pilot facility is expected to be constructed in 1979, probably at the French-Belgian Nuclear Energy Corporation of the Ardennes (SENA), with a technique based on French patents. A German technique (STEAG) will be further developed at the same time, including the choice of the best resins and processes, and construction and operation of a mobile pilot plant is expected before the end of the decade.

Decontamination and conditioning of irradiated fuel element hulls is also being studied under a two-year EC-funded contract at several nuclear research laboratories: the French Atomic Energy Commission (CEA) is examining the melting process; the Belgian Center of Nuclear Studies (CEN) is examining volume reduction under pressure and incorporating the fuel hulls into a low-temperature melting alloy; the German Society for Atomic Research (GfK) is studying the mechanical volume reduction and storage in concrete; and the United Kingdom Atomic Energy Authority is conducting tests on hull contamination.

Satisfactory specific processes exist for the treatment and conditioning of certain types of nuclear waste, but further research is needed for some types into the reduction of volume, conditioning of the waste for disposal and recovery of plutonium, when justified. To answer these needs, EC-funded contracts have been awarded for research in incineration and plutonium recovery until the end of 1979: Nukem, in Germany, is examining an acid digestion process and will build and operate a pilot plant neat the Mol site in Belgium; the Italian Committee on Nuclear Energy (CNEN) is to build and operate a laboratory-scale pilot facility on the molten salt incineration process; British Nuclear Fuel Ltd. will operate an existing incineration and plutonium extraction pilot plant for high-temperature incineration; the Belgian Center of Nuclear Studies (CEN) will operate an existing pilot facility to incinerate low-level and contaminated waste through high-temperature incineration, with the aim of producing a highly insoluble product suitable for disposal. The Belgian center will also build and operate a small plant for incineration of high-level and contaminated waste with the aim of producing highly soluble ashes for plutonium recovery.

Although joint work at the research centers and through the EC-funded contract work has made possible considerable progress, the attitude toward disposal options differs within the member countries -- Britain, for example, is storing concentrated aqueous wastes in tanks while developing a vitrification process; Germany has already stored medium-level waste in concrete containers in the Asse salt mine. Germany expects to begin storing high-level waste in a "fuel cycle park" in the late 1980's and is considering filling excavated chambers with low and medium-level waste in a slurry form that then solidifies to become an integral part of the geologic formation.