70-107

SYLVANIA-CORNING NUCLEAR CORPORATION

Bayside, Long Island, New York

May 1, 1957

MAY 3 1957

U. S. Atomic Energy Commission
1901 Constitution Avenue, N.W.
Washington 25, D. C.

Attention: Mr. Harold E. Price, Director
Division of Civilian Application

Gentlemen:

We desire to obtain a special nuclear material license for the purpose of fabricating nuclear reactor fuel elements or parts thereof at our Bayside, New York Engineering Laboratory. This would be in addition to the license which we already possess for fuel element fabrication at our Hicksville Plant.

We believe that the procedures outlined in the enclosure are adequate to protect health and property, both of our employees and of the general public, and to meet the other requirements of Part 70 of Title 10 of the Code of Federal Regulations.

If you have any questions regarding this application, we will, of course, be glad to provide additional information.

Very truly yours

SYLVANIA-CORNING NUCLEAR CORPORATION

Garth W. Edwards

Garth W. Edwards
Controller

GWE:ral

State of New York)
County of Queens) ss

Sworn to before me this 1st day of May, 1957, at Bayside, N. Y.

JENNIE K. BROUTHERS
Notary Public, State of New York
No. 52-5468900, Suffolk County
Certificate filed in Queens County
Term Expires March 30, 1958

Jennie K. Brouthers

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APPLICATION FOR SPECIAL NUCLEAR MATERIAL LICENSE

FOR BAYSIDE FACILITY

The General Engineering Laboratory of the Sylvania-Corning Nuclear Corporation wishes to apply for a license to receive, possess, process and transfer special nuclear material at its Bayside, New York, location for the purpose of fabricating, as part of its civilian application program, nuclear reactor fuel elements or parts thereof for other licensees, for holders of bilateral agreements, and in support of the Company's production facilities, located at Hicksville, New York, which have already been granted a special nuclear material license.

Specifically, a license is desired which would permit the Engineering Laboratory to have an unlimited amount of special nuclear material with various degrees of enrichment in uranium 235, ranging from full enrichment to normal. This material may be in the form of metal, oxide or other chemical compound, solution, liquid dispersion or slurry. Although a license for an unlimited amount of special nuclear material is being requested, material in process and in stores at any one time will be maintained at a minimum because of the monetary value of the material and the potential criticality hazard involved. No reliable schedule of the estimated dates of shipments for this material nor of the form in which the material will be required is possible at this time, since in the manufacture of fuel elements, the material required is very often furnished by the customer.

In the fabrication of fuel elements, the special nuclear material will be converted into rods, plates, tubes, cylinders, spheres or other geometric shapes. These may have the same chemical composition as the as-received material, or they may be composed of alloys or dispersions of the enriched uranium with aluminum, zirconium, stainless steel or other desirable metals or compounds. The special nuclear material may also be comminuted from massive form to powder, consolidated from powder to a shaped solid, converted from metal to oxide or otherwise transformed chemically or physically. The equipment to be used in these operations will consist of standard items used in the metal fabrication and chemical industries for these general processes.

BACKGROUND OF THE GENERAL ENGINEERING LABORATORY

The Engineering Laboratory of the Sylvania-Corning Nuclear Corporation is well experienced in the handling and processing of metals and chemical compounds, especially those used in the nuclear energy field. Prior to April 1, 1957, the Engineering Laboratory had been part of the Atomic Energy Division of Sylvania Electric Products Inc., and had been actively engaged for over ten years in research and development in the area of reactor fuel elements and components. During this period, research and development work in these areas had been undertaken both for the Atomic Energy Commission and for many of its prime contractors. This work resulted in the development of new and improved processes for the conversion of uranium oxide to metal, for the comminution of massive uranium to powder, for the preparation of uranium alloys, either by melting and casting or by the powder metallurgy approach, and for the fabrication and assembly of complete fuel element components. As a result of this wide experience, considerable background and technical know-how have been acquired in the chemical and metallurgical

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processing technology of uranium. Both natural uranium and enriched, ranging from 2.8% to full enrichment, have been processed at Bayside in connection with the above work, and quantities of material equivalent to seven kilograms of fully enriched material have been repeatedly handled by the Laboratory without incident. This prior experience has enabled the organization to formulate basic health, safety, criticality, accountability and security practices pertaining to the processing of fissionable material which will be applied in the handling of enriched uranium under the Sylvania-Corning Nuclear Corporation's civilian application program.

TECHNICAL QUALIFICATIONS AND ORGANIZATION OF THE GENERAL ENGINEERING LABORATORY STAFF

The technical staff of the General Engineering Laboratory is made up of approximately 60 scientists and engineers whose backgrounds and professional training cover the fields of physics, mechanical and chemical engineering, metallurgy, and reactor technology. In addition, the laboratory has on its staff an equal number of highly skilled technicians many of whom have had several years of experience with this organization and are well versed in the art of handling nuclear materials including both normal and enriched uranium.

The General Engineering Laboratory is under the overall direction of Dr. B. Kopelman, Chief Engineer, who reports directly to Mr. W. E. Kingston, Executive Vice-President of the Sylvania-Corning Nuclear Corporation. The laboratory is made up of three engineering development groups and a technical services group, each headed by an engineering manager reporting to Dr. Kopelman. Also reporting directly to the Chief Engineer is the Laboratory Safety Engineer, Mr. R. Early.

A brief technical resume of Dr. Kopelman, the engineering managers and other key personnel who will be associated with the work to be performed under the proposed license are described below:

Bernard Kopelman, Chief Engineer

Ph.D., Physical Chemistry, Clark University, 1941.

For the past ten years Dr. Kopelman has been associated with the reactor program at Sylvania Electric Products Inc., and has participated in fuel element development and in investigations for the preparation of fissionable material which have resulted in improved and lowered cost processes for structural and moderating elements in reactors. In addition, Dr. Kopelman has initiated and directed the research and development programs of Sylvania's Atomic Energy Division as its Chief Engineer and has been responsible for the development of major new processes for the preparation and purification of refractory and difficultly reducible metals, and for the separation of various chemical elements in irradiated materials.

He is an Associate Member of the American Institute of Physics, the American Chemical Society, the American Society for Metals, and the Electrochemical Society. Some of his recent technical publications include: Fundamental Considerations in Reduction Processes of Thorium and Uranium; Nuclear Fuels-Liquid vs. Solid; Review of Solid Hydrides; and two articles on tungsten and its compounds for the Encyclopedia of Chemical Technology.

J. L. Zambrow, Engineering Manager, Process Metallurgy and Chemistry

Ph.D., Metallurgy, Ohio State University, 1948.

Since joining Sylvania in 1949, Dr. Zambrow has supervised and directed development work in the fabrication of fuel elements, including bimetallic fuel elements, in the powder metallurgy and cladding of uranium and thorium, in the reduction of uranium oxide and thorium oxide to metal, and in the separation of constituents of irradiated fuel elements. Prior to his employment by Sylvania Electric Products Inc., he was associated with the Cutler-Hammer Manufacturing Company, the Battelle Memorial Institute and Ohio State University, where he developed a considerable background in welding technology, particularly the pressure welding of alloy steel and heavy aluminum plate, as well as in the properties of aircraft alloys at extremely low temperatures.

Dr. Zambrow is a member of several technical societies including American Society for Metals, Research Society of America and the American Nuclear Society. He has published in The Welding Journal, Metal Progress, Transactions of American Society for Metals, Metallurgy and Ceramics.

H. P. Kling, Manager, Physical Metallurgy and Ceramics

Sc.D. in Physical Metallurgy, Massachusetts Institute of Technology, 1949.

Since joining Sylvania Electric Products Inc. in 1949, Dr. Kling has been associated with the fuel element development program. His background with the Company includes fundamental work in the mechanism of creep in metals, experience in the development of fuel element fabrication techniques for oxide dispersion, ceramic and wire fuels, the development of suitable techniques for fabricating rhenium, and the development of brazing alloys for metal-ceramic bonding. He has also done considerable work on high-temperature oxidation studies and is currently directing a program on niobium and niobium-based alloys. He is a member of the American Society for Metals.

H. S. Kalish, Engineering Manager, Metal Fabrication and Assembly

M.S., Metallurgical Engineering, University of Pennsylvania, 1948.

Professional Degree of Metallurgical Engineering, Missouri School of Mines and Metallurgy, 1953.

Prior to joining Sylvania Electric Products Inc. seven years ago, Mr. Kalish was a Metallurgist at the Gary Works of the Carnegie-Illinois Steel Corporation, a Research Engineer at the Battelle Memorial Institute, and Research Metallurgist at the Electric Storage Battery Company. At Sylvania, he has been engaged almost exclusively in work on fuel element materials which have included uranium and uranium alloys, zirconium, beryllium and thorium and has directed extensive programs on dispersion-type fuel elements of various compositions. He is a member of American Institute of Mining, Metallurgical and Petroleum Engineers, the American Welding Society, Scientific Research Society of America, and is now Chairman of the Long Island Chapter of American Society for Metals. He is also on the Advisory Committee of the Mechanical Technology Department of the Long Island Agricultural and Technical Institute. In addition, Mr. Kalish has written numerous technical publications and is an applicant for several patents.

R. S. Stewart, Engineering Manager, Technical Services

B.S., Metallurgical Engineering Missouri School of Mines and Metallurgy, 1940.

In 1953, Mr. Stewart joined the Atomic Energy Division of Sylvania Electric Products Inc. as Manager of Development Engineering in charge of plate-type fuel element research and production. His present position is Engineering Manager of Technical Services. He was an Instructor of Metallography and Physical Metallurgy at the Illinois Institute of Technology, and has also taught Engineering Materials and Metallurgy at the University of Buffalo. In 1951, as Superintendent of the Metals Fabrication Plant of the National Lead Company of Ohio, he built an organization for producing finished shapes of uranium, thorium, and related metals, and directed experimental and production operations for the AEC at several installations in the country. He is a member of American Society for Metals, and has published in the Journal of the American Nuclear Society and Atomic Industrial Forum.

E. E. Early, Safety Engineer, Metallurgy

He has been in charge of the safety program at Metallurgy since 1953, and has been engaged in health and safety work in the Atomic Energy Division of Sylvania Electric Products Inc. since January, 1956. He has been chiefly concerned with the monitoring, analysis and control of airborne radioactive materials, ventilation design, and inspection and maintenance of safe radiation levels.

His health and safety training and experience has been supplemented by course work at the Safety Center at New York University. He has studied at City College of New York, and is presently following the engineering curriculum at Queens College, Flushing, New York.

Henry E. Grish Area Safety Engineer

He has had the responsibility for the Health and Safety Program of the Atomic Energy Division of Sylvania Electric Products Inc. since 1949. In that capacity he has been Sylvania's representative in dealing with the health and safety personnel of the Atomic Energy Commission's New York Operations Office, thereby being responsible for enforcing compliance with AEC health and safety regulations, concerning control of radiation airborne contamination and criticality levels. Mr. Grish has directed health and safety programs for projects involving both normal and enriched uranium metal, alloys or compounds in solid and powder forms.

He has participated in design and layout of equipment and procedures used on projects involving research, development and production of nuclear fuels and is experienced in supervising air sampling and radiation monitoring programs. He has also been responsible for the organization and supervision of non-nuclear health programs for six other Company plants and laboratories in the Long Island area. Mr. Grieb is a member of the American Society of Safety Engineers.

William N. Young, Radiation Safety Physician

Dr. Young has been with Sylvania Electric Products Inc. since November, 1953 as assistant to the Company Medical Director. In his capacity of Area Medical Doctor, he has full medical responsibility for the approximately 800 employees of the Sylvania Electric Products' Research Laboratories and the Atomic Energy Division, the latter to be known shortly as the Sylvania-Corning Nuclear Corporation.

Dr. Young took his pre-medical training at Cornell University, served as a Captain in the United States Air Force from 1941 to 1945 and continued his medical studies at Johns Hopkins Medical School, from which he received his M.D. degree in 1949. Piror to coming to Sylvania, he had a private practice in Delaware. Because of his association with the Atomic Energy Division, Dr. Young has familiarized himself with the health and medical aspects of work connected with radioactive materials.

Apart from his position with Sylvania, Dr. Young has a limited private practice in Huntington, Long Island, and is on the staff of Huntington Hospital. He is a member of the American Medical Association, the Queens and Suffolk County Medical Societies and the Industrial Medical Association of the New York Medical Association. In addition, he teaches First Aid to the police and firemen of Huntington.

Criticality Engineer

At the present time, this Company is actively engaged in seeking the services of a physicist or reactor engineer who is qualified to assume the responsibilities for criticality calculations involving the processing and shipment of special nuclear material license. Pending the addition of such a man to the Company's staff, criticality limits will be determined by the Safety Engineer based upon past experience with enriched material and after consultation with recognized criticality experts of the AEC New York Operations Office. Some of these material quantity limits have been indicated in the following sections of this license application.

CONTROL OF SPECIAL NUCLEAR MATERIAL

Received cases or containers of fissionable material will be inspected and surveyed with appropriate radiation detection instruments by the Laboratory Safety Engineer prior to being accepted and stored. Upon acceptance of the material by the Laboratory, responsibility for its storage, movement during processing and accountability will be assumed by the accountability engineer. As soon after receipt as convenient, all fissionable material will be unpacked and stored in a rigidly fixed position under the joint supervision of the safety engineer and the accountability engineer. Before being store, however, all incoming fissionable material will be weighed and transferred to plastic bottles, each containing no more than two kilograms of fully enriched uranium or its equivalent in U^{235} content. These bottles will be stored on shelves at a distance of at least 21 inches from center to center. This spacing will be maintained by fastening the bottles down to pre-determined positions on the shelves by means of metal yokes bolted down to the shelves by wing-nuts. Sampling of all incoming material for isotopic content and chemical analysis will be made at this time by the accountability engineer, and except for incoming quantities of less than two kilograms, no material will be processed until results of these analyses have been received.

All licensed fissionable material will be stored in a locked repository, having a fire resistant, electrically wired door alarm. This repository will be used exclusively for licensed, enriched uranium and will have in storage all in-process material and finished product as well as incoming material. The storage room (room 138 on the attached plan) is internally located on the first floor and is accessible by a single entrance only. It has a concrete floor and ceramic tile-block walls. No service piping is located within this repository, and all automatic overhead sprinkler heads will be removed whenever enriched material is in storage. In their stead, a combined burglar and fire detection unit will be installed. A standard radiation symbol colored magenta on a yellow background will be prominently displayed on the storage room door.

Criticality control of in-process material and finished product will be maintained both in the processing area and in storage through the use of tote trays, racks or all-safe shipping containers. The quantity of material in these tote trays and racks will be controlled by means of prominently displayed weight, piece count or batch limits, which have previously been determined by a qualified criticality engineer after a careful study of each particular processing step. These limits will be re-evaluated for each new process and before process changes or modifications are put into effect. All in-process material will be transported from one operation to another by means of these containers. At each processing station, the allowed maximum number of racks or trays consistent with criticality safety will be conspicuously posted, and at no time will this number be exceeded. All movement of enriched material must be authorized by the accountability engineer who will first determine that maximum limits will be adhered to at all points. In-process material will be stored in the locked repository at the end of each work day and will be contained in the same tote trays or racks used to transport the material during processing. These racks and trays will be placed on the shelves in rigidly fixed positions and will be spaced so as to conform to an all-safe geometric configuration as determined by the criticality engineer.

Accountability records for in-process material will be maintained by the accountability engineer who will have sole responsibility for removing enriched material from the storage area and for accounting for its return at the end of each work day. Numbers will be assigned to each batch of material handled at the initial processing operation, and the identity of the material in-process will be maintained throughout fabrication. These numbers will be carried through to the finished product. In addition, individual items in each batch such as compacts, plates, punchings, etc. will also be numbered individually, where possible with a vibrating tool, and these numbers tied in with accountability records. Completed fuel assemblies will also be numbered and records maintained to show the identity of specific components incorporated into each assembly.

A weighing station or area will be set up in close vicinity to the processing area. This area will be equipped with a Seederer-Kohlbusch balance having a capacity of six kilograms, or its equivalent, a precision torsion balance with a capacity of two kilograms and a chemical analytical-type balance. Scrap will be removed from tote trays and amassed in scrap containers only at the weighing station and only by the accountability engineer or his representative. Scrap containers will be limited to a maximum of 1500 grams of fully enriched uranium or its equivalent in lower enriched uranium. This material will be stored until it is recycled, reclaimed or otherwise disposed.

The operation and material movement described above will be checked by the Laboratory Safety Engineer.

FABRICATION PROCESS

In the fabrication of fuel elements, the manufacturing process required will vary considerably from one type of element to another and will be dependent largely upon the composition and the geometry of each type of fuel. In general, however, the processes used will follow either the standard metallurgy approach used with reguline material or powder metallurgy techniques used with dispersion or ceramic type compositions.

As an example of the former method, procedures to be followed in the fabrication of MTR type elements will be described in detail. However, with modifications, this general method can be adapted for the fabrication of elements alloyed with zirconium or other metals as well as for those having shapes other than that of a flat plate; viz., solid slug, rod, etc. An example of the latter processing technique can be obtained from a description for the fabrication of elements having a core composed of a metal-ceramic dispersion.

MTR-Type Elements

The initial operation for this type of element involves the preparation of a uranium-aluminum alloy of the proper composition by a melting and casting operation. In the case of other type elements, zirconium, molybdenum, niobium or other suitable metals may be used as the alloying metal. The amount of uranium to be incorporated into a single melt will be limited to 2000 grams of fully enriched uranium or its equivalent for lesser enrichments. This limit will be applied to all subsequent operations unless otherwise stated. In the event that the alloying element is beryllium or other metal having strong moderating properties, however, the allowable maximums will be sharply reduced as required for criticality safety. These new limits will be determined by the criticality engineer.

The amount of uranium to be melted will be removed from the locked storage area by the accountability engineer or his representative, weighed and placed in a closed container in a tote tray for transfer to the melting area. Also in the tote tray will be a weighed amount of the alloying material. A numbered ticket describing the movement of this material through the fabrication process will be attached to the tote tray and will remain with it until changed by the accountability engineer, who will also retain a copy of it. The uranium and the alloying metal are then melted, and the melt is poured into at least two molds. After being cast, the alloy is removed from the molds and placed in the tote tray. The crucible skimmings, thermocouple scrap and mold fins are placed in a small can which in turn is placed in the tote tray. This tray remains at the melting station until it is picked up by the accountability engineer or his representative. The accountability engineer will not deliver another batch of enriched material to the melting station until the previous melt has been removed. At no time will more than two kilograms of enriched material be accumulated at the melting area. A material balance will be obtained for each melt before the uranium alloy ingot is processed further. Each ingot is also marked, retagged and then transported to the next processing station, the heat treating furnace, after approval for its movement is obtained from the accountability engineer. After being heated, the ingot is rolled to a plate between ½ to ¼ inch thick. The plate is then sheared at both ends and along its longitudinal axis, and samples for chemical analysis are removed and marked for identification. A material balance is again obtained for the plates, scrap and samples, and the tote tray with a new tag is returned to storage to await the results of analysis.

After the analytical results have been received, the two end pieces are marked and placed in the scrap tote tray together with the end pieces from previously rolled ingots to a limit of 1500 grams and stored until needed as remelt material. The remaining two plates are again retagged, marked and transported to the next processing station.

Each plate is then sent to a punch press where the inserts used for cladding by the picture frame technique are punched out. The punched pieces, and perforated plate are returned to the weighing station and another material balance taken. The perforated plate together with any reject inserts are then removed to a scrap tray, limited to a maximum of 1500 grams of enriched uranium or its equivalent, and returned to storage until recycled. The punchings, sufficient in number for one complete assembly, are then clad by means of the picture frame technique as one batch. For MTR-type assemblies, this batch size is approximately 350 grams of enriched uranium. However, other fuel element designs may require a larger amount of enriched material per batch for each assembly.

It may be necessary, because of rejects, to assemble plates from more than one batch into the same element. However, at no time will more than 1500 grams be accumulated at the assembly point.

Completed fuel elements will be packed as finished in shipping containers of such a type that an all safe configuration is formed. For MTR type fuel elements, a container similar to that used by the Oak Ridge National Laboratory for this type of element will be employed.

Dispersion-Type Elements

A powder metallurgical process is generally used for the manufacture of dispersion-type fuel elements. These are usually composed of a uranium compound, such as the oxide, carbide, nitride or an intermetallic, dispersed in a metallic matrix to form a type of cermet as the fuel element core. The core is then clad with a material generally identical to that of the core matrix. This material may be aluminum, zirconium, stainless steel, nichrome, molybdenum, niobium or other suitable metal or alloy.

As an example of this type of process, the procedures to be used for the manufacture of uranium dioxide-aluminum cored, aluminum clad MTR-type flat plates will be described. With modifications, this procedure can be adapted to other compositions and modified to include other fuel element shapes such as tubes, rods, stacked wafer elements, etc. Many of these general types of operations will also be encountered in the manufacture of wholly ceramic elements.

The initial operation in this type of process involves the weighing and blending of two materials, in this case the ceramic and metallic component. A batch of uranium dioxide powder limited to 2,000 grams of fully enriched U-235 will be removed from the locked storage room by the Accountability Engineer or his Representative, placed on the tote-tray and transferred to the weighing room. As with the procedure for the fabrication of alloy MTR-type elements previously described, a numbered tag describing the movement of this material through the weighing process will be attached to the tote-tray and will remain with it until changed by the Accountability Engineer who also retains a copy of it. In the weighing room, the uranium dioxide in the required amount is weighed and transferred under a well ventilated hood to numbered jars containing the weighed aluminum charge. Each jar will contain enough material for one compact only. The jars will then be tightly closed with the lids taped on with electric tape, placed within plastic bags and then into tumbling cans containing a packing material to prevent breakage. The bottles containing the weighed UO_2-aluminum powder charges will then be transferred to the blending station. The movement of the weighed material from the weighing area to the blending area will take place by means of tote-trays after authorization for this movement has been obtained from the Accountability Engineer in the form of a new processing tag. The Accountability Engineer will not deliver another batch of enriched material to the weighing room until the preceeding batch has been removed. Neither will more than one batch, limited to 2,000 grams of U-235, be permitted in the tumbling area at one time. After being tumbled, the jars will then be placed on the tote-tray which is retagged by the Accountability Engineer and transferred to the compacting area. Issuance of a new tag by the Accountability Engineer will constitute authority for the movement of the tote-tray to the next processing area.

Compaction of the blended mixtures will be done in a well ventilated hood. Each mixture will be loaded, one at a time, into a cold pressing die and compacted to the desired density. After each pressing, all loose powder will be collected and placed into a tared scrap bottle. If a slight fin should be formed in the pressing operation, it will be removed at this time and scrap material resulting therefrom will also be placed in the scrap bottle. The compacts, numbered to correspond to the blend from which each was prepared, will be wrapped in aluminum foil and placed on the tote tray for transfer to the weighing area after being retagged by the Accountability Engineer.

At the weighing station, each compact will be weighed and inspected, the weight of each being recorded together with its identifying number. Reject compacts will be placed in the scrap bottle corresponding to this batch, and the amount of scrap material determined so that a material balance can be obtained.

The pressed compacts, after being weighed, are again placed on the tote-tray, retagged and after proper authorization is obtained, are transported to the cladding station. There, the compacts are loaded into aluminum picture frames and covered with aluminum cover plates which are tack welded to the picture frame body. These are then heated, hot rolled and annealed. From this point on, the processing is similar to that described for the uranium-aluminum alloy MTR elements.

Processing of Chemical Waste Solutions

Chemical waste solutions in the laboratory will be collected in covered containers until five liters have been accumulated. The entire volume will then be evaporated to dryness with a fully enhanced uranium content limit of 250 grams or its equivalent in uranium of lesser enrichment. This uranium concentration in solution will be determined by means of accountability and material balance records and will be verified by chemical analysis prior to evaporation of the solutions. The dry material will be stored in plastic jars in the storage room until disposed of or reclaimed. The amount of material stored per jar will be limited to 500 grams of fully enriched uranium or its equivalent.

HEALTH AND SAFETY

Prior to the start of each enriched uranium project, all dies, hood, floors, work bench surfaces, dry box interiors and all equipment which may ultimately come in contact with the material are surveyed to establish base lines. Immediately following the completion of the program and the cleanup, the surfaces are resurveyed to insure that decontamination has been completely effective. During the progress of each enriched project, floors in the work area will be monitored periodically to serve as an additional control on the uranium handling procedures which have been established.

Air sampling data on most metallurgical and chemical processes and operations have been collected over a period of nine years and are available so that an intelligent appraisal of possible air-dust exposures on new jobs can be made. If such data on a particular phase are not available, a dry run with normal uranium is made where warranted and the resulting data are extrapolated based upon the enrichment contemplated for use. Air sampling is done with metered air pumps and Whatman 1-1/8" filter papers. These samples are counted on scintillation counters available in the laboratory.

Each job will be engineered separately on the basis of the above information, and where necessary, controlled atmosphere, ventilation, special handling procedures, etc. will be employed to eliminate exposures to radiation.

In the event of spills or other accidents, or where required to verify the effectiveness of the health-safety program, urine samples will be taken and analyzed for uranium content. Otherwise, urine sampling will not be done routinely.

All employees are currently required to undergo complete pre-employment physicals and are re-examined every 18 months. Blood counts are taken at six month intervals. Film packets are supplied to employees where beta-gamma radiation exposure of 25% of the m.p.d. or greater is possible. All personnel assigned to enriched uranium handling areas are required to wear rubber surgical gloves of a suitable type, protective laboratory coats and/or coveralls, so as to reduce personal contact and to maintain material control. Smoking and eating is prohibited in areas where enriched uranium is handled.

Two types of respiratory equipment are available for use in emergencies: Bureau of Mines approved mines safety appliances dust respirator and self-contained "Scott Air Paks."

Listed below are the precautions and procedures employed in some of the various metallurgical operations which may be encountered:

Powder Manufacturing

The hydride process for powder preparation begins with the weighing and cleaning of the massive metal, done in a specially designed, doubly filtered hood with a face velocity in excess of 100 linear feet of air per minute. The material is next loaded, in the hood, into hydriding retorts, which are then sealed, evacuated, purged, and filled with hydrogen. The vacuum system is protected from contamination by special fritted glass filters. After the hydriding and decomposition, the sealed retort is introduced into an argon atmosphere metal dry box where the final grinding and sieve sizing operations are carried out. If the powder must be transferred to another location, it is placed in polyethylene envelopes inside portable steel pressurd vessels for protection against air contamination and consequent ignition. All dry box entrance and exit chambers in the lab are ventilated through a doubly filtered system.

Clad Uranium Fabrication

There are essentially two methods employed in this type of fabrication:

a. The cladding and hot rolling of uranium-containing cores. No particular health problem is encountered in this type of work; however, ventilation is available at the large rolling mill and will be used when necessary. Operators are thoroughly familiar with the operation of the unit, and the technology of eutectic formation is well understood. Nonetheless, the operators wear face shields, gloves, asbestos aprons and gloves. The mill is segregated from the remainder of the area by a large asbestos curtain.

b. The hot rolling or hot pressing of metal envelopes containing uranium or uranium-bearing metal powders.

   This operation involves the loading of metal powder into a metallic sheath under a protective atmosphere. The sheath is sealed by the arc welding of an end plug into place. The assembly is then hot pressed sequentially and/or hot rolled in a mill to the desired density. The same precautions listed above will be observed and G-1 powder extinguishers will also be strategically placed.

Uranium-Alloy Fabrication

This operation involves the preparation of the alloy material in a hi-frequency induction heated crucible by the melting and casting of the proper uranium and alloy mixtures. The crucible is ventilated and situated over a recessed concrete pit. Operators wear the appropriate safety equipment such as face shields, asbestos aprons and gloves, etc. The material is cast directly into copper molds.

Ceramic Fabrication

In this work, the hazard of pyrophoricity is not present and the main concern is that of air contamination. This aspect is closely controlled through the use of glove boxes, ventilated hoods, presses, and furnaces and air-tight blenders and sieve machines.

Machining

The laboratory has two machine shops equipped with the necessary facilities for the machining of uranium. A rough summary of ventilated equipment follows:

3 lathes (1 enclosed)
2 surface grinders (both enclosed)
2 cutoff wheels (both enclosed)
1 milling machine
1 drill press
1 centerless grinder

Where liquid coolants are used, the coolant is filtered and recirculated. Periodically, or at the completion of a run, the scrap is recovered for reclamation.

General

The metallurgical laboratory is housed in a two-story and penthouse building consisting of prefabricated concrete slabs on steel beams. Floor covering is non-flammable tile throughout. Interior walls are steel and fibre glass laminated partitions or tile brick. The lab is protected by an internal closed-circuit fire alarm. There is a twenty-four hour security guard force serving also as fire watchmen, reporting through the American District Telegraph system.

Distributed throughout the building are 30 CO_2 extinguishers, 5 twenty-pound dry chemical extinguishers, a large quantity of G-1 powder and several water type extinguishers where Class "A" combustibles are present. Water for fire purposes is supplied directly by one six-inch and one eight-inch city main. The building is completely sprinklered with a "Globe Automatic" wet system.

All flammable liquids are stored in a special combustible liquid storage room, sprinklered, ventilated and equipped with separate drain and pump. Flammable liquids in the building are limited to quantities of one gallon or less. Larger amounts are kept in containers approved by the Factory Mutual Insurance Company. Alkaline metals are stored outside the building in a waterproof shed.

Hydrogen leak detectors manufactured by Mines Safety Appliances and David Emergency Equipment Company, continuously monitor all areas where hydrogen gas is used. Cylinders of compressed gases (flammable and non-flammable) are restricted in number within the building and require special location, support, etc. before their use is authorized.

A disaster unit has been organized to take control in the event of an emergency. This unit is made up of the following groups.

1. A six-member first aid squad under the direction of an ex-navy medical corpsman.
2. An eight-member fire control group, thoroughly familiar with our exposures and methods of controlling them.
3. A personnel mustering group responsible for evacuation control and personnel accounting following evacuation.

The operation of the building is fully approved by the United States Atomic Energy Commission Health and Accident Branch (NYCO) for all contract work under their jurisdiction and by the State Labor Department. It complies fully with local, state and federal laws and regulations governing receipt, storage and handling of radioisotopes.