BNWL-1917
UC-70

2F

Decontamination and Decommissioning of Nuclear Facilities —

A Literature Search

May 1975

Prepared for the U.S. Energy
Research and Development Administration
under Contract AT(45-1):1830

Battelle
Pacific Northwest Laboratories

BNWL-1917

NOTICE

PACIFIC NORTHWEST LABORATORY
operated by
BATTELLE
for the
U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
Under Contract AT(45-1)-1830

Printed in the United States of America
Available from
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, Virginia 22151
Price: Printed Copy $5.45; Microfiche $2.25

ERDA-RL RICHLAND, WA

BNWL-1917
UC-70

DECONTAMINATION AND DECOMMISSIONING OF NUCLEAR FACILITIES - A LITERATURE SEARCH

Compiled by

W. E. Sande, H. D. Freeman, M. S. Hanson, and R. L. McKeever
Chemical Technology Department

May 1975

Battelle
Pacific Northwest Laboratories
Richland, Washington 99352

ABSTRACT

This bibliography includes 429 unclassified references to the decontamination and decommissioning of nuclear facilities. The references are arranged in chronological order and cover the period from 1944 through 1974. Subject and author indexes are provided.

ACKNOWLEDGMENTS

Others whose aid was vital in the preparation of this bibliography are: J. K. Ballard, H. T. Fullam, M. V. Heid, D. J. Kennedy, S. Mandell, and J. L. Simmons.

CONTENTS

CONTENTS (contd)

DECONTAMINATION AND DECOMMISSIONING OF NUCLEAR FACILITIES - A LITERATURE SEARCH

INTRODUCTION

With the continuing growth of the nuclear industry, an increasingly important problem is the disposition of excess or obsolete contaminated equipment and facilities. The high levels of residual radioactivity associated with this equipment and facilities make their decontamination, dismantling and ultimate disposal a serious technical and economic problem. Disposal criteria for contaminated wastes are not well defined at the present time and, in many cases, the disposal cost for a given facility can reach or exceed its original installation cost.

This problem is especially acute at Hanford where a great many contaminated nuclear facilities have been retired during the past three decades. As part of the planning effort for the disposition of retired facilities at Hanford, PNL has been commissioned by the Energy Research and Development Administration to establish methods, costs and priorities for the disposition of contaminated retired Hanford facilities.

One phase of the program involves establishing an information center containing available literature relating to the decontamination, decommissioning, and disposal of nuclear equipment and facilities. The more pertinent unclassified references, of those assembled in the center, have been abstracted and are presented in this report.

The references are arranged in chronological order and cover the period from 1944 through 1974. Subject and author indexes are included.

REFERENCES LISTED IN CHRONOLOGICAL ORDER

1944

1. N. D. Peterson, Equipment Decontamination, CN-1617, Clinton Laboratories, Oak Ridge, TN, May 1944.

This report summarizes the information and data compiled at Clinton Laboratories on the decontamination of various equipment pieces. Included are decontamination studies on various types of plant vessels, laboratory glassware and concrete. Wash solutions used include HNO_3, HF, HCl and mixtures at differing temperatures and concentrations.

2. N. D. Peterson, Equipment Decontamination Problem Assignment NO242-X2145, CN-1869, Clinton Laboratories, Oak Ridge, TN, August 1944.

The decontamination of stainless steel (25-12) by use of nitric acid followed by HF solutions was studied. One topic is the development of water soluble paints with respect to both metal and concrete surfaces.

3. L. J. Beaufeit et al., Use of Ferric Hydroxide as a Decontamination Agent, CN-2449, University of California, Davis, CA, November 1944.

This report data verifies that many fission product activities can be removed from a solution by precipitating a colloidal hydroxide in the so-called meta form.

4. W. H. Baldwin, Equipment Decontamination, Problem Assignment NO242-X21AS, CN-2208, Clinton Laboratories, Oak Ridge, TN, December 1944.

Work on finding a substitute for sodium tartrate, when used as an additive for a secondary decontamination NaOH solution for 25-12 stainless steel (which follows a HNO_3 solution), was not successful; substitutes tried were citrate, borax, mannitol, and glycerine. Successful decontamination of instruments made with mild steel and brass was accomplished by brief immersion in a 6N HNO_3 solution at 65°C. Glycerine as an additive to a water soluble paint (Topoganth-$CaCl_2$) was tested as a plasticizer at low humidities with successful results. The paint would be used as an easily removable coating for surfaces which would become decontaminated.

1945

5. B. C. Nylen, 200 Area Report for Period 2-1-45 Through 2-28-45, M-2163, Richland, WA, March 1945.

The work that began during January to decontaminate equipment and place the buildings in standby condition was completed. With the exception of a few isolated spots, the cells and tunnel were brought below the tolerance level of 12.5 mrad/hr. Alpha activity was reduced essentially to background with localized areas showing only 10,000 to 50,000 disintegrations per min. Decontamination of alpha activity was particularly successful in Room D and in 204 Building where only a few small areas remain above background counts. The added precaution of applying paint was taken whenever residual contamination remained. Additional details covering the procedures used during clean-up work are presented in the latter portion of this report.

1946

6. Decontamination of Product and Fission Product Activity from Various Surfaces, M-3270, January 1946.

Preferred methods for decontaminating plant and laboratory equipment and various surfaces have been ascertained by a thorough search of the project literature. Also, the personal opinions of individuals concerned with the problems have received due consideration.

7. E. J. Witkowski, Experience in Equipment and Building Decontamination in the Manufacture of Ba^{140}, MONT-205, December 1946.

Decontamination procedures in general are described with regards to experience gained in treatment of equipment and buildings used for the manufacture of Barium-140.

1947

8. G. Strickland, Conference on Hot Laboratory Design Held at Brookhaven National Laboratory on September 19, 1947, BNL-11/AECD-3259, Brookhaven National Laboratory, Brookhaven, NY, 1947.

A meeting on the planning and design of "hot" laboratories is summarized with some discussion concerning surface decontamination.

9. W. T. Moore, Conference Concerning Boiler Decontamination, ORNL-540, Monsanto Chemical Co., Oak Ridge, TN, February 1947.

This report details a conference on ways and means for decontaminating the power pile boilers with the particular idea of designing the boilers to facilitate decontamination, both as to the materials and construction details.

10. J. E. Lee et al., Reclamation of Contaminated Kinney and Diffusion Pump Oils and Removal of Uranium Therefrom, AECD-4089, Clinton Engineer Works, Oak Ridge, TN, March 1947.

Test distillations were made on Kinney and diffusion pump oils under vacuum to discover temperature ranges for adequate distillate, to recommend satisfactory heating equipment, and to refine equipment to aid in producing uranium-free distillate.

1948

11. Minutes of Laboratory Design Conference on Decontamination Surfaces, GEH-12363, Argonne National Laboratory, Chicago, IL, February 1948.

This report outlines a conference on decontaminatable surfaces. The main topics are floors and floor coverings, floor paint tests, laboratory walls, ship decontamination, and working surfaces; a summary is included.

12. S. W. Mayer, Complex-ion Formation with Fission Products I.A. Review of Recent Developments Relating to Decontamination, ADC-16, April 1948.

Mass law expression for the decontamination of surfaces with solutions of complexing agents has been formulated for the ion exchange mechanism. The relative strength of complexes formed by cations and several anions is listed, and the important effect of pH on the efficacy of weak acids in decontamination is stressed. Also, a suggestion is made that plastic finishes having only polar groups would be less susceptible to contamination by ion exchange.

13. F. N. Browder, Summary of Surface Decontamination Experience at Oak Ridge National Laboratory, AECD-3998, Oak Ridge National Laboratory, Oak Ridge, TN, August 1948.

The experience in decontamination during the last 5 years at Oak Ridge National Laboratory is summarized. Impervious material such as steel and glass can be decontaminated by vigorous washing with the proper reagents. Each operation begins with use of mild reagents, i.e., water, and increases in reagent strength until the material is sufficiently decontaminated. Porous material such as bare concrete and wood have been impossible to decontaminate except by physical removal of contaminated portions.

14. R. G. Stirling, Use of Zinc Nitrate in Decontamination Solutions, k-315, Massachusetts Institute of Technology, Cambridge, MA, September 1948.

Investigation into the use of zinc nitrate in decontamination solutions showed that the replacement of calcium nitrate by zinc nitrate had no appreciable effect on decontamination properties, and that distribution coefficients obtained were satisfactory. Results from extraction column operation were inconclusive.

15. F. N. Browder, Summary of Surface Decontamination Experience at Oak Ridge National Laboratory, ORNL-158, Oak Ridge National Laboratory, TN, October 1948.

The experiences at Oak Ridge National Laboratory in decontaminating equipment and working areas are summarized covering the period of November 1943 to July 1948.

16. E. S. Busk and K. D. Johnson, Removal of Radio-Active Contamination from Various Surfaces, AERE-C-R-286, UKAEA, Harwell, England, December 1948.

Results are given of a series of routine tests on the removal of β-active fission products from various paint and other surfaces.

1949

17. W. W. Hawes and B. Singer, Survey of Decontamination IX. Decontaminability of Proposed Composition Decking Material, AD-143C, Naval Radiological Defense Laboratory, San Francisco, CA, 1949.

Eight similar composition decking materials were studied under conditions that have been used extensively in the comparative evaluation of engineering materials for contaminability-decontaminability behavior.

18. W. W. Hawes and B. Singer, Survey of Decontamination VII. Decontaminability of Radiac Instrument Housings, AD-140C, Naval Radiological Defense Laboratory, San Francisco, CA, 1949.

The contaminability-decontaminability behaviors of the housings of four gamma survey meters in commercial production are compared. No substantial differences among them were found.

19. W. W. Hawes and B. Singer, Survey of Decontamination VIII. Decontaminability of 1. Several Miscellaneous Materials and 2. Natural and Synthetic Rubbers, AD-141C, Naval Radiological Defense Laboratory, San Francisco, CA, 1949.

The contaminability-decontaminability behaviors of six miscellaneous materials and of seven rubbers have been investigated. No instances of unusual behavior were observed. Glass, natural mica, porcelain and GR-1 synthetic rubber appear to be preferred engineering materials in the group investigated.

20. R. D. Hammond, Decontamination of Radioactive Waste Air, LAMS-911/AECD-2711, Los Alamos Scientific Laboratory, Los Alamos, NM, 1949.

Contaminated waste air was treated with a baffle-plate water scrubbing tower with 42 plates in three stages. With only six plates per stage a plain cold water wash gave 99.6% efficiency while the efficiency was 99.92% for the "cloud chamber" mode of operation where the second stage was heated to about 110°F and the third stage was cooled to 65 to 73°F.

21. W. W. Hawes and L. Leventhal, Survey of Decontamination IV. Decontaminability of Resins and Plastics, ADC-86, Naval Radiological Defense Laboratory, San Francisco, CA, April 1949.

The contaminability-decontaminability behavior of 17 representative resins and plastics are compared. The Hanford dissolver was used for contamination, and acid, neutral and basic citrate solutions were employed for removal. Decontaminability was generally high.

22. H. A. Bernhardt et al., Rate of Solution of Uranium Tetrafluoride in Various Solvents, K-442, Carbide and Carbon Chemicals Corporation, July 1949.

A survey was made of the effectiveness of approximately 40 solutions, representing a variety of oxidizing agents and complexing agents, in removing uranium tetrafluoride from nickel equipment. The rate of solution of uranium tetrafluoride and the rate of corrosion of nickel in these solutions were measured.

23. I. M. Rehn, Decontamination of Personnel and Materials from Uranium, HW-14301, General Electric, Richland, WA, August 1949.

A decontaminant which does not harm the skin, hair or wool but is as effective as dilute sulfuric acid and other strong chemicals is described. The formula is a mixture of one part sodium bicarbonate (dry powder) to one part Duponol-C.

24. J. M. Smith and J. G. Bradley, Observations and Evaluation of the Decontamination Procedures Employed at Oak Ridge National Laboratory Redox Pilot Plant Equipment, HW-14532, General Electric, Richland, WA, September 1949.

Facilities at ORNL to be decontaminated are described. Recommended procedures for decontamination of these facilities are outlined.

25. Final Report on Decontamination Surfaces for Low Level Radioactivity Laboratory to the University of Chicago and Argonne National Laboratory, ALI-19-OUO, Arthur D. Little Inc., Chicago, IL, October 1949.

This report summarizes the results of an investigation of surface materials to determine the most suitable type for the new low-level radioactivity chemistry building of the Argonne National Laboratory.

26. D. G. Reid, Pilot Plants Section Report for August-September 1949, ORNL-490, Oak Ridge National Laboratory, Oak Ridge, TN, December 1949.

Decontamination studies conducted in the ORNL 205 Building Pilot Plant on equipment that had processed Hanford production material indicate that process vessels and lines can be adequately decontaminated within a reasonable length of time to permit the use of direct maintenance procedures. This can be done by the use of steam, nitric acid, sodium hydroxide and chemical solutions having a reducing action on the passivated surface of the stainless steel process equipment.

1950

27. P. C. Tompkins and O. M. Bizzell, "Working Surfaces for Radiochemical Laboratories Glass, Stainless Steel, and Lead," Industrial and Engineering Chemistry, vol. 42, pt 2, Oak Ridge National Laboratory, Oak Ridge, TN, 1950.

The determination of the susceptibility of protective coatings and structural materials to radioactive contamination and their subsequent ease of decontamination is essentially a new field, but one which is rapidly becoming very important. A systematic attempt has been made to develop simple tests which permit comparisons between surfaces, decontamination reagents, and contaminating conditions.

28. R. C. Heatherton, Decontamination of Buildings by Flame, NYO-1513, New York Operations Office, New York, NY, May 1950.

An oxygen-acetylene blow torch was found to have certain advantages in radioactive decontamination of structural concrete (principally floors) in a dismantled uranium processing plant. It was tried on other building materials with varying degrees of success.

29. P. C. Tompkins et al., "Practical Aspects of Surface Decontamination," Nucleonics, August 1950.

Results of extensive decontamination tests of materials, surfaces and coatings are reported. Decontamination theory is considered, and step-by-step procedures for laboratory decontamination are given. Possible use of less expensive materials and reagents such as detergents is noted.

30. C. D. Watson, Decontamination and Corrosion Resistance Properties of Selected Laboratory Surfaces, AECD-2996, Oak Ridge National Laboratory, Oak Ridge, TN, August 1950.

A selection of 50 materials has been compared for decontaminatable surfaces applicable to radiochemical laboratories. The susceptibility of these materials to contamination with a fission product mixture, their subsequent ease of decontamination with various reagent washes, and resistance to common laboratory reagents are presented.

31. H. F. Henry, Acid Scrubbing Table, K-1410, KS-140, Union Carbide and Carbon Corporation, Oak Ridge, TN, August 1950.

An inter-company correspondence outlines the consideration of special hazards associated with the installation and operation of a hooded acid scrubbing table in the K-1410 general recovery system. The purpose of the table is to supplement existing scrubbing facilities for removing uranium from contaminated process equipment.

32. H. F. Henry, Decontamination of DBM and PBM Transmitters, KS-145, Union Carbide and Carbon Corporation, Oak Ridge, TN, September 1950.

An inter-company correspondence details the considerations of special hazards associated with the decontamination of DBM and PBM transmitters in K-1024.

33. R. C. Heatherton, Decontamination and Survey of Uranium Refinery Plant, NYO-1536, Lind Air Products Company, December 1950.

The use of sandblasting, portable, rotating, abrading equipment, and high temperature flame treatment to remove radioactivity from various building surfaces is evaluated. The surfaces were measured before and after decontamination by spot check and statistical random survey schemes. Cost estimates of decontaminating by the various techniques are presented, with recommendations for increasing efficiency of future operations of this type.

1951

34. L. A. Welsch and E. J. Reber, SPRV Cell No. 7 Decontamination During December 1950, KAPL-493, Knolls Atomic Power Laboratory, Schenectady, NY, March 1951.

Decontamination of process equipment contained in a cell was required for maintenance and piping changes. The decontamination procedure and results are described.

35. K. Z. Horgan et al., Health Physics Insurance Seminar, TID-388, Technical Information Service, Oak Ridge, TN, March 1951.

Papers from an AEC-sponsored health physics seminar are presented. One discusses, in general, decontamination and disposal of radioactive wastes (including radioiodine, phosphorus-32, and carbon-14).

36. A. P. Talboys, Contamination of Metal Surfaces by I^{131} in Solution: Final Report June 1, 1950 to January 1, 1951, NYO-1573, Johns Hopkins University, Baltimore, MD, April 1951.

This report describes the laboratory investigation of the uptake of radioiodine (^{131}I) from solution by metallic materials commonly used in drain systems. Chemisorption of the ^{131}I is primarily responsible for contamination of the metals, and the most important factors involved are the type of metal, concentration of ^{131}I in solution, time of contact, condition of surface, and pH of solution.

37. W. Shelberg et al., Chemical Decontamination of Stainless Steel and 24ST Alclad Aluminum, AD-337-C, Naval Radiological Defense Laboratory, San Francisco, CA, July 1951.

Comparisons are made regarding the abilities of a number of surface active agents, complexing agents, commercial detergents and mixtures of these materials to decontaminate surfaces of stainless steel and alclad aluminum (24ST).

38. Patent Application - 20 percent HNO_3 - Three Percent HF by Weight Reagent for the Decontamination of Stainless Steel, CF-51-10-205, Oak Ridge National Laboratory, Oak Ridge, TN, October 1951.

A reagent mixture of 20% HNO_3 - 3% HF (by weight) has been found to exhibit extremely effective decontamination properties on both laboratory specimens and pilot plant contaminated stainless steel material. Three outstanding observations were made after each decontamination: 1) the corrosion rate was very low (less than 0.1 mil/hr), 2) the metal surfaces were clean and lustrous, and 3) there was no pitting.

39. M. R. Bennett and F. L. Rogers, Evaluation of Reagent Decontamination for Period August 10, 1951 to November 10, 1951, CF-51-11-123, Oak Ridge National Laboratory, Oak Ridge, TN, November 1951.

The results of a program to investigate the decontamination and corrosion properties of various reagents on 309 and 347 stainless steel are presented. The best results were obtained with a solution of 20% HNO_3 - 3% HF (by weight) which gave a decontamination factor of 1,000 and corrosion rates less than 0.1 mil/hr (at 25°C).

40. Control and Removal of Radioactive Contamination in Laboratories, NBS-Handbook-48, National Bureau of Standards, December 1951.

The contamination and decontamination of the skin, clothing and bedding, laboratory tools and glassware, and other common materials are described. A section on decontaminating detergents is included.

41. E. G. Struxness, Health Physics Progress Report, January 1, 1951 to June 30, 1951, Y-836, Carbide and Carbon Chemicals Co. Y-12 Plant, Oak Ridge, TN, December 1951.

This report covers the activities of the Health Physics Department of the Y-12 plant at Oak Ridge (January 1, 1951 to June 30, 1951). Part of the report describes an accidental spill of a mixture of radioactive Po-Be and the subsequent decontamination of the facilities and building.

1952

42. C. D. Watson, Protective Coatings and Decontamination, CF-52-10-230-DEL, Oak Ridge National Laboratory, Oak Ridge, TN, 1952.

Tests were performed on certain protective coatings to determine the susceptibility of various materials of construction to contamination and the subsequent ease of decontamination. The protective coatings tested were air-dried paints, baked panels, bench top materials, and floor tiles.

43. J. A. McLaren et al., Quarterly Electrochemical Studies, CF-32-2-217, Oak Ridge National Laboratory, Oak Ridge, TN, January 1952.

An electrochemical decontamination method, which uses 2% sulfuric acid and various currents, was developed.

44. Removal and Decontamination of Valve and Piping from K-305-1, KS-279, Carbide and Carbon Chemical Co., Oak Ridge, TN, February 1952.

The procedure used for decontamination of valves and pipes with special emphasis on safety is explained. Methods of decontamination include vacuuming and water washing.

45. H. E. Voress, Surface Decontamination Methods, Bibliography, TID-3025, Technical Information Service, Oak Ridge, TN, March 1952.

This bibliography contains 65 references to classified and unclassified research on decontamination methods. Information on decontaminating process and laboratory equipment, buildings, walls, floors and protective coatings is given. Author, subject and report-number indexes are included. Reports published up to about March 15, 1952 are covered.

46. A. P. Talboys, Contamination of Plumbing by Low Level Radioisotope Wastes, NYO-4010, Johns Hopkins University, Baltimore, MD, May 1952.

Solutions of iodine-131, strontium-89 and phosphorus-32 at low activity levels were passed through a 9-ft section of plumbing. An average of 16% ^{131}I and ^{89}Sr was retained and 22% of the ^{32}P. Flushing with water

removed 30% of the ^{131}I, 40% of the ^{89}Sr, but only 25% of the ^{32}P. 90% of ^{32}P was removed with NaOH and Na citrate. Nitric acid was effective in ^{89}Sr removal.

47. N. P. Wood, Decontamination of ORNL Purex Pilot Plant, ORNL-1242-DEL, Oak Ridge National Laboratory, Oak Ridge, TN, May 1952.

This report describes the decontamination of Oak Ridge National Laboratory Purex Pilot Plant facilities and presents an appraisal of the decontaminating techniques and reagents that were employed.

48. H. Wells et al., Decontamination of Surfaces Contaminated by Radioactive Isotopes, Part 1, Stainless and Mild Steel Surfaces, AERE-ER-1022-OUO, UKAEA, Harwell, England, August 1952.

Results are given illustrating the relative efficiency of various reagents in removing radioactive contamination due to plutonium, polonium, fission products, strontium-89, cerium-144, phosphorus-32, and cobalt-60 from stainless and mild steel surfaces. The disadvantages attendant in the use of certain reagents were considered, such as the corrosive effect of acidic reagents and the interference in the normal treatment processes that certain chelating or complexing compounds cause when present in effluent.

49. D. Callihan and D. Ross, Review of a Polonium Contamination Problem, ORNL-1381-REV, Oak Ridge National Laboratory, Oak Ridge, TN, August 1952.

This report details an incident in which about 7 Ci of polonium from a Po-Be neutron source were spilled in an Oak Ridge laboratory. The decontamination procedures which were followed are described and the clinical findings of one person who was significantly exposed to polonium are given. There is no evidence of any permanent personnel damage.

50. P. C. Walkup, Surface Decontamination with a Jet Cleaner, HW-25951, General Electric, Richland, WA, October 1952.

The results obtained with a Sellers Type B jet cleaner when used for decontamination of the exteriors of reactors and adjacent areas are summarized. The Sellers jet cleaner mixes steam, water and a liquid detergent into a directed spray. Very favorable results were obtained when an inhibited organic cleaner of high pH was used.

1953

51. Facilities for Decontamination of Laboratory Equipment, HW-26502, General Electric, Richland, WA, 1953.

An inexpensive, versatile decontamination chamber has been constructed for cleaning laboratory equipment. It has been used successfully for manual disassembly and cleaning of equipment showing radiation levels as high as 5 r/hr.

A sandblasting cabinet was also constructed for decontamination of laboratory equipment. Trial runs showed that sandblasting would often reduce radiation levels as much as 99% on equipment which had been previously subjected to chemical decontamination without success.

52. E. J. Cox and R. F. Barker, Routine Decontamination Procedures and Formulas for Plutonium Contamination, LA-1530-UOU, Los Alamos Scientific Laboratory, Los Alamos, NM, January 1953.

This report consists of a list of methods, equipment, and formulas which have been used routinely in removal of plutonium contamination. The methods include manual cleaning, mechanical agitation, degreasing, and blast cleaning. Formulas are given for general cleaners and for cleaners for some metals, skin, cloth, floors, or rubber. Pictures of the laboratory layout and some of the procedures and equipment are included.

53. F. Johnston and J. J. Katz, Decontamination of Stainless Steel, ANL-4970, Argonne National Laboratory, Chicago, IL, January 1953.

Decontamination of (#304) stainless steel was studied with respect to slug failures in water-cooled reactors which result in the circulation and dissolution of UO_2. Although many reagents were studied, including organic and oxidizing, the oxidizing reagents generally gave better results.

54. M. L. Feldman and R. F. Rogers, Development of Decontamination Reagent for Period November 1, 1952 to February 1, 1953, CF-53-1-283, Oak Ridge National Laboratory, Oak Ridge, TN, January 1953.

The results of developmental tests for an alkaline or low pH decontamination reagent for stainless steel (Type 347) are presented. Two procedures are recommended: washing with 6.1 M NaOH - 1 M $Na_2C_4H_4O_6$ or 6.1 M NaOH - 0.1 M NaF followed by 1 M $H_2C_2O_4$ - 0.1 M NaF.

55. R. J. McNamee, Decontamination of HRE Loop for Period November 1952 to January 1953, CF-53-2-75, Oak Ridge National Laboratory, Oak Ridge, TN, February 1953.

Developmental work on a reagent and/or procedure to remove radioactive fission product contamination from the Homologous Reactor (#347 SS) piping system is reported. Several solutions appear promising for scale removal: 1.2 M HCl - 1.8 M H_2SO_4 and 1.2 M HCl - 0.7 M H_3PO_4. Alkyl pyridines HB was found to be a satisfactory corrosion inhibitor for each.

56. General Decontamination Manual for the Idaho Chemical Processing Plant, IDO-26081, Idaho Operations Office, Idaho Falls, ID, March 1953.

In this general decontamination manual, the decontamination procedures are given for stainless steel processing equipment, bare concrete surfaces, painted surfaces, stainless steel laboratory surfaces, asphalt floor tile, and copper and brass surfaces. Also included are suggested aids for writing a detailed decontamination procedure.

57. M. N. Raile, Decontamination of 221-224B Process Equipment, HW-27774, General Electric, Richland, WA, April 1953.

A decontamination program was initiated for decontaminating the bismuth phosphate separation plant in the 200 East Area. The primary objective of the program was recovery of products remaining in the process vessels, while the secondary objective was the decontamination of the equipment and cells. A 60% nitric acid solution was effectively employed for removal and recovery of product heels. Citrate-caustic solutions showed insignificant product pickup, and was found undesirable in solutions that are to be

reworked for product recovery. A tartrate-caustic flush showed excellent product and by-product removal, but was found undesirable in cribbed wastes. Citrate-caustic and peroxide-caustic solutions were found to be excellent agents for removal of fission products absorbed on stainless steel surfaces.

58. L. W. Wray, Decontamination Studies on Contaminated Tanks and Pipe Lines, PDB-82, Atomic Energy of Canada, Ltd., Chalk River, April 1953.

Decontamination tests have been run on metal panels coated with Lithcote, Heresite and Sherwin-Williams tank coating and on uncoated mild steel panels. Panels were contaminated by active cooling water.

A solution of 1% Versene plus 1% Alconox was the most effective for the soak cleaning of Lithcote and Heresite. A solution of 1% trisodium phosphate plus 1% Alconox was the best for Sherwin-Williams tank coating and was equally effective on Lithcote. Scrubbing improved the effectiveness of the decontamination solutions. Uncoated mild steel panels presented a special case. Scrubbing with a solution of 1% trisodium phosphate plus 1% Alconox was satisfactory. However, if soaking alone was required, a solution of 0.3 M citric acid plus 1% Alconox was necessary.

59. R. K. Skow et al., "Hazard Evaluation and Control After a Spill of 40 mg of Radium," Nucleonics, vol. 12, no. 8, pp. 45-47, 1953.

A contamination survey was made on laboratory personnel and equipment on the occasion of a 40 mg spill of radium. Decontamination procedures are outlined.

60. C. M. Unruh, Decontamination of Portable Instruments, HW-28431, General Electric, Richland, WA, May 1953.

The decontamination of portable instruments is described with such reagents as hydrogen peroxide, sodium hypochlorite solution, saturated oxalic acid, saturated citric acid, aerosol O.T., Lava soap, masking tape, lacquer thinner, saturated ammonium oxalate solution, acetone, and ethyl alcohol.

61. D. O. Campbell, Decontamination of Stainless-Steel Survey and Proposed Program, CF-53-5-233, Oak Ridge National Laboratory, Oak Ridge, TN, May 1953.

A general survey of past experience in the decontamination of stainless steel is given along with a proposed program of research in decontamination.

62. R. L. Curtis, Decontamination Literature Search, Y-965, Union Carbide and Carbon Corporation, Oak Ridge, TN, May 1953.

A bibliography of methods for decontaminating various materials, this report contains 232 references with abstracts. Author and subject indexes are included. See Reference No. 63.

63. R. L. Curtis, Decontamination Literature Search, Y-964, Union Carbide and Carbon Corporation, Oak Ridge, TN, May 1953.

Included are 70 references to unclassified publications on methods of removal of radioactive contaminants from various materials. A subject index is provided.

64. L. Galanter, Decontaminability of Finishes for Radiac Instruments, NP-4910, Evans Signal Laboratory, Belmar, NJ, June 1953.

The decontaminability of various finishes, both glossy and semi-gloss, for radiac instruments is described. Results show that the glossy paints were most readily decontaminable. Unichrome 400-35 had the highest decontamination factor of the semi-gloss, olive drab types tested and was recommended for use on radiac instruments for Signal Corps equipment.

65. F. J. Johnson et al., Dissolution of Uranium Oxide Arising from Slug Failure, ANL-5084, Argonne National Laboratory, Lemont, IL, July 1953.

The purpose of this work was to study reagents which might be effective in dissolving uranium oxide produced during slug failure in water-cooled reactor systems. An aspect of the problem which has subsequently become of primary importance is the solubility or transportability of the oxide in pure water.

66. E. T. Jurney, Disassembly of the Los Alamos Fast Reactor, LA-1575, Los Alamos Scientific Laboratory, CA, July 1953.

The procedures used in the complete and permanent disassembly of the Los Alamos Fast Reactor are described.

67. L. E. Kattner, Sandblast Decontamination of Stainless Steel, HW-29576, General Electric, Richland, WA, October 1953.

This report deals with controlled tests on the decontamination of 347 stainless steel by sandblast methods.

68. G. Segura et al., "Detergency as Applied to Radiological Decontamination," Chemistry and Industry, 72nd Annual Meeting of Chemical Industry in Nottingham on July 24, 1953, England, November 1953.

Detergents such as Ivory, Dreft, Rinso, Surf, Breeze, Duz, Tide, Calgon and Carolite-100 were tested for use in decontamination.

69. J. L. Linsley-Hood, Effect of Ultrasonic Agitation on Surface Decontamination Rates, R-DB-WTN-113, Windscale Works, December 1953.

The effect of ultrasonic agitation was investigated with five different decontamination solutions. In general, this technique appeared to increase the speed and extent of decontamination.

70. R. E. Burns, Removal of Ruthenium Contamination from Surfaces by Alkaline-Permanganate, HW-30325, General Electric, Richland, WA, December 1953.

This report describes the decontamination of ruthenium from surfaces by using alkaline-permanganate solution.

71. Pressurized Water Reactor Program Technical Progress Report (for the Period July 15 to August 26, 1954) WAPD-MRP-47, Westinghouse Electric, Pittsburgh, PA, 1954.

The progress on the pressurized water reactor program (July 15, 1954 to August 26, 1954) is reviewed. A section of the report is devoted to coolant loop decontamination. Periodic acid was found to provide the greatest success in decontamination. Corrosion tests were also carried out with 304 stainless steel coupons.

72. R. S. Bell and V. R. Chapman, Redox Plant Shutdown of November 1953, HW-36078-RD, General Electric, Richland, WA, January 1954.

On November 2, 1953 the Redox Plant was shutdown for an estimated 2 weeks in order to decontaminate the canyon and the crane, thereby enabling maintenance personnel to carry out their first mechanical and electrical inspection, lubrication, and repair of this vital piece of equipment since startup of the plant about 2 years previous.

Unforeseen difficulties encountered in the crane decontamination work prolonged this phase of the shutdown and resulted in seriously grounding out the intricate direct current control circuits. The building remained down until November 28.

73. W. T. McDuffee, Thorax Process, Demonstration of Feasibility on Use of Steam Jets in Internal Decontamination of Vessels, CF-54-2-101, Oak Ridge, TN, February 1954.

The feasibility of using steam jets for lifting liquid under pressure to one or more spray nozzles was investigated with regard to developing a decontamination method for the interior of radiochemical processing vessels. This procedure would allow the use of minimum volumes of decontamination solutions.

74. A. P. Talboys and E. C. Spratt, An Evaluation of Laundering Agents and Techniques Used in the Decontamination of Cotton Clothing, Johns Hopkins University, Baltimore, MD, March 1954.

An investigation was made concerning the laundering of protective clothing contaminated with radioactive material. Objectives were to evaluate laundering agents as a function of effectiveness of decontamination with consideration given to economical biological treatment of the resulting wastes, and to evaluate techniques of decontamination in terms of maximum decontamination efficiency with respect to minimum volume of waste to be evaporated.

75. D. O. Campbell, Decontamination of Stainless Steel, CF-54-3-171, Oak Ridge National Laboratory, Oak Ridge, TN, March 1954.

The decontamination of stainless steel was studied with special consideration given to steel exposed to the Purex process solutions. This steel is contaminated mainly with niobium. The best reagent for decontamination was a 20% HNO_3-3% HF solution, but it did cause corrosion.

76. P. B. Klevin et al., Decontamination of Buildings for Processing Alpha Emitters, NYO-4600, New York Operations Office, NY, April 1954.

Obsolescence of the original Atomic Energy Commission uranium processing plants has resulted in the dismantling of several of the early units and their replacement by new facilities. In the course of dismantling, contamination by the radioactive uranium and radium had to be removed from buildings and equipment so that the facilities would be acceptable to other commercial enterprises. Proposed levels are believed to permit such sale or transfer. Data is presented showing the levels of contamination before and after decontamination. Decontamination procedures and cost figures are presented.

77. W. E. Thompson, compiler, Homogeneous Reactor Project Quarterly for Period Ending January 31, 1954, ORNL-1678, Oak Ridge National Laboratory, Oak Ridge, TN, April 1954.

A quarterly report on the homogeneous reactor project is presented including a section on corrosion of seven different metals by decontamination solutions. The metals were Stellite 6, Stellite 98M2, Inconel, Inconel X, tantalum, Zircaloy II, and 347 stainless steel. The solutions were 20 wt.% nitric - 3 wt.% HF, 1.2 M HCl - 1.8 M H_2SO_4, and 1.2 M HCl - 1.8 M H_2SO_4 - 0.05 M H_2O_2. The latter two solutions were inhibited with an alkyl pyridine (2 ml/ℓ).

78. F. J. Krieger, Residual Gamma Radiation Hazard After Limited Decontamination Operations, RM-1226, U.S. Air Force Project, Rand, Santa Monica, CA, April 1954.

Results are given of calculations showing the reduction in gamma radiation level at any point 1 m above an area which has been either completely or 80% decontaminated. The geometries considered are typical of those which would be encountered in clean-up of areas around buildings and air strips.

79. W. A. Clark, Waste Disposal - Decontamination and Decontamination Laundry Facilities, LRL-120, Livermore Research Laboratory, Livermore, CA, May 1954.

This report gives a description of the waste disposal, decontamination and decontamination laundry facility at LRL and a description of some procedures.

80. F. W. Gilbert, "Decontamination of the Canadian Reactor," Nuclear Engineering Magazine, vol. 50, no. 5, Atomic Energy of Canada, Ltd., Chalk River, May 1954.

This paper describes the restoration program necessitated by an accident which occurred at the Chalk River project when its reactor released thousands of Ci of fission products into the building and equipment. Some details of the original accident are given along with an explanation of the problems and techniques.

81. Radioactive Contamination, Decontamination and Waste Disposal, Water Supplies; Liquid Series and Commonwealth X-Ray, Radium Laboratory, Melbourne, Australia, July 1954.

This bibliography contains references to contamination and decontamination of radioactive materials, mainly water supplies and liquid wastes.

82. M. Eisenbud et al., "How Important is Surface Contamination," Nucleonics, vol. 12, no. 8, Health Safety Laboratory, New York, NY, August 1954.

The importance of surface contamination is related to personal hygiene. Costly decontamination of a surface need not be undertaken unless the surface is so heavily contaminated as to be reflected in excessive atmospheric dustiness or external radiation levels.

83. W. W. Kendall and M. Nazar, Removing the Sodium Residue from the Alplaus Main Heat Transfer System with Ethylene Glycol, KAPL-M-WWK-5, Knolls Atomic Power Laboratory, Schenectady, NY, August 1954.

The sodium residues were cleaned from the Main Alplaus Heat Transfer System to: 1) remove all sodium from the system for base shut down and, 2) to demonstrate the use of ethylene glycol in cleaning a large-scale system. The latter objective is in support of the program for developing a non-sodium flushing agent for use in the Mark B Coolant System.

All residual sodium was cleaned from the system. Slight traces of carbon were found on the inside of the pipe by wiping with a white cloth. The decomposition of the glycol caused operational difficulties such that ethylene glycol cannot be recommended as the non-sodium flush for Mark B.

84. R. Fowler et al., Corrosion of Reactor Structural Materials in High Temperature Water I. Descaling Methods, KAPL-1198, Knolls Atomic Power Laboratory, Schenectady, NY, August 1954.

Three descaling techniques have been found suitable for removal of the oxide layers formed on ferrous and nickel alloys when the latter corroded in high-temperature water. These three methods are: 1) cathodic treatment

in inhibited sulfuric acid, 2) immersion in a sodium hydride bath, and 3) immersion in Clarke's solution. The results of an extensive investigation of the descaling blanks (metal loss suffered by a clean metal specimen), the materials for which each descaling procedure is effective, and important variables are reported.

85. E. G. Pierick, Plutonium Metal Turnings Fire, HW-33125, General Electric Company, Richland, WA, September 1954.

This report deals mainly with a plutonium metal turnings fire on July 27, 1954, Decontamination after the incident is described. The surfaces were decontaminated mainly through vacuuming and mopping.

86. Decontamination of Surfaces, Literature Survey, HW-33710, General Electric Company, Richland, WA, November 1954.

Enclosed is an annotated listing of reports on decontamination of various surfaces. Reports issued prior to May 1953 but not included in Y-964 (unclassified) and Y-965 (secret) and all reports issued subsequent to May 1953 are included.

87. M. R. Bennett, Electrodecontamination of Stainless Steel, AECD-4169, Oak Ridge National Laboratory, Oak Ridge, TN, November 1954.

In experimental studies, decontamination factors of 1000 to 3000 were obtained by electrostripping deposited radioactivity from stainless steel surfaces, used as the anode, in 2% sulfuric acid at current densities as low as 0.01 amp/in.^{2} Stainless steel cathodes were used. The method was successfully applied to contaminated equipment.

88. M. R. Bennett, Electrodecontamination of Stainless Steel, ORNL-1608, Oak Ridge National Laboratory, Oak Ridge, TN, November 1954.

See Abstract for Reference 87.

1955

89. H.A. Droll, High-Temperature Stability of Aqueous Solutions of Reagents that are Potentially Applicatory to PWR Decontamination Processes, WAPD-PWR-CP-2079, Westinghouse Electric, Pittsburgh, PA, 1955.

The thermal stability of potentially useful decontamination reagents was studied for the PWR system. All reagents decomposed faster at 400°F than at 300°F. Two reagents which appeared to be suitable for use at 300°F were citric acid and disodium salt of EDTA; catechol was only slightly less stable.

90. D. O. Campbell, Decontamination of Stainless Steel, ORNL-1826 DEL, Oak Ridge National Laboratory, Oak Ridge, TN, March 1955.

Decontamination of stainless steel contaminated by Purex process solutions was studied. Niobium is the predominant contaminant followed by zirconium. Addition of a fluoride solution decreased the adsorption of niobium and zirconium, but ruthenium then became important. The most effective noncorrosive decontaminant was alkaline tartrate-peroxide. The rate of decontamination of the preceding solution and sodium hydroxide, alkaline tartrate, nitric acid, and oxalic acid solutions is reported. The most effective decontaminant was 3% HF in 20% HNO_3, but this solution was severely corrosive. Aiding decontamination by the use of ultrasonics was also studied. A literature survey is included.

91. J. L. Norwood, A Study of the Effectiveness of Decontamination Agents on Contaminated Protective Clothing, HW-38218 REV, General Electric, Richland, WA, July 1955.

A series of 139 tests were conducted using 22 agents either singly or in combination.

The tests clearly indicated that complexing agents are most effective in removing metallic ions strongly fixed to cotton cloth.

Large quantities of water in the washer wheel were also demonstrated to provide greater possibilities for floating away loose radioactive

particles and also showed better results in removing complexed or inactivated metallic ions from cotton fabric.

92. L. A. Waldman, Contamination and Decontamination Effects in PWR-I, Effect of Surface Finish on Contamination, WAPD-CP-1200, Westinghouse Electric, Pittsburgh, PA, July 1955.

Data indicating that surface finish is not an important variable with regard to contamination in the PWR primary coolant piping and components is given.

93. J. B. Huff, Electrodecontamination of Metals, IDO-14352, Phillips Petroleum Company, August 1955.

Studies were conducted at the Idaho Chemical Processing Plant on decontamination using an electrolytic process. Primary consideration was given to decontaminating stainless and carbon steels. The experimental procedure, results and conclusions are included.

94. H. R. Hughes, Contaminated Equipment Renovation Shop, HW-38052, General Electric, Richland, WA, August 1955.

A preliminary study was made to establish more complete justifications for constructing a decontamination plant. The proposed plant would repair contaminated process equipment, and its value as an engineering and research unit could ultimately exceed that of its usefulness in repair. The economics, additional functions, cleaning methods, description of the plant and alternate facilities are summarized.

95. J. E. Kaveckis, Report on Demonstration of Bendix Ultrasonic Cleaning, HW-51965, General Electric, Richland, WA, November 1955.

Observations were made on a Bendix Ultrasonic Cleaner Type U-12, consisting of a UG-2 generator and a UTL-2 tranducer. Significant decontamination effects were obtained.

96. A. K. Hardin, In-Pile Defilming of Process Tubes, HW-40120, General Electric, Richland, WA, November 1955.

This document reports the results of small-scale tests on defilming process tubes and also outlines larger-scale, more conclusive tests. The process tube film is responsible for the major source of radiation and contamination during process tube removal. The small-scale tests showed that defilming could be accomplished using a slurry of diatomaceous earth and a sodium dichromate, sulfuric acid solution.

97. J. C. Bresee et al., Gamma Radiation Damage Studies of Organic Protective Coatings and Gaskets, ORNL-2174, Oak Ridge National Laboratory, Oak Ridge, TN, November 1955.

Studies have been carried out on the effect of gamma irradiation on mounted and unmounted protective coatings and various gasket materials. Qualitative results of screening studies and quantitative results of decontamination tests and physical property measurements are reported.

98. R. F. Stearns, High Level Contamination Control and Waste Disposal, KAPL-1406, Knolls Atomic Power Laboratory, Schenectady, NY, November 1955.

The clean-up and disposal of radioactive waste in the Radioactive Materials Laboratory at the Knolls Atomic Power Laboratory is lessened considerably if the problems of radioactive contamination are taken into consideration during the design of irradiation test devices and laboratory equipment.

Operational experience and engineering work have also resulted in development of many techniques and equipment which have aided in reducing the costs of high-level radioactive clean-up and waste disposal.

99. F. P. Schilling, Effect of First Cycle Scrub Ratio Reduction on Decontamination in the 25 Process, IDO-14358, Phillips Petroleum Company, December 1955.

A report was made on a plant test at the Idaho Chemical Processing Plant (ICPP) on the effect of first cycle scrub flow ratio on decontamination

in the "25" Process. Uranium is recovered from aluminum-uranium alloys at the ICPP in three solvent extraction cycles using packed columns with hexone extractant. Results and conclusions are given for a reduced first cycle scrub rate.

100. Investigation of Radioactive Decontamination Methods for Sodium Reactor System Components, KAPL-1456, Knolls Atomic Power Laboratory, Schenectady, NY, December 1955.

Experimental results obtained by decontaminating sodium handling equipment in an MTR in-pile loop irradiation test resulted in a recommended decontamination procedure for sodium handling systems.

1956

101. R. Lloyd, Decontaminability of Structural Materials and Surface Coatings for Use in Nuclear Installations, WAPD-PWR-CP-3052, Westinghouse Electric, Pittsburgh, PA, 1956.

Fifteen common building materials and six commercial surface coatings have been investigated in regard to their retention of fission products and their ease of decontamination by ordinary janitorial methods.

102. Pressurized Water Reactor Program for the Period January 13, 1956 to February 23, 1956, WAPD-MRP-60, Westinghouse Electric, Pittsburgh, PA, 1956.

A technical progress report was made on the pressurized water reactor program including sections on fission product removal from water and air, and chemical decontamination of equipment.

103. Proposed Procedures for Chemical Decontamination of PWR, WAPD-CP-2719, Westinghouse Electric, Pittsburgh, PA, 1956.

Decontamination procedures are proposed for a PWR plant. The procedures deal mainly with decontamination of an isolated coolant loop and associated purification loop.

104. Decontamination of H Loop Following a Fuel Element Failure, HW-42081, General Electric, Richland, WA, March 1956.

During an experiment being performed in the recirculation loop utilizing process tube 0961-H, a standard uranium fuel element failed by intergranular attack of the aluminum jacket. Radioactive matter reached the out-of-pile components of the loop before the effluent was diverted to a hot drain. This report describes the work performed in decontaminating the loop and placing it back into service.

105. Thorex Pilot Plant, Decontamination of the Feed Adjustment System and Radiation Exposures Received by Personnel Engaged in Modifying a Vapor Line in the System, CF-56-3-154, Oak Ridge National Laboratory, Oak Ridge, TN, March 1956.

Easy decontamination was accomplished in seven 30% nitric acid treatments and five 20% sodium hydroxide - 2% sodium tartrate treatments.

106. J. H. Walker and G. S. Sadowski, Thorex Pilot Plant Decontamination Run IX-16, CF-56-4-184, Oak Ridge National Laboratory, Oak Ridge, TN, April 1956.

Decontamination was required in the Thorex Pilot Plant to permit replacement of faulty equipment and to install shielding. The procedure used in the decontamination is included, and decontamination and radiation exposure data collected during this work are reported.

107. J. B. Huff, Effectiveness of Various Solutions for Decontaminating Stainless Steel, Lead and Glass, IDO-14379, Phillips Petroleum Company, May 1956.

The results of a series of comparative tests are presented in three tables. Spots were uniformly contaminated on lead, glass and stainless steel surfaces. The effectiveness of various reagents and proprietary compounds toward removal of radiocontaminants was studied. Some solutions were thousands of times more effective than certain used cleaning agents. Separate techniques are generally required for decontaminating the individual surfaces.

108. W. L. Walker, Corrosion of Types 304-6 and 347 Stainless Steel by Oxalic Acid, HW-40804, General Electric, Richland, WA, May 1956.

Corrosion damage was incurred in the use of oxalic acid as a cleaning agent for process equipment. Samples of types 304-L and 347 stainless steel which have been subjected to a sensitizing heat treatment, and samples of A-55 titanium in the "as received" condition, were exposed to 10 vol% oxalic acid for periods ranging from 0.5 to 100 hr at temperatures ranging from 25 to 100°C. Results are given.

109. Status of 202-A Building Areas Contaminated with Plutonium as Result of L-6 Blowback, HW-43073,OUO, General Electric, Richland, WA, May 1956.

On February 27, 1956, plutonium solution and mist (nitric acid solution) was forced from an instrument line leading to the L-6 tank, when the tank was pressurized, grossly contaminating the west end of the pipe gallery, west PVC station and to a lesser degree the canyon lobby. Partial decontamination was accomplished and residual contamination was contained by overcoating with paint.

110. C. E. Sinclair, PWR Radioactive Waste Disposal System Decontamination Room Waste Evaporation Unit Shop Order 1-43-8043, WAPD-PWR-PMF-311, Westinghouse Electric, Pittsburgh, PA, May 1956.

The decontamination room waste evaporation unit required for the PWR radioactive waste disposal system is described.

111. F. B. Fairbanks and D. C. Morse, Calculation of Residual Activity in APPR-1 Reactor Components After Shutdown, APAE-MEMO-31, Alcoa Products, Inc., June 1956.

An analysis was undertaken in order to examine the radiation hazards associated with disassembling the APPR-1 sometime after shutdown and shipping the various components to a new location.

112. D. O. Campbell, Decontamination of the Homogeneous Reactor Experiment, ORNL-1839, Oak Ridge National Laboratory, Oak Ridge, TN, June 1956.

After shutdown the Homogeneous Reactor Experiment system was decontaminated in about 1 month, without descaling, from an activity level of 1000 r/hr to 5-200 r/hr. This was sufficient to permit dismantling. The treatment consisted in washing twice with each of the reagents 5% nitric acid, 35% nitric acid, and 10% sodium hydroxide - 1.5% sodium tartrate - 1.5% hydrogen peroxide and numerous times with water. Overall decontamination factors were 22 to 25, including decay. Decontamination factors with a single reagent were between 1 and 2.25.

113. B. H. Morrison and R. E. Blanco, The Hermex Process for Metal Decontamination by Mercury Processing, CF-56-1-151, Oak Ridge National Laboratory, Oak Ridge, TN, 1956.

The Hermex process for decontaminating metals was investigated. The process involves dissolution of the metal in hot mercury, removal of fission products and impurities by slagging and solvent washing, and recovering the purified metal by volatization.

114. E. S. Bomar, Copper Decontamination Work at Federated Metals in St. Louis, CF-56-6-87, Oak Ridge National Laboratory, Oak Ridge, TN, June 1956.

An industrial scale experiment involving 100 tons of scrap copper has been completed to check the results of laboratory equipments on the use of fire refining as a means of removing uranium contamination. Samples of the refined metal were checked at ORNL for uranium content by activation analyses and found to have on the average less than 0.66 μg of U/g of metal sample. The bulk of the activity was found in the slag. The above level of activity was considered acceptable by the ORO of the AEC.

115. K. H. McCorkle and W. R. Winsbro, Decontamination of the ORNL Thorex Pilot Plant, ORNL-2058, Oak Ridge National Laboratory, Oak Ridge, TN, July 1956.

Decontamination of the Thorex Pilot Plant is described. Twenty-four major pieces of highly contaminated stainless-steel processing equipment were decontaminated in 19 days to safe working levels by alternate treatments with 20% sodium hydroxide - 2% sodium tartrate and 20% nitric acid. Oxalic acid or citric acid was substituted for tartaric acid in about half the treatments. The average cost per treatment was $222; the total cost was $36,000.

116. W. L. Walker, Corrosion of Type 304L Stainless Steel by Solution of Nitric Acid-Sodium Dichromate and Nitric-Hydrofluoric Acids, HW-46369, General Electric, Richland, WA, October 1956.

Forty-eight samples of Type 304L stainless steel were given a sensitizing heat treatment and exposed to solutions of 29 wt% nitric acid - 20 wt% sodium dichromate and 20 wt% nitric acid - 3 wt% hydrofluoric acid for times ranging from one-half to 24 hr at temperatures from 25°C to the atmospheric boiling points of the two solutions. At the boiling point, the nitric-dichromate solution exhibited corrosion rates as high as 0.2 in. penetration per month (ipm) and the nitric-hydrofluoric solution gave rates of about 1.0 ipm. The nitric-dichromate solution appeared to show a change in corrosive mechanism with increasing temperature, while the nitric-hydrofluoric solution simply exhibited an increase in corrosion rate with increasing temperature. Both solutions are extremely corrosive; however, judicious selection of contact time and temperature can minimize the damage.

117. A. Brunstad, Corrosion of Stainless Steel, Titanium and Tantalum in Plutonium-Nitric Acid Solutions, HW-46779, General Electric, Richland, WA, November 1956.

This report contains information and results on corrosion of stainless steel, titanium and tantalum in plutonium-nitric acid solution, with and without sulfate ions.

118. N. W. Blansky et al., Decontamination of Calder and Chapel Cross Irradiated Fuel Element Containers and Baskets Part I, Preliminary Small Scale Tests, IGR-TN-W-478, UKAEA, Risley, England, February 1957.

Small scale tests have been run to compare the effectiveness of various decontamination procedures on steel, rusted steel, painted steel, and Limpetite coated steel surfaces. Hosing with 10% S.D.G.3 (2 parts EDTA, 4 parts citric acid, 3 parts Comprox A, and sufficient Na_2CO_3 to produce a pH of 3 in aqueous solution) using a recirculating system showed the most potential for full scale operation.

119. Evaluation of Montmorillonite Clay for Use in Decontamination of PWR Radioactive Waste Liquors, WAPD-PWR-CP-2164, Westinghouse Electric, Pittsburgh, PA, February 1957.

The feasibility of using montmorillonite clay for decontamination of waste liquors because of it's cationic exchange properties was studied.

120. L. A. Waldman, Addendum and Errata of WAPD-CP-1200, WAPD-CP-1364, March 1957.

Results are presented on testing of the effect of surface finish on contamination with irradiated UO_2.

121. G. S. Sadowski, "Decontamination of Processing Plants," Nucleonics, vol. 15, no. 3, Oak Ridge National Laboratory, Oak Ridge, TN, March 1957.

The efficiency of built-in decontamination facilities in reactor-fuel processing plants is documented.

122. "Decontaminable Surfaces and Procedures for Hot Cells," Fifth Hot Laboratories and Equipment Conference, Philadelphia, PA, March 1957.

The decontaminability of protective surfaces used in hot cave construction is compared. Also included are the surfaces in use in Oak

Ridge National Laboratory hot caves, methods to decontaminate the caves and general decontamination procedures for (a) stainless steel surfaces, (b) concrete, (c) painted surfaces, (d) asphalt floor tile, and (e) copper and brass surfaces.

123. F. L. Culler and W. H. Pennington, Decontamination Study of 1205 Canyon/TD-416, ORNL-541, Oak Ridge National Laboratory, Oak Ridge, TN, March 1957.

The procedure used for decontamination of equipment by washing with hot nitric acid, water, steam and other agents for fairly long periods of time was studied.

124. The Decontamination of KAPL 120 Loop, KAPL-M-SMS-67, Knolls Atomic Power Laboratory, Schenectady, NY, May 1957.

This report summarizes the procedures and data obtained in the decontamination of KAPL-120 loop at HAPO. A fill and flush procedure, using the concentrated reducing decontamination solution, was used to solubilize and remove the crud scale from the out-pile loop surfaces.

125. S. F. Lanier, Radioactive Environs Contamination, TID-3603, OUO, Technical Information Service, Oak Ridge, TN, May 1957.

References are given to 88 reports on radioactive environs contamination excluding weapons test reports. The period covered is from 1953 to 1957.

126. H. A. McLain, Chemical Cleaning and Storage of the HRT Steam and Cooling Water Systems, CF-57-6-36, Oak Ridge National Laboratory, Oak Ridge, TN, June 1957.

A 10% phosphoric acid solution with 0.2% "Rodine 45" inhibitor is recommended for chemical cleaning. Wet storage is recommended for both systems. The steam system is to be stored in steam condensate with 100 ppm hydrazine and the cooling system in steam condensate with 1000 ppm potassium chromate.

127. H. Suss, Cleaning of Carbon, Low Alloy and Stainless Steel Pipe and Tubing for Nuclear Coolant Systems, KAPL-M-HOS-3, Knolls Atomic Power Laboratory, Schenectady, NY, July 1957.

The problems and applicability of the various standard methods for cleaning unirradiated individual lengths of carbon, low alloy, and AISI 300 series stainless steel piping and tubing for nuclear service are described. The bibliography contains details on cleaning methods and/or solutions to be used.

128. J. O. Blomeke and M. F. Todd, Uranium-235 Fission-Product Production and a Function of Thermal Neutron Flux, Irradiation Time, and Decay Time I. Atomic Concentrations and Gross Totals, ORNL-2127, pt. 1, vol. 1, Oak Ridge National Laboratory, Oak Ridge, TN, August 1957.

Levels of fission products resulting from thermal fission of ^{235}U in reactor fuels were computed over a wide range of reactor operating conditions and decay times. Values for approximately 300 fission products are presented in graphical form together with gross totals of radioactivities, radiation powers, and thermal neutron poisoning. The gamma spectrum is further broken into four groups of specified energy ranges which are suitable for use in shielding design. (Tabulations of these properties are arranged as to chain or mass number, element, and as to the rare-gas and rare-earth groups. The calculations assume constant replenishment of ^{235}U, constant reactor power operation, and no fission-product separations during irradiation.)

129. J. O. Blomeke and M. F. Todd, Uranium-235 Fission-Product Production and a Function of Thermal Neutron Flux, Irradiation Time, and Decay Time I. Atomic Concentrations and Gross Totals, ORNL-2127, pt. 1, vol. 2, Oak Ridge National Laboratory, Oak Ridge, TN, August 1957.

See Abstract for Reference 128.

130. Radioactive Decontamination Procedures and Equipment, IGRL-IBR-27, UKAEA, Risley, England, September 1957.

A bibliography was compiled on radioactive decontamination publications which were issued up to December 1956. Sources used were United Kingdom, Canadian, and U.S. report abstracts, Nuclear Science Abstracts, Engineering Index (1950-1955), and Industrial Arts Index (1956).

131. R. D. Baybarz, "Decontamination of a Homogeneous Reactor," Presented at American Nuclear Society Meeting, Pittsburgh, PA, June 1957, CF-57-9-59, Oak Ridge National Laboratory, Oak Ridge, TN, September 1957.

A satisfactory method of decontaminating a homogeneous reactor has been developed using a chromous sulfate-sulfuric acid solution to dissolve and remove the oxide corrosion film deposited on stainless steel from uranyl sulfate solutions at 300°C.

132. M. L. Smith, Internal and External Decontamination of Rear Face Piping, HW-53297, General Electric, Richland, WA, October 1957.

The internal and external decontamination of H Reactor is accomplished through the utilization of existing facilities with slight modifications. The rear relief riser was used as a supply manifold and the solid feeds system as a supply system to pump the decontaminating solution through the rear face piping. This cleaning technique allowed a large reduction of the smearable contamination on the rear face.

133. G. E. Henry, Ultrasonics for Radioactive Decontamination, AECU-3590, General Electric, Richland, WA, November 1957.

Preliminary tests have been run to determine whether ultrasonic vibration would be effective in removing mixed radioactive deposits from the inside surface of steel pipes in a heat exchanger. Different frequencies (20 KC/S, 1000 KC/S) have been used at the maximum power levels conveniently attainable. Different liquids were compared for cleaning effectiveness, with and without ultrasonics.

134. Radioactive Decontamination of the 60 Ton Overhead Crane in a Separations Facility, HW-52734, General Electric, Richland, WA, November 1957.

A crane decontamination program, incorporating new cleaning and personnel exposure control techniques, was employed to achieve a significant reduction in radiation levels on the crane within a 2-week period. As a result of this program crane catwalk time limits, which prior to cleaning ranged from less than 30 sec to 6 min, were increased to 10 to 20 min.

The principal decontaminating agent was an organic solvent, Inhibited 1,1,1 trichloroethane (Methyl Chloroform, CH_3CCl_3). The use of a spray gun assembly, through which compressed air at 25 psi was introduced to the solvent stream near the spray nozzle, increased the effectiveness of the solvent spray method, particularly on oily surfaces and in cracks and crevices.

135. W. N. Koop, Disposal of Decontamination Agents for Reactor Rear Face Piping, HW-53372, General Electric, Richland, WA, November 1957.

A sampling and analytical program was designed to determine the toxicological and radiological consequences of decontaminating with Turco 4306-B, and to recommend control measures for future uses of this reagent. Results show that no major river pollution problems developed from disposal of the spent cleaning solution.

136. P. W. Frank, Calculation of Fission Product Activity in PWR from a Seed Plate Failure, WAPD-TM-83, Westinghouse Electric, Pittsburgh, PA, November 1957.

Equations are developed in this report to serve as a basis for the evaluation of the fission product problem associated with a cladding failure of a PWR seed plate.

137. E. L. Shirley, Decontamination of a Primary Coolant Water Loop After a Magnesia Incident, KAPL-M-ELS-8, OUO, Knolls Atomic Power Laboratory, Schenectady, NY, November 1957.

A procedure is proposed for removing magnesia deposited on fuel surfaces in a carbon steel loop. The basis is the relatively high solubility of MgO in CO_2-water.

138. F. C. Stainer, Decontamination of the S3G/S4G Steam Generators, KAPL-M-SMS-88, Knolls Atomic Power Laboratory, Schenectady, NY, November 1957.

This report contains information on chemical methods for the decontamination of steam generators.

139. Preliminary Report of T-552352, Decontamination of S1W Starboard Loop, Pressure Vessel, Pressurizer, Hydraulic Service System and Purification System, NRFS-PR-63, Westinghouse Electric, Pittsburgh, PA, December 1957.

A test was made to obtain direct experimental information on the overall aspect of decontaminating the primary surface area of the S1W plant. Information obtained was: 1) operation feasibility of the decontamination process, 2) cost of decontamination and time required, 3) engineering requirements, 4) decontamination factor, 5) immediate and long-term effects on plant materials, and 6) reducing decontamination solution chemistry of large-scale processes.

140. C. F. Miller et al., "Decontamination Reactions of Synthesized Fallout for Nuclear Detonations, I. Nuclear Detonation in Sea Water," J. of Colloid Science, vol. 13, no. 337-347, 1958.

The expected general composition of fallout from a nuclear detonation in a homogeneous liquid medium (sea water) is reported. Simplified contaminants each containing a single fission product (FP) element and sea water applied to a painted surface were decontaminated by water washing. Decontamination as a function of initial level or surface density of most of the FP elements used follows the modified Freundlich relationship.

141. Z. Dlouhy and J. Maly, "Kinetics of Adsorption of a Mixture of Radioisotopes on Surface," Proceedings of the 2nd United Nations International Conference on the Peaceful Use of Atomic Energy, 2096-Czechoslovakia, vol. 28, Geneva, Switzerland, 1958.

Studies were made using platelets of stainless steel for determining the kinetics of desorption in the washing process and the kinetics of adsorption of the radioisotope causing the contamination of the surface as a function of concentration, pH of contaminating solution, and concentration of the inactive salts or decontaminating agent in the decontaminating solution. Results are given.

142. R. E. Larson and S. L. Williams, "Removal of Corrosion Products from High Temperature, High Purity Water Systems with an Axial Bed Filter," Corrosion, vol. 14, 1958.

The concentration of corrosion products and other impurities which produce undesirable radionuclides must be maintained at extremely low values in the primary coolant systems of nuclear power plants to keep the resulting dose rate below certain maximum values. Normally this has been accomplished by low temperature ion exchange of the pressurized water coolant. An axial bed filter has been developed which can remove radioactive corrosion products from high purity pressurized water coolant at operating temperatures.

143. W. B. Seefeldt, Alkaline Permanganate, ANL-6029, 1958.

The use of alkaline-permanganate, potassium permanganates and sodium hydroxide, to decontaminate reactors is described briefly.

144. Decontamination of Aluminum-Plutonium Alloys, HW-54735, General Electric, Richland, WA, 1958.

The excellent surface scrubbing action attained in ultrasonically agitated solutions was utilized to loosen the contamination particles from the alloy surface. A flowing water rinse cycle with continuous ultrasonic agitation flushed out the loosened radioactive particles leaving a nonsmearable surface after drying.

The work reported here was undertaken to develop a method for decontaminating plutonium containing aluminum alloys to a radioactively nonsmearable state.

145. General Instructions for the Recovery of Radioactive Contaminated Equipment, SC-4225 M, Sandia Corporation, Albuquerque, NM, 1958.

This document contains the essentials of the planning and action necessary for the recovery of radioactive contaminated equipment following a radiological disaster. Records are listed which should be collected before a disaster, and the training of personnel for recovery teams is outlined. Radiation doses, radiation indicators, and protective clothing are all treated in a general fashion. Procedures are given for the actual recovery of equipment, with emphasis on personnel safety, and decontamination techniques and materials are reviewed. Graphs and simple calculations are presented for determining safe work limits and radiation doses under varied conditions. A list of typical sources for radiological supplies and a brief bibliography are also included.

146. P. J. Barry, "Some General Considerations in Chemical Decontamination," Health Physics, vol. 1, Atomic Energy of Canada, Ltd, Chalk River, 1958.

The elementary principles involved in the removal of radioactive contamination from surfaces are given. The properties of the materials used in washing formulae and their use in freeing cotton from different forms of contamination and the role of detergents and sequestering agents in preventing re-contamination until the wash liquor is removed are described.

147. C. M. Unruh, Chemical Decontamination of the Internal Surfaces of Reactor Coolant Systems, HW-54509, General Electric, Richland, WA, March 1958.

This report deals with chemical decontamination of the internal surfaces of reactor coolant systems. The most reasonable decontaminate is found through variation of chemicals, concentrations and temperatures.

148. E. J. Witkowski, Radioactive Waste Disposal and Decontamination Annual Report for 1957, CF-57-12-143, Oak Ridge National Laboratory, Oak Ridge, TN, April 1958.

The main waste disposal facilities at Oak Ridge National Laboratory are covered including descriptions of the operations of the hot-chemical and the metal waste systems, the process waste system, and the radioactive gas system. Equipment decontamination and off-shift services are also described.

149. H. F. Jensen, Production Test Authorization IP-161-AE K-Reactor Test Internal Chemical Decontamination, HW-55849, General Electric, Richland, WA, April 1958.

This production test (IP-161-AE) establishes: 1) the decontamination efficiencies of Turco 4306-B when used as a through-pile internal decontaminant, and 2) corrosion effects of Turco 4306-B when used as a through-pile internal decontaminant.

150. T. D. Dow, Production Test Authorization IP-160-AE Determination of Corrosion Rates and Decontamination Efficiency of a Through-Reactor Application of Turco 4306-B, HW-55818, General Electric, Richland, WA, May 1958.

This production test authorizes the through-reactor application of Turco 4306-B as a decontaminating agent and the use of a rear nozzle flushing device (flow adaptor) for a prototype test on 11 selected process tubes at the DR-Reactor. The objectives of this test were: 1) to determine the corrosion effects on slug can walls and associated process tubes when Turco 4306-B and subsequent corrosion inhibitors are passed through the tubes, 2) to determine the decontamination effectiveness associated with the use of Turco 4306-B, 3) to establish procedures for the installation of flow adaptors and the addition of Turco 4306-B to the process water, and 4) to determine the effectiveness of decontaminating with flow adaptors in the rear nozzles as against no flow adaptors.

151. W. A. Oldham, Decontamination Studies in the 1706-KER Facility, HW-55720, General Electric, Richland, WA, April 1958.

A number of chemical reagents were tried and Turco 4463-2A gave some success on pieces that could be scrubbed vigorously while in the solution for 3 to 4 hr. A series of decontamination runs was made on pieces of the loop equipment using the Turco 4501 process. The specimens were successfully decontaminated to extremely low levels with only one decontaminating cycle.

All equipment pieces decontaminated were 304 stainless steel; some contained a small area of Stellite No. 6.

152. T. V. Lane, Corrosion Effects of a Turco 4306-B Simulated Flush on a 1706-KE Mock-Up Tube, HW-55854, General Electric, Richland, WA, April 1958.

Tests were made to determine the corrosive rates of the Turco 4306-B process on an aluminum mock-up tube. The Turco 4306-B process did not produce unusual or severe pitting on the tubes.

153. W. B. Cottrell et al., Disassembly and Postoperative Examination of the Aircraft Reactor Experiment, ORNL-1863, Oak Ridge National Laboratory, Oak Ridge, TN, April 1958.

The disassembly and examination of components of an aircraft reactor experiment was concluded in November 1954.

154. W. A. Oldham et al., Decontamination Studies in the 1706-KER Facility Phase II, HW-55987, General Electric, Richland, WA, May 1958.

This report contains data resulting from a continuation of the decontamination studies reported in HW-55720. All tests were conducted using the Turco 4501 Decontaminating Process, by varying the time, temperature, concentration, etc., of the various baths.

Most of the testing was done on materials from the high temperature KER loops. Several tests were also conducted on stainless steel pieces contaminated by 105-KE Reactor.

155. H. F. Jensen, Tests Performed at the K Reactors to Effectively Decontaminate the Process Piping by an Internal Chemical Flush, HW-56001, General Electric, Richland, WA, May 1958.

Tests were performed on the K-reactors to effectively decontaminate the process piping by internal chemical flushing with Turco 4306-B. Corrosion rates for Turco 4306-B upon aluminum were determined.

156. N. R. Miller, Supplement Authorization for Modifications of Production Test Authorization IP-160-AE, HW-55818, General Electric, Richland, WA, May 1958.

The concentration of the Turco 4306-B solution and length of time of injection for the desired decontamination efficiencies are presented.

157. H. F. Jensen, Production Test Authorization IP-164-AE Second K Reactor Test Internal Chemical Decontamination, HW-56039, General Electric, Richland, WA, May 1958.

The objective of this production test was to obtain additional information to corroborate the findings obtained from the Production Test Authorization, IP-161-AE. Tests were run to evaluate the effect of increasing the length of the decontamination flush, increasing the flow rate of the Turco solution, and improving the water flush after the decontamination to establish the decontamination procedures.

158. C. C. Wheeler, Production Test Authorization IP-170-I Decontamination of Internal Surfaces of Rear Face Fittings at D&D Reactors, HW-56198, General Electric, Richland, WA, May 1958.

The objective of this test was to reduce discharge area radiation levels and to determine the effectiveness of the decontamination of the internal surfaces or rear nozzles, pigtails and crossheaders by injecting Turco 4306-B into the fittings through the rear drain riser. The decontamination procedure used is given in detail.

159. L. D. Perrigo, The Turco 4501 Process for the Decontamination of Carbon Steel, HW-56090, General Electric, Richland, WA, May 1958.

The corrosive effects of the Turco 4501 on carboneous steel, its decontaminating ability and possible useful variations to the manufacturer's process are determined.

160. D. G. Stevenson, Recommended Reagents for Radiological Decontamination, AWRE-09 58/FWE-196, OUO, UKAEA, Aldermaston, England, May 1958.

Cleaning agents and decontaminants are cataloged to summarize the general recommendations of the AWRE Decontamination Research Section.

Details of composition, purpose and methods of use are given for a number of reagents and cover most of the problems encountered. Information is also given on laundry processes and certain special protective coatings.

161. T. D. Dow and R. B. Hall, Development Test Authorization IP-182-AE Decontamination of Process Tubes with Turco 4306-B Cleaner Prior to Removal from the Reactor, HW-56521, General Electric, Richland, WA, June 1958.

The Development Test Authorization (IP-182-AE) authorizes the through reactor application of Turco 4306-B at the DR reactor as a decontaminating agent on tubes prior to their removal. This test will determine the benefits to be gained in reduced personnel exposure by decontaminating tubes prior to removal and by reducing contamination on the tube removal equipment and the front and rear face fittings.

162. H. F. Jensen, Production Test Authorization IP-173-AE Reactor Rear Face Chemical Decontamination-105-KW Total Rear Face and Ten Crossheaders Including Pigtails and Nozzles, HW-56294, General Electric, Richland, WA, June 1958.

This Production Test Authorization performs a chemical decontamination on the rear face of the KW Reactor by flushing a chemical cleaner, Turco 4306-B, through 10 crossheaders and their component pigtails and nozzles. This test establishes the procedures for decontaminating the total rear face, and the Production Test Authorization approves the decontamination of the total rear face by the procedures tested if this method of performing a complete rear face decontamination is justified.

163. Radioactive Decontamination Process Enables Rebuilding of Worn Parts, Industrial Laboratories, vol. 9, no. 6, June 1958.

Worn or damaged parts are decontaminated to enable repair. Substantial savings were made through this decontamination and rebuilding process rather than the complete replacement of parts.

164. Disposal of Spent Demineralizer Resin from Nuclear Powered Ships, WAPC-COA-AP-106, Westinghouse Electric, Pittsburgh, PA, June 1958.

The disposal of spent demineralized resin from nuclear powered ships is outlined.

165. J. Bertrand, Tests for Decontamination of Surfaces Contaminated by Plutonium, CEA-868, July 1958.

Studies were made on the decontamination of polyvinyl and polyethylene watertight containers which are used to protect instruments. The polyvinyl containers were adequately decontaminated by washing with a nitric acid solution and fixing the surface with a plexiglass coating.

166. R. L. Rod, "Recent Advances in Ultrasonic Decontamination," Nucleonics, vol. 16, no. 7, July 1958.

Several types of ultrasonic decontaminators are described.

167. Internal Chemical Decontamination Through Reactor Decontamination with Turco 4306-B, HW-56001 A, General Electric, Richland, WA, July 1958.

This report sums up the data reported in the first interim report, HW-56001, and data compiled subsequent to the initial results. Of special interest will be the complete presentation of corrosion data indicating the effects of the Turco 4306-B and subsequent post-cleaning corrosion compared to normal corrosion rates experienced by aluminum dummies inserted in the rear nozzle configuration.

168. Decontamination with Turco-4306-B, HW-56001 B, General Electric, Richland, WA, July 1958.

Results are reported from Development Test IP-182-AE, "Decontamination of Process Tubes with Turco 4306-B Cleaner Prior to Removal from the Reactor." Materials Development Operation at DR Reactor performed this test on July 11, 1958 during a tube replacement outage.

169. Decontamination of Stainless-Steel with Acid-Persulfate Solutions, HW-56865, General Electric, Richland, WA, July 1958.

Acid-persulfate solutions are used as commercial descaling agents. These solutions were investigated as possible decontaminating agents for high-temperature, high-pressure reactor recirculation facilities. In this study emphasis is placed on gathering data pertaining to decontaminating effectiveness in static and dynamic systems and corrosive properties under these conditions.

170. Interim Report No. 4 on Internal Decontamination, Rear Face Process Piping Only with Turco 4306-B, HW-56001 C, General Electric, Richland, WA, July 1958.

Data was obtained from the chemical decontamination of rear face piping at the KW and DR Reactors with Turco 4306-B. These decontaminations differ from the previous decontaminations in that only the rear piping was decontaminated. The cleaner was not pumped through the process piping from the front face, but introduced into the rear crossheaders from the rear relief riser and back flushed through the pigtails and discharged out the rear nozzle.

171. J. E. Mendel, On the Laboratory Investigation of Carbon Steel Decontamination, HW-56875, General Electric, Richland, WA, July 1958.

Indications were that carbon steel could be adequately decontaminated from activated corrosion products. Decontamination factors of 10 to 20 and corrosion rates of less than 0.02 mil/hr were obtained with several formulations. Decontamination of stainless steel in the presence of carbon steel was more difficult. Oxalic acid and modifications of the Turco 4501 process appeared to be promising.

172. Corrosion Film Removal as an Indication of Decontamination Effectiveness, HW-58126, General Electric, Richland, WA, 1958.

The purpose of this report is to present the steps necessary to fulfill the requirements of Development Test Authorization IP-182-AE, which involves decontamination of process tubes with Turco 4306-B cleaner prior to removal from the reactor.

173. H. F. Jensen, Detailed Procedure for 105 KW Reactor Rear Face Decontamination by Chemical Flush of the Rear Crossheaders, Pigtail and Nozzles as Authorized by the Production Test Authorization IP-173-AE, HW-57248, General Electric, Richland, WA, August 1958.

The purpose of this procedure is to detail a chronological presentation of the preliminary decontamination and post-decontamination steps necessary to fulfill the requirements of the Production Test Authorization IP-173-AE. The procedure attempts to present the required operation in sufficient detail to successfully accomplish the intent of the test.

174. F. E. Owen, Effectiveness of Water Flushing as a Means of Decontaminating Amercoated Concrete Surfaces, HW-57135, General Electric, Richland, WA, August 1958.

The effectiveness of water flushing as a means of decontaminating Amercoated Concrete surfaces was tested with five variables: 1) water temperature, 2) addition of a wetting agent, 3) treating the paint with a water repellant, 4) contact time of contamination before flushing, and 5) prescrubbing the paint with a strong solution of "Tide" detergent.

Only the contact time of contamination before flushing seemed important for effective decontamination.

175. J. W. Snider and P. A. Haas, Dissolution of Zirconium and Stainless Steel Corrosion Product Oxides, CF-58-8-28, HRP-CPP., Oak Ridge National Laboratory, Oak Ridge, TN, August 1958.

Dissolution methods were developed to permit representative sampling of the slurry of corrosion and fission products collected by the HRT chemical processing plant. The procedure selected for HRT-CPP application was to use 15 ml of 10.8 M H_2SO_4/g of solids with agitation by boiling in a tantalum lined dissolver.

176. W. N. Koop, Internal Decontamination with Turco 4306-B -- Disposal Aspects, HW-56001 D, General Electric, Richland, WA, September 1958.

In an effort to develop a method to reduce personnel exposure rates in reactor discharge areas, individual process tubes have been flushed with the chemical cleaner Turco 4306-B. This is a report of the first experiment devised to provide information on precipitation of radioactive material from spent cleaning solution for possible use in developing a satisfactory disposal method. Results indicate caustic treatment and trench filtration should be used as the method for the disposal of the spent cleaning solution.

177. N. R. Miller et al., Production Test Authorization IP-203-AE 105-C Reactor Test Internal Chemical Decontamination, HW-57357, General Electric, Richland, WA, September 1958.

The objectives of this production test were: 1) to establish the decontamination effect of Turco 4306-B when used as a through reactor internal decontaminant of process tubes, 2) to compare two new Turco formulations against Turco 4306-B, and 3) to obtain additional corrosion data regarding aluminum and other reactor components contacted by Turco solutions. Procedures and results are given.

178. W. A. Oldham and R. D. Weed, Decontamination Studies in the 1706-KER Facility, Phase III, HW-57050, General Electric, Richland, WA, September 1958.

Additional data from continued decontamination studies in the high-temperature, high-pressure 1706-KER facility are presented. All tests have been conducted using the "Turco 4501 Decontamination Process,"

or modifications of the process since this is the only known process that will effectively decontaminate stainless steel exposed to high-temperature, high-purity water. Materials tested were 304 stainless steel, Stellite No. 6 and No. 12, graphite and 403 stainless steel.

179. R. L. Jolley, Equipment Decontamination Methods for the Fused Salt-Fluoride Volatility Process, ORNL-2550, Oak Ridge National Laboratory, Oak Ridge, TN, September 1958.

The decontamination methods studied included barren salt flushes, 0.5 M ammonium oxalate solution, 5 wt% nitric acid - 5 wt% nitrate solution, and 10 wt% sodium hydroxide - 2.5 wt% hydrogen peroxide - 10 wt% sodium tartrate solution. The latter solution was particularly effective in decontaminating descaled reactors and equipment exposed to gaseous reactants and products of the fluoride volatility process. Some of the decontamination procedures may be applicable in other fused salt projects such as the molten salt reactor.

180. R. H. Heiskell, Summary of Methods for Decontaminating and Protecting Concrete, USNRDL-TR-257, Naval Radiological Defense Laboratory, San Francisco, CA, September 1958.

Work conducted at NRDL since 1949 on the decontamination and protection of concrete is summarized. Studies have shown that ionic contaminant penetrates beneath the surface of bare concrete and surface removal methods are required to obtain more than 90% removal of contaminant. Dry and slurry contaminants are effectively removed by liquid cleaning methods and dry contaminants can be removed by vacuum pick-up. Protective coatings minimize the problem of removing ionic contaminants from concrete and increase the effectiveness of liquid cleaning methods in removing both dry and slurry contaminants.

181. F. C. Steiner, Decontamination of the KAPL-120 Loop by Alkaline-Permanganate-Acid Treatments, KAPL-M-SMS-95, November 1958.

The failure of a fuel element in the KAPL loop during April 1958 resulted in extensive radioactive contamination of the facility. The

decontamination of this facility using the alkaline-permanganate method is described, and an evaluation is given of the Turco process for decontamination.

182. R. M. Watkins, Study of Decontamination Agents for Use in the Yankee Reactor, YAEC-90, Yankee Atomic Electric, November 1958.

A study was made of chemical decontamination agents for possible use in the Yankee Reactor. Included is a survey of decontamination information and a description of the experimental test program. Bench scale tests indicated that a method employing basic permanganate and citrate solutions had the most promise. Data on corrosion of these solutions is reported along with a section on future larger-scale testing.

183. Chemical Decontamination for Tube Replacement, HW-58208, General Electric, Richland, WA, November 1958.

Decontamination of 64 tubes of 79 scheduled for replacement at DR on July 11, 1958, with a Turco 4306-B solution, indicated substantial benefits with a 90% reduction of airborne contamination, a reduction of 75% in dose rates on tools, and a 90% reduction in dose rates to personnel while handling used tools. A succeeding decontamination was performed on 77 tubes at DR in October 1958.

184. L. D. Perrigo and R. D. Weed, Dynamic Decontamination Studies Summary of ELMO-10 Operation from September 1, to November 1, 1958, HW-60604, General Electric, Richland, WA, November 1958.

Exploratory and screening tests on promising decontaminating processes were conducted in a small recirculation loop, ELMO-10. Methods showing good decontamination ability with low corrosion losses under static conditions were given their first dynamic evaluation in this facility. Emphasis was placed on obtaining information pertaining to the decontaminating effectiveness in a dynamic versus static system.

This report contains a summary of eight tests that were conducted in September and October.

185. B. Griggs, Decontamination of Reactors and Reactor Loops, Literature Review, HW-57642, General Electric, Richland, WA, November 1958.

The purpose of this document is to assemble and organize the data on reactor decontamination in order to develop and select compatible materials and decontaminants.

186. Summary of Decontamination Studies in the 1706-KER Facility for the Period 1-1-58 to 10-1-58, HW-57635, General Electric, Richland, WA, December 1958.

A number of chemical reagents and proprietary compounds were tested on the KER components during the decontamination studies. An extremely effective decontamination process, the "Turco Decontamination 4501 Process" manufactured by Turco Products, Inc., Los Angeles, CA, has demonstrated 95 to 100% effectiveness in removing activated corrosion products and fission products from high-temperature stainless steel recirculating systems.

187. J. H. Hoage, Production Test Authorization IP-228-AE Reactor Rear Face Chemical Decontamination 105-B Total Rear Face Including Pigtails and Nozzles, HW-58697, General Electric, Richland, WA, December 1958.

The objective of this Production Test Authorization was to obtain approval to perform a chemical decontamination on the rear face of the B-Reactor by flushing a chemical cleaner, Turco 4306-B, through all rear cross-headers and their component pigtails and nozzles. (See Reference 199 for the procedure.)

188. Reactor Chemistry and Plant Materials, WAPD-BT-11, Westinghouse Electric, Pittsburgh, PA, December 1958.

This is a compilation of reports including:

1) "Contamination Effects in Pressurized Water Reactors: The Effects of Surface Finish on Contamination by Particulate Activities."
2) "Third Interim Report on the Deposition of Corrosion Products Under Irradiation."
3) "Thermal Stability of Aqueous Solution of Some Decontamination Reagents for Pressurized Water Reactors."

4) "Batch Treatment Procedure for Wastes Containing Chromate at Inhibitor Concentrations."
5) "Flocculation - Adsorption Waste Disposal Treatment Investigation for Hot Laundry and Decontamination Room Wastes."
6) "Decontamination of the WAPD-29 Loop."

1959

189. Pressurized Water Reactor Project for the Period December 24, 1958 to February 23, 1959, WAPD-MRP-78, Westinghouse Electric, Pittsburgh, PA.

The technical progress on a pressurized water reactor project, a section on decontamination development and application, and a section on fission product source and detection of failed fuel elements are included.

190. Pressurized Water Reactor Project for the Period February 24, 1959 to April 23, 1959, WAPD-MRP-79, Westinghouse Electric, Pittsburgh, PA.

See Abstract for Reference 189.

191. L. D. Perrigo and R. D. Weed, Dynamic Decontamination Studies, Summary of ELMO-10 Operation from November 1, 1958 to July 1, 1959, HW-62122 General Electric, Richland, WA, 1959.

Exploratory and screening tests on promising decontaminating processes were conducted in a small recirculation loop, ELMO-10. Those methods showing good decontamination ability with low corrosion losses under static conditions were given their first dynamic evaluation in this facility. Emphasis was placed on obtaining information pertaining to the decontaminating effectiveness in a dynamic versus static system.

This report contains a summary of six tests that were conducted between November 1958 and July 1959.

192. W. B. Seefeldt, Reactor Decontamination, Liquid Phase, Foam, 6101, 1959.

The practicality of using foaming agents in the decontamination of reactors and the use of liquid decontaminating reagents are reviewed. The foams used were sodium salts of fatty acids, sodium alkyl sulfates, sodium salts of aliphatic sulfonic acids, and ethylene oxide condensation products. The liquid decontaminants were alkaline-permangantes, ammonium citrate and citric acid.

193. P. K. Conn et al., "Isotope Deposition Hazards in Gas Cycle Reactors," Amer. Nucl. Soc. Trans., vol. 1-2, 1958-1959.

An air line going through the reactor is used to reduce fission product activity.

194. R. E. Moore, Corrosion Evaluation of Effects of the Citric Acid-Disodium EDTA Decontamination Process on Plant Structural Materials With and Without Ultrasonics Treatment, WAPD-BT-25, Westinghouse Electric, Pittsburgh, PA, 1959.

A corrosion evaluation was made of the effects of the citric-acid disodium EDTA decontamination process on plant structural materials with and without ultrasonic treatment.

195. F. W. Davis, Discussion of the Decontamination of a High Pressure Water-Cooled Loop Using the Turco-4501 Process, BAW-99, General Electric, Richland, WA, 1959.

The decontamination of a high-temperature, water-cooled loop at Hanford Works, using the Turco-4501 Process, is discussed. Radiation levels of the loop components, resulting from both corrosion and fission product activities, were satisfactorily reduced. Radiochemical results for the various decontamination solutions are not available but radiation levels are plotted and the changes with each decontamination step are discussed.

196. J. Pomarola, "Problems of Decontamination," Franco-Italian Conference on Protection Held at Grenoble, AEC-TR-3952, 1959.

General decontamination procedures and a decontamination facility for equipment (layout, operation) are described.

197. P. C. Tompkins, "Surface Contamination and Decontamination," Radiation Hygiene Handbook, 1st Edition, Section 18, 1959.

The contaminability of various materials and methods of decontaminating these materials are explained.

198. W. N. Koop. Internal Decontamination with Turco 4306-B -- Disposal Aspects II, HW-56001 E, General Electric, Richland, WA, January 1959.

Soil column studies were conducted in support of the program to use Turco 4306-B reagent for decontaminating reactor tubes. Evaluation was accomplished by determining how effectively the trench soil would remove and retain radioisotopes from the spent cleaner as well as estimating the quantity of rupture debris that may be leached from the trench soil by this waste solution. A secondary purpose was to determine how minor modifications of the proposed disposal method would affect the radioisotope concentration in the Columbia River. Experimental results showed that trench soil will remove, from the spent cleaner, more than 99.9% of each of the five hazardous radioisotopes investigated. Experimental procedures and results are given in detail.

199. J. H. Hoage, Detailed Procedure for 105-B Reactor Face Decontamination by Chemical Flush of the Rear Crossheaders, Pigtails, and Nozzles as Authorized by Production Test IP-228-AE, HW-58747, General Electric, Richland, WA, January 1959.

The purpose of this procedure is to present the preliminary decontamination and post-decontamination steps necessary to fulfill the requirements of the Production Test Authorization IP-228-AE. The procedure attempts to present the required operation in sufficient detail to successfully accomplish the intent of the test.

200. C. C. Wheeler, Supplement a Production Test Authorization IP-170-AE Decontamination of Internal Surfaces of Rear Face Fittings at DR-Reactor, HW-58979, General Electric, Richland, WA, January 1959.

A supplement was added to authorize downtime for the determination of the relative effectiveness of a second decontamination of the internal surfaces of rear nozzle, pigtails, and crossheaders with Turco 4306-B.

201. W. B. Silker, Decontamination of Reactor Cooling Water with Aluminum, HW-59029, General Electric, Richland, WA, January 1959.

Aluminum turnings are used to decontaminate reactor cooling water.

202. J. R. Parrott, Evaluation of the Turco 4501 Process for Decontamination of the Thorex Dissolver, CF-59-1-23, Oak Ridge National Laboratory, Oak Ridge, TN, January 1959.

The Thorex dissolver was decontaminated with Turco reagents after 4 years operation. The Turco system of decontamination proved far superior to the previously used caustic-tartrate-nitric acid method.

203. J. M. Lojek and W. T. Lindsay, Attempted Decontamination of the Chalk River CR-VI Loop, WAPD-CDA-AD-50, February 1959.

The carbon steel CR-VI loop at Chalk River was given a three-stage treatment with dilute alkaline and neutral oxidizing-complexing solutions after failure of a U-Nb fuel alloy specimen. The treatment was unsuccessful in reducing the high radiation level in the vicinity of the delayed neutron monitor. The radiation was later shown to be caused by long-lived, leach-resistant fission products, which were present in a particle trap in the delayed neutron monitor piping.

204. Detailed Procedure for K Reactors Rear Face Decontamination by Chemical Flush of the Rear Crossheaders, Pigtail and Nozzles as Authorized by the Production Test Authorization IP-239-N, HW-59372, General Electric, Richland, WA, February 1959.

Detailed procedures were developed for K reactors rear face decontamination by chemical flush of the rear crossheaders, pigtails and nozzles.

205. J. L. Zegger and G. P. Pancer, Contamination and Decontamination in Nuclear Power Reactors, APAE-43, vol. 1, Alco Products, Schenectady, NY, February 1959.

A survey of the problem of reactor system contamination by radioactive material and methods that have been employed to remove the material was carried out. Following this survey, an investigation of chemical solutions was undertaken to find one which might be successfully employed in the

decontamination of a stainless steel steam generator. From a preliminary screening the most promising chemical method from the view point of minimum corrosion and maximum decontamination is a caustic permanganate treatment followed by an acid rinse.

206. J. L. Zegger and G. P. Pancer, Evaluation of Chemical Agents for Nuclear Reactor Decontamination, APAE-43, vol. 2, Alco Products, Schenectady, NY, February 1959.

The caustic permanganate-rinse decontamination treatment was investigated. Loop and metallurgical studies were performed to determine optimum operating conditions as well as the metallurgical effects of the treatment. A treatment with 10% sodium hydroxide and 5% potassium permanganate solution followed by a rinse with a 5% ammonium citrate, 2% citric acid and 0.5% Versene solution was chosen for the decontamination of a stainless steel steam generator. Decontamination factors of greater than 50 were obtained in loop tests using the above treatment. Corrosion and metallurgical results indicated a total penetration of less than 0.01 mil on annealed Type 304 stainless steel with no evidence of any deleterious effects.

207. G. P. Pancer and J. L. Zegger, Recommended Procedure for Decontamination of a Stainless Steel Steam Generator, APAE-43, vol. 3, Alco Products, Schenectady, NY, February 1959.

A decontamination procedure for a stainless steel steam generator similar to the APPR-1 using a fill-flush application of a caustic permanganate-citrate combination solution is recommended. The isolation of the steam generator is to be accomplished by means of specially designed plugs at the reactor vessel outlet and at the primary coolant pumps. Anticipated results, including corrosion rates and decontamination factors are presented.

208. H. V. Carabedian, Decontamination and Corrosion Resistance Tests of Some Selected Coatings, AECU-4187, March 1959.

The purpose of this investigation was to determine the characteristics of various coatings for a radiation facility and to determine the resistance of the coatings to corrosion and decontamination procedures.

209. R. J. Sherwood, editor, Short Course in Radiological Protection, AERE-L-101, UKAEA, Harwell, England, March 1959.

This is a general report on radiological protection which includes sections on the Control of Contamination and Decontamination and Waste Disposal.

210. R. D. Weed and L. D. Perrigo, Decontamination of the KER Rupture Product Prototype - Test Series A, HW-59659, General Electric, Richland, WA, March 1959.

An investigation was made using three different decontamination processes in a loop constructed of carbon steel and stainless steel. No effective method was demonstrated for dissolving UO_2 during the test.

211. R. M. Watkins, Development of Agents and Procedures for Decontamination of the Yankee Reactor Primary Coolant Systems, YAEC-117, Yankee Atomic Electric Company, March 1959.

This report covers recent developments on decontamination achieved under the Yankee Research and Development program. The cleaning, or decontamination of a large test loop was used to conduct corrosion rate studies for the Yankee reactor program. The basic permanganate-citrate decontamination procedure suggested for application in Yankee reactor primary system cleanup was used.

212. A. E. Symonds, Removal of Tritium Contamination from Surfaces of Metals, DP-367, DuPont De Nemours, April 1959.

The removal of tritium from metals by a heat treatment at 300°C for 30 min followed by quench treatments has been effective. The "smear" technique for detection of tritium on surfaces is more effective if the paper smear is wet with a low volatility compound (oil or glycerol).

213. A. P. Larrick and F. J. Lobsinger, Corrosion of Zr-2 and 304 Stainless Steel Following the Turco-4501 Decontamination Process, HW-59708, General Electric, Richland, WA, April 1959.

The corrosion effects of the Turco-4501 Decontamination Process solutions during and after decontamination are indicated.

214. W. W. Porter, Improved Rear-Face Decontamination B, C, D, DR, F, and H Reactors, HW-60131, General Electric, Richland, WA, April 1959.

Due to the uneconomical use of Turco 4300-B with zirconium tubes, there is a need for improved decontamination procedures in the B, C, D, DR, F, and H reactors.

215. J. W. Savage and D. J. Stoker, Equipment Decontamination by Abrasive Blasting in the Processing Refabrication Experiment, NAA-SR-3261, Atomics International, Canoga Park, CA, April 1959.

Abrasive blasting was investigated as a method of decontamination. Cut steel wire as an abrasive created less dust than mineral abrasives. A design study was made for an abrasive blasting system for decontamination in a cell (remotely operated) including a blast cabinet and requirements for an air-handling system.

216. W. A. Oldham, Preliminary Investigation of Alkaline Permanganate-Sodium Acid Sulfate for Decontamination of High Temperature Recirculating Systems, HW-60767, General Electric, Richland, WA, June 1959.

The preliminary results of an alkaline-permanganate-sodium acid sulfate decontamination process, which has demonstrated effective decontamination and low cost, are presented for stainless and carbon steels.

217. L. D. Perrigo and R. D. Weed, Decontamination Studies for HAPO High Temperature Reactor Recirculation Systems, June 1958-June 1959, HW-60677, General Electric, Richland, WA, June 1959.

This report summarizes studies done by HAPO on decontamination of the primary system of a recirculating type reactor, mainly using the Turco 4501 process.

218. Reactor Technology No. 10 - Chemistry, KAPL-2000-1, Knolls Atomic Power Laboratory, Schenectady, NY, 1959.

Radiochemistry and corrosion-coolant chemistry at the Knolls Atomic Laboratory are discussed.

219. Internal Chemical Decontamination of KW, KE, and B Reactors Rear Face Piping with Turco-4306-B, HW-56000l F, General Electric, Richland, WA, July 1959.

Results and the procedures from three highly successful reactor rear face decontaminations are presented.

220. H. A. McLain, Decontamination of the PRFR Pilot Leaching Plant Preliminary Process Design, CF-59-7-75, Oak Ridge National Laboratory, Oak Ridge, TN, July 1959.

The Turco 4501 process is recommended for the decontamination of the PRFR pilot leaching plant equipment and the caustic-tartrate-nitric acid process is recommended for the decontamination of the cell and the equipment exterior.

221. N. B. Garden and C. Dailey, High-Level Spill at the Hilac, UCRL-8919, Lawrence Radiation Laboratory, Berkeley, CA, September 1959.

On July 3, 1959, an accidental high-level radioactive spill occurred at the Hilac building. The main radioactive contaminant was ^{244}Cm. The accident itself, decontamination procedures, and medical and bioassay aspects are discussed.

222. W. E. Bost, Radioactive Decontamination, Literature-Search, TID-3535, Technical Information Service, Oak Ridge, TN, September 1959.

This bibliography includes 351 references to unclassified reports on radioactive decontamination. The following aspects were covered by the search: decontamination of surfaces of various materials, metals, equipment, buildings, clothing, skin, earth, etc. Both physical and chemical methods are included.

223. J. W. McVey, editor, Power Plant Disassembly Procedure, DC-61-6-16, October 1959.

The disassembly of the D102A power plant is described in detail.

224. J. C. Bresee, Reactor Coolant Decontamination, Literature Study, CF-59-10-124, Oak Ridge National Laboratory, Oak Ridge, TN, October 1959.

Literature on reactor coolant and coolant loop contamination and decontamination is reviewed. The survey covered the four main reactor coolant types (water, gas, organic, and liquid metal) and both activated corrosion products and fission product from leaks. The mechanisms and rates of deposition of the various materials in coolants are compared. Various chemical decontaminating solution compositions and procedures were collected.

225. R. D. Weed, Decontamination of the KER Rupture Experiment Loop Test Series B - Test No. 3, Test Series D - Test No. 1, HW-62844, General Electric, Richland, WA, November 1959.

The Bettis COD(S-4) decontamination process is compared to a Turco-Wyandotte combination decontamination process (Turco-4502 followed by Wyandotte-1112). Average specific decontamination factors and average total specific corrosion penetration are used for the comparison.

226. R. D. Weed, Decontamination of the KER Rupture Experiment Loop Test Series B - Test No. 1 and 2, HW-62598, General Electric, Richland, WA, November 1959.

A Turco process (Turco-4501, Turco-4502, Turco-4512) is compared to a dual cycle of the APACE process (alkaline-permanganate, ammonium citrate ethylenediaminetetraacetic acid). Decontamination factors and corrosion factors are used for the comparison.

227. A. P. Larrick, Additional Tests on the Corrosion of Carbon Steel Following the Turco-4512 Decontamination Process, HW-62690, General Electric, Richland, WA, November 1959.

A-212 carbon steel, 304 stainless steel and zircaloy-2 coupons were treated in Turco-4512-2b (inhibited phosphoric acid) decontaminating solution and then charged in a pH 10, 290°C recirculating water loop. The decontaminating solution pretreatment did not affect the corrosion behavior of 304 stainless steel or Zr-2 but did increase the carbon steel initial penetrations by a factor of 2 and the corrosion product film weight by a factor of 1.7 over those of the nontreated carbon steel coupons. The corrosion rate of the carbon steel coupons was not increased by the decontaminating solution pretreatment.

228. E. L. Christensen, Procedures for Decontamination of Plutonium from Various Surfaces, LAMS-2319, Los Alamos Scientific Laboratory, November 1959.

Decontamination solutions, procedures, and their effectiveness in the removal of plutonium from various types of surfaces are reported.

229. W. Resnick and E. Rau, Evaluation of the Corrosion Effects of a Concentrated Oxidizing Decontamination Solution on Reactor Plant Construction Materials, WAPD-BT-16, December 1959.

An evaluation of the corrosive effects of a concentrated oxidizing decontamination solution, COD (S.4), on Shippingport PWR construction materials has been completed. The test conditions used were: 1) exposure to COD (S.4) at 180 to 200°F under both static and flow conditions with

total exposure period equaling the estimated time needed to fill, circulate, and drain the solution from the plant; 2) tests at 275 to 300°F to simulate overheating the solution and 3) tests at 500°F to simulate heating of retained solutions to operating temperature. The results of these tests indicate that, with the exception of pump materials which will undergo further investigation in the near future, COD (S.4) does not attack PWR construction materials to such an extent as to preclude successful post decontamination plant operation.

230. R. Lloyd, Chemical Characteristics of COD (S.4) Solution for Solubilizing Uranium Dioxide Fuel and Associated Fission Product Contamination, WAPD-BT-16, December 1959.

A concentrated oxidizing decontaminating solution [COD (S.4)] has been under investigation for possible use in removing particulate, irradiated, sintered UO_2 fuel and the associated fission products that would contaminate the PWR primary system in the event of blanket fuel element ruptures. This paper reports on that phase of the study regarding the physical and chemical characteristics which influence the preparation, application and disposal of the COD (S.4) solution and the cleanup of the system following decontamination. The major conclusion from this test phase was that no significant deterioration in the performance of the reference COD (S.4) solution should result from its holdup time in the loop.

231. T. F. Demmitt and G. L. Stiffler, Effects of Velocity on the Corrosion Characteristics of Several Acidic Proprietary Decontaminating Solutions, HW-63008, General Electric, Richland, WA, December 1959.

A program has been initiated to define a decontamination procedure that will be effective in reducing the activity of reactor piping, stainless steel and carbon steel, and at the same time, minimize the amount of corrosion during the process. The corrosion characteristics of the following two-step decontamination processes were investigated: 1) standard alkaline-permanganate and 2) various acidic proprietary compounds. Three

types of corrosion for polished carbon steel were also investigated: 1) uniform steel, 2) carbon steel to stainless steel galvanic couples, and 3) concentration cell and galvanic couple. Results are given.

232. W. B. Silker, Effect of Temperature and Flow Velocity on the Decontamination of Reactor Effluent Water with Aluminum, HW-62874, General Electric, Richland, WA, December 1959.

The efficiency of aluminum turnings for the removal of several radioactive isotopes from reactor effluent water has been studied. Evaluation was made at flow velocities ranging from 43.6 to 872 cm/min and in the temperature range of 50.5 to 76.8°C.

233. Reactor Chemistry and Plant Materials, WAPD-BT-16, Westinghouse Electric, Pittsburgh, PA, December 1959.

An extensive series of tests, both in loops and in the laboratory, was undertaken to find a satisfactory decontaminating solution that would not be intolerably corrosive on PWR materials. These tests led to the suggestion of COD (S.4) as a decontaminant for use in PWR in the event of major blanket fuel rod failure with release of pieces of UO_2. The tests described in this report were conducted as a demonstration of the effectiveness of the selected solution under realistic conditions.

234. J. M. Lojek et al., Pilot-Plant Evaluation of COD (S.4) Decontaminational Solution for Removal of UO_2, WAPD-BT-16, Westinghouse Electric, Pittsburgh, PA, December 1959.

Methods used and results obtained during the pilot plant evaluation of the concentrated oxidizing decontaminants (COD) decontaminating solution are given. The possibility of a plant being severely contaminated as a result of a blanket fuel element failure led to the development of the COD (S.4) solution to dissolve the UO_2 fuel particles which might be distributed through the primary system. Early work showed that dilute oxidizing solutions were ineffective in dissolving sintered irradiated UO_2.

1960

235. Proceedings of the Eighth Conference on Hot Laboratories and Equipment, San Francisco, December 13-15, 1960, TID-7599, Sponsored by the Hot Laboratory Division of the American Nuclear Society, 1960.

The proceedings of a conference on hot cells and equipment sponsored by American Nuclear Society are reported with the following session titles: Hot Laboratory Facilities and Hot Cells, General Purpose Manipulators and Viewing, Shielding and Experiments, and Glovebox Design and Specialized Equipment.

236. G. M. Allison et al., Decontamination of the X-3 Loop Pressure Tube Using Alkaline-Permanganate and Ammonium Citrate Solutions, CRRL-940, 1960.

The pressure tube from the X-3 Loop in the NRX Reactor was decontaminated using alkaline-permanganate and ammonium citrate solutions. Decontamination factors obtained for uranium and for the major corrosion-product activities were in the range 1.5 to 2.1, considerably lower than those obtained in laboratory-scale tests.

237. H. F. Jensen, "Chemical Decontamination of the Hanford In-Production Reactors," Amer. Nucl. Soc. Trans., vol. 3, pt. 1, General Electric, Richland, WA, 1960.

An evaluation of the ion-exchange efficiency of zirconium phosphate and zirconium oxide was conducted with radioactive solutions of typical corrosion products. In these tests, two 100 ml columns were arranged in series, zirconium phosphate followed by zirconium oxide. Solutions passed through the columns were iron (0.06 ppm), chromium (0.0007 ppm), and cobalt (0.012 ppm), each having an activity concentration of about 0.5 μc/ml and a pH of 8.5. An equilibrium decontamination factor (i.e., constant ratio of influent to effluent activity) was determined for each nuclide.

238. J. L. Zegger and G. P. Pancer, "A Chemical Method for Nuclear Reactor Decontamination," Nuclear Engineering, vol. 56, no. 28, Chemical Engineering Progress Symposium Series, 1960.

An alkaline-permanganate-citrate treatment is used to decontaminate Type 304 stainless steel surfaces.

239. NPR Single Pass Decontamination, HW-63533, General Electric, Richland, WA, January 1960.

The design of the NPR showed large quantities of carbon steel pipe and fittings in the rear and front face areas. Most work would be done in these areas during an outage, and consequently lower radiation levels would be needed here than elsewhere in the piping system. A decontamination procedure was desired involving a short cycle and consisting of a single pass only through the front and rear piping. This report presents laboratory data pertaining to this procedure.

240. Research Equipment Waste Water, Pilot Disposal Plant, LADC-789, Los Alamos Scientific Laboratory, January 1960.

Considerable work has been done on decontamination procedures for both corrosion products and fission products. Testing of promising procedures under typical rupture conditions is an important phase of this work. The Irradiated Rupture Prototype (IRP) has been used since August in this evaluation work. This document is one of a series reporting these data.

241. L. D. Perrigo and J. F. Hokenson, Once Through Decontamination Studies, HW-63414, General Electric, Richland, WA, January 1960.

This report contains information on a series of tests performed in the 242-B single pass flow facility. Information concerning the following are presented:

1) Efficiency of decontaminating KER Loop 1 and 2 contaminated specimens.
2) Efficiency of decontaminating present reactor pigtails by different methods.
3) Areas that need further study.

242. Once Through Decontamination Studies, HW-63916, General Electric, Richland, WA, February 1960.

Four once-through decontamination tests were performed on contaminated H-Reactor pigtails using citric acid and proprietary decontaminating agents composed primarily of oxalic acid, phosphoric acid or sodium-bisulfate. Two other runs were made on KER Loop contaminated coupons and mockup tube pigtails using an inhibited phosphoric acid to determine once-through cleaning efficiencies on high temperature contaminated films.

243. The Irradiated Rupture Prototype (IRP) Design, HW-62701, General Electric, Richland, WA, February 1960.

This report gives a description, drawings, pictures, and comments on the Irradiated Rupture Prototype, which has been in use since August 1959. The program has been almost entirely that of decontamination process evaluation, but actual rupture testing of fuel elements is planned in the near future.

244. G. E. Wade, Project CAI-816 105-N Design Criteria, Reactor Single-Pass Decontamination System, HW-57017-REV. 1-RD, General Electric, Richland, WA, February 1960.

The design criteria for a reactor single-pass system and the requirements to be met, design descriptions and a criteria drawing are contained in the report.

245. G. P. Pancer, Engineering Study of Methods for Decontamination of SM-2, APAE-MEMO-234, Alco Products, Schenectady, NY, February 1960.

An investigation was performed to determine the most effective method of decontaminating SM-2. The results indicate that full system decontamination is more advantageous than partial decontamination. The engineering method and its associated hazards for both full and partial system decontamination are presented.

238. J. L. Zegger and G. P. Pancer, "A Chemical Method for Nuclear Reactor Decontamination," Nuclear Engineering, vol. 56, no. 28, Chemical Engineering Progress Symposium Series, 1960.

An alkaline-permanganate-citrate treatment is used to decontaminate Type 304 stainless steel surfaces.

239. NPR Single Pass Decontamination, HW-63533, General Electric, Richland, WA, January 1960.

The design of the NPR showed large quantities of carbon steel pipe and fittings in the rear and front face areas. Most work would be done in these areas during an outage, and consequently lower radiation levels would be needed here than elsewhere in the piping system. A decontamination procedure was desired involving a short cycle and consisting of a single pass only through the front and rear piping. This report presents laboratory data pertaining to this procedure.

240. Research Equipment Waste Water, Pilot Disposal Plant, LADC-789, Los Alamos Scientific Laboratory, January 1960.

Considerable work has been done on decontamination procedures for both corrosion products and fission products. Testing of promising procedures under typical rupture conditions is an important phase of this work. The Irradiated Rupture Prototype (IRP) has been used since August in this evaluation work. This document is one of a series reporting these data.

241. L. D. Perrigo and J. F. Hokenson, Once Through Decontamination Studies, HW-63414, General Electric, Richland, WA, January 1960.

This report contains information on a series of tests performed in the 242-B single pass flow facility. Information concerning the following are presented:

1) Efficiency of decontaminating KER Loop 1 and 2 contaminated specimens.
2) Efficiency of decontaminating present reactor pigtails by different methods.
3) Areas that need further study.

242. Once Through Decontamination Studies, HW-63916, General Electric, Richland, WA, February 1960.

Four once-through decontamination tests were performed on contaminated H-Reactor pigtails using citric acid and proprietary decontaminating agents composed primarily of oxalic acid, phosphoric acid or sodium-bisulfate. Two other runs were made on KER Loop contaminated coupons and mockup tube pigtails using an inhibited phosphoric acid to determine once-through cleaning efficiencies on high temperature contaminated films.

243. The Irradiated Rupture Prototype (IRP) Design, HW-62701, General Electric, Richland, WA, February 1960.

This report gives a description, drawings, pictures, and comments on the Irradiated Rupture Prototype, which has been in use since August 1959. The program has been almost entirely that of decontamination process evaluation, but actual rupture testing of fuel elements is planned in the near future.

244. G. E. Wade, Project CAI-816 105-N Design Criteria, Reactor Single-Pass Decontamination System, HW-57017-REV. 1-RD, General Electric, Richland, WA, February 1960.

The design criteria for a reactor single-pass system and the requirements to be met, design descriptions and a criteria drawing are contained in the report.

245. G. P. Pancer, Engineering Study of Methods for Decontamination of SM-2, APAE-MEMO-234, Alco Products, Schenectady, NY, February 1960.

An investigation was performed to determine the most effective method of decontaminating SM-2. The results indicate that full system decontamination is more advantageous than partial decontamination. The engineering method and its associated hazards for both full and partial system decontamination are presented.

246. D. W. Danielson and M. L. Brewer, Vallecitos Boiling Water Reactor Decontamination Program, GEAP-3372, General Electric, March 1960.

A test program was carried out to determine the corrosion effects and decontamination efficiency of selected solutions for use in the VBWR system. Local and non-chemical decontamination methods were also considered, Local decontamination with a power wire brush was the method finally used.

247. W. D. Bainard, 100-N Decontamination Facility Design Guide, HW-64154, General Electric, Richland, WA, March 1960.

The design of a decontamination facility for the 100-N Area at Hanford is outlined with regard to various functions such as decontamination of the single pass reactor, the single cell primary loop, and the major primary loop.

248. T. F. Demmitt et al., Decontamination Studies for HAPO High Temperature Reactor Recirculation Systems, June 1959 to January 1960, HW-62806, General Electric, Richland, WA, March 1960.

An intensive decontamination program at the Hanford Atomic Products Operation was conducted to determine the effectiveness of prospective processes for decontamination of: 1) high-temperature, recirculating, water-cooled, and 2) low-temperature, single-pass, water-cooled nuclear reactor systems. Candidate processes were also being evaluated to determine their corrosion characteristics.

The general decontamination procedure involves a hydrogen peroxide solution for uranium dioxide dissolution, an alkaline-permanganate solution for film conditioning, and an acidic solution for film removal. Several variations of this procedure were evaluated for application in specific situations.

249. H. J. Jensen, Chemical Decontamination of the Hanford Production Reactors, HW-SA-1851, General Electric, Richland, WA, March 1960.

The development and application of a safe, economical, and reliable method for decontaminating Hanford reactors is outlined. The system developed resulted in considerable reductions in personnel exposure and

dollar savings. The chemical, a formulation containing sulfuric acid coupled with salts, wetting agents and inhibitors, was satisfactory for removing radioactive films which cause radiation exposure.

250. E. R. Sorom, Material Decontamination at Nevada Test Site, TID-19108, April 1960.

A decontamination evaluation program was conducted to determine the most practical and economical methods for removing radioactive contaminants from skin, clothing, masks, metals, and miscellaneous equipment at the Nevada Test Site (NTS). Due to the lapse in time since a general operation at NTS most of the test material was artifically contaminated with weapon test debris to simulate actual field conditions.

251. D. T. James, Requirements for Radioactive Decontamination of P140B1 Power Plant, Remote Handling Equipment Design Unit, DCL-60-4-41, General Electric, Cincinnati, OH, April 1960.

Ultrasonics and chemical decontaminants are proposed to decontaminate the P140B1 power plant.

252. W. J. Posey, editor, Progress No. 57 for February and March 1960, MSAR-60-49, MSA Research Corporation, Callery, PA, April 1960.

Progress related to reactor coolant problems is reported. Included is a section on decontamination with the following subsections: Industrial Survey Questionnaire, Evaluation of Decontaminating Solutions-Electrolytic Descaling, Improvements in Physical Procedures, Evaluation of Crevice Decontamination, Component Decontamination, and Decontamination of Waste Solutions.

253. H. F. Jensen, Chemical Decontamination Activities 105-Reactors During the Period July 1959 through April 1960, HW-56001 G, General Electric, Richland, WA, May 1960.

The activities carried out by the Material Development unit involving the efforts to decontaminate the 105 Production Reactors are summarized.

The use of steam cleaners has established an effective maintenance tool for decontaminating procedures on short notice. Satisfactory results were obtained using Turco 4306-B cleaning solution.

254. G. A. West and C. D. Watson, Decontamination Testing of Highly Contaminated Protective Coatings, ORNL-2811, Oak Ridge National Laboratory, Oak Ridge, TN, May 1960.

Decontaminability measurements of 34 protective coatings (primarily vinyls and epoxies) and 10 comparative control surfaces (metals, glass, and plastics) highly contaminated with either mixed fission products from typical Purex waste or Oak Ridge National Laboratory Thorex waste did not indicate any unusual improvement over coatings tested in 1950 (AECD-2296).

Coatings determined to be sufficiently decontaminated from Purex waste by a water flush and acid scrub and to be of superior resistance to common acids and alkalis are: DuBois Peel-Filmite, Nukemite-33, -40, Amercoat-31, -33HB, -23, -55 and 33, Polyclad 120-1 DG, Ucilon-K, DEL Series A, du Pont Eng. 6200 system 1 and 2, and Polychem-1500. Only Ucilon-K, Amercoat-31, Peel-Filmite, Nukemite-40 and possibly Amercoat-35 and Polychem-1500 appeared useful in the presence of Thorex contamination.

255. G. I. Maughan, Bibliography on Radioactive Decontamination of Areas and Equipment, DEF-1NF-SER-147, UKAEA, Risley, England, June 1960.

A selection is presented of 124 unclassified references listed under books, reports, patents, and journal references to the decontamination of areas and equipment. Sources searched included Nuclear Science Abstracts (1947 to date), Engineering Index (1950-1958), and Applied Science and Technology Index (1959-March 1960).

256. L. D. Perrigo, Once-Through Decontamination Studies on Reactor Components, HW-65523, General Electric, Richland, WA, June 1960.

Several decontamination tests on Hanford reactor components were made in a study to develop effective and workable once-through decontamination processes. These tests gave results varying from very successful to ineffective component decontamination.

257. P. S. Kingsley and M. L. Short, Decontamination, HW-63110, General Electric, Richland, WA, June 1960.

This report reviews the development of decontamination procedures for large, high unit cost, chemical processing equipment. This equipment is used in separating fission products from non-fissioned material contained in irradiated plutonium-producing fuel elements. Stainless steel constructions permit the use of aggressive chemicals including strong acids to dislodge the contaminated particles. The optimum procedures are generally dictated by what is to be decontaminated and the particular contaminants present. In most cases the contaminants are fission products ranging from 0.1 MeV gamma energy to 0.75 MeV level.

258. E. E. Pierce, Relative Effectiveness of Decontamination of Various Stainless Steel Surface Finishes, CF-60-6-54, Oak Ridge National Laboratory, Oak Ridge, TN, June 1960.

An investigation was made to obtain information on surface finish specifications, prices, and decontamination properties of stainless steel. Samples studied were 1/4 in. plate - No. 1 finish, 3/16 in. sheet - No. 1 finish, and 11 gauge sheet - 2B finish.

259. C. C. Crothers, Chemical Decontamination of the ANL-2 High-Pressure Loop, ANL-6151, Argonne National Laboratory, July 1960.

The chemical decontamination of the ANL-2 High-pressure Water Loop at the MTR is described. Three separate chemical treatments were employed, each followed by a water flush. A mixture of sodium hydroxide and potassium permanganate was first applied to partially oxidize and loosen the magnetite corrosion film on the loop surfaces. Next, the system was treated with a solution of Versenol 120 to remove and suspend the loosened oxide film. The third chemical treatment was a mixture of sulfamic acid, HEDTA, hydrazine, and Rodine 80. After the first two chemical treatments a brown residue remained, which was presumed to be manganese dioxide. The third solution completely removed all traces of residue from the first two treatments.

260. F. P. Hungate, Decontamination of Plants Exposed to a Simulated Reactor Burn, HW-63173, General Electric, Richland, WA, July 1960.

^{131}I was decontaminated from plants using H_2O, NaS_2O_3, acetone, Tide, HCl, plastic stripping and ultrasonics.

261. F. E. Owen, Results of PT-IP-336-R Reactor Rear Face Decontamination 105-H, HW-66151, General Electric, Richland, July 1960.

The object of this test was to reduce the 105-H rear face dose rates as economically as possible with Turco 4306-B. The method chosen was basically the same one used at "H" January 1959, incorporating the use of a loosened rear nozzle cap for flow control. Several improvements were planned from the experience of the previous H Reactor rear face Turco decontaminations.

262. W. S. Brown and C. A. Bergmann, "Reducing Radioactivity Buildup in PWRs," Nucleonics, vol. 18, no. 7, Alco Products, Inc., Schenectady, NY, July 1960.

Radioactivity of the PWR is reduced through design considerations.

263. S. J. Rodgers and W. A. Everson, Industrial Survey on Decontamination of Radioactive Components, MSAR-60-89, MSA Research Corporation, Callery, PA, July 1960.

A total of 330 questionnaires were sent to 113 different companies to obtain information on currently used chemical and mechanical methods of decontamination. Completed returns were received from 63 companies (56%) representing a total of 75 replies. The data have been compiled to give a representative cross section of standard decontamination practices.

264. G. E. Neibaur, Decontamination Evaluation Facility, HW-SA-1968, General Electric, Richland, WA, August 1960.

The Irradiated Rupture Prototype is a facility for studying decontamination problems. It was designed to circulate water at 600°F and 2000 psi under gross fission product contamination conditions. It was prototypical

of a high-temperature pressurized water reactor system. Contamination was accomplished by purposely rupturing an irradiated fuel element in a detachable cask designed for high temperature and pressure. Candidate decontamination processes were then evaluated in cleaning up the loop. Data on decontamination factors, corrosion, effects of filtering, dead logs, and velocity were obtained.

265. J. E. Mendel, Laboratory Investigation of Decontaminating Solutions for Present Reactors, HW-67037, General Electric, Richland, WA, September 1960.

Studies were done to find effective decontaminating agents whose corrosive attack on Zircaloy-2 as well as on aluminum is satisfactorily low.

266. G. E. Neibaur, Decontamination of IRP with Phosphoric Acid Processes, HW-66690, General Electric, Richland, WA, September 1960.

Recent tests with one proprietary acid compound, "Phos-1", show promise for both total NPR reactor decontamination by recirculating the decontaminants and for a single-pass decontamination cycle of the front and rear piping. The tests were made in a fission product contaminated loop, the Irradiated Rupture Prototype (IRP).

267. I. Charak, Removal of EBWR Fuel Element Scale by Slurry Honing, ANL-6216, Argonne National Laboratory, Argonne, IL, September 1960.

The scale deposit on the EBWR fuel plates can be removed by slurry honing the plates with an abrasive-water mixture. Problems inherent in any production operation of this type are noted. Areas of continued investigation of the method are suggested.

268. G. G. Plastino, Procedure, Material, Equipment and Facilities Requirement for Decontamination of D140E-1 Power Plant, DC-60-10-726, General Electric, October 1960.

This report has been prepared to outline the methods, procedures, materials, equipment and facilities requirements for remote and/or manual decontamination of the X-211 turbomachinery.

Included are a discussion of the chemical and physical aspects of the plate-out particulate, a classification of materials into major groups, a general decontamination procedure for the various material groups, methods and procedures for decontaminating the major components of the turbine and compressor assemblies, general description of the solutions and materials to be used, equipment, utilities and facilities required.

269. Effects of Turco 4501A, 4502, 4518 Decontaminating Reagents on Stainless Steel Bearing Materials Experimental Gas Cooled Reactor, TID-11396, Allis-Chalmers Manufacturing Company, October 1960.

This study considers the effects of Turco (4501A, 4502, 4518) decontamination reagents on AISI 440 C stainless steel. Considerable corrosion was discovered to occur.

270. A. B. Meservey et al., Decontamination of EGCR Charge and Service Machines, CF-60-10-46, Oak Ridge National Laboratory, Oak Ridge, TN October 1960.

Methods have been developed for the noncorrosive removal of volatile fission products and UO_2 dust from carbon steel and stainless steel. Procedures are described for applying these methods to the decontamination of the EGCR charge and service machines.

271. J. E. Mendel, Laboratory Investigation of Decontamination Solutions for Primary Loop Decontamination in the New Production Reactor, HW-67364, General Electric, Richland, WA, November 1960.

An investigation of methods for decontaminating the primary loop of the New Production Reactor (NPR) is described. The decontamination problem is unusual because both carbon steel and stainless steel are used in the loop.

The Coolant System's Development Operation is investigating possible NPR decontamination procedures in test loops. Preliminary beaker scale testing of several potential decontaminating solutions was done by the Development and Corrosion Operation.

272. Dynamic Decontamination Studies, Summary of ELMO-10 Scanning Tests with Contaminated S1W Boiler Tubing, HW-67202, General Electric, Richland, WA, November 1960.

Exploratory and screening tests on promising decontaminating processes were conducted in a small recirculation loop, ELMO-10. Those methods that have shown good decontamination ability with low corrosion losses under static conditions were given their first dynamic evaluation in this facility. Emphasis was placed on obtaining information pertaining to the decontaminating effectiveness in a dynamic versus static system.

This report is a summary of the tests that were conducted in the ELMO-10 facility using contaminated sections of the boiler tubing from the S1W.

273. C. A. Bergmann, SM-1 R&D Program Long-Lived Induced Activity Buildup During SM-1 Core I Lifetime Task XVIII - Phase I, APAE-77, Alco Products, Schenectady, NY, November 1960.

The results of activity buildup studies in the SM-1 performed during Core I lifetime (June 3, 1957 to April 28, 1960) are reported. Data are presented on the extent, nature, and mechanism of the buildup of long-lived gamma emitting nuclides in the reactor primary system. Radiation levels after reactor shutdown are presented, as well as mathematical equations used to account for the observed activity levels.

274. F. W. Davis, Reactor Decontamination, Literature-Review, BAW-1217, Babcock-Wilcox Company, New York, NY, December 1960.

The purpose of this document is to detail the problem of reactor decontamination and to review the unclassified literature on chemical decontamination methods. On this basis recommendations are given for chemicals and procedures to be used in chemical decontaminations.

275. J. A. Ayres, Decontamination Studies for HAPO Water-Cooled Reactor Systems, January 1, 1960 through September 1, 1960, HW-67937, General Electric, Richland, WA, December 1960.

See Abstract for Reference 248.

276. A. B. Meservey, Procedures and Practices for the Decontamination of Plant and Equipment, CF-60-12-71, Oak Ridge National Laboratory, Oak Ridge, TN, December 1960.

A review has been made of 131 papers and progress reports on equipment decontamination. The review is to comprise an invited chapter for inclusion in Volume 4 of Progress in Nuclear Energy, Series IV, Technology, Engineering, and Safety, published by Pergamon Press.

277. A. B. Meservey, Decontamination of EGCR Components, CF-60-12-37, Oak Ridge National Laboratory, Oak Ridge, TN, December 1960.

Further developments in methods for the decontamination of EGCR components are described. Oxalate-peroxide mixtures at controlled pH compared favorably with other decontamination reagents for stainless steels, including sulfuric, nitric, citric, tartaric, and phosphoric acid mixtures and several proprietary reagents. The corrosion of dilute sulfuric acid on stainless steel was reduced and its decontamination effectiveness increased by the addition of hydrogen peroxide. Peroxide acted as a corrosion inhibitor with H_2SO_4-NaF mixtures also. Steam spraying with oxalate reagents was an effective method of removing contamination from gas loop piping. Ammonium oxalate was superior to sodium oxalate in peroxide mixtures both in speed of UO_2 dissolution and in decontamination effectiveness. This report is a continuation of ORNL-CF-60-10-46, Decontamination of EGCR Charge and Service Machines.

1961

278. S. Siegel, "Decontamination Processes for Boiling Water Reactors," American Nuclear Society Trans., vol. 4, GE-APED, 1961.

This review deals with the decontamination of a boiling water reactor using alkaline-permanganate solutions.

279. A. B. Meservey, "Procedures and Practices for the Decontamination of Plant and Equipment," Progress in Nuclear Energy Series 4, vol. 4, Oak Ridge National Laboratory, Oak Ridge, TN, 1961.

The removal of contamination from the metal surfaces of chemical processing equipment and reactors with chemical solutions is reviewed.

280. Dissolution of Uranium Oxides Formed During a Fuel Element Failure, HW-69594, General Electric, Richland, WA, 1961.

The failure and corrosion of metallic uranium fuel elements in a high-temperature pressurized water system produces uranium oxides with a large percentage of the fission products remaining associated with these oxide particles. Decontamination of such a system requires dissolution and/or flushing of these oxides from the system. This report covers some of the laboratory and pilot plant work directed toward this problem.

281. E. Mestre, "La Decontamination Des Surfaces," Energie Nucleaire, vol. 3, Commissariat, A, L, Energie Atomique, 1961.

Studies relating to the process of decontamination are described. The process is related both to the nature of the radioactive product and that of the surface contaminated. These investigations were preceded by contaminating tests from which the factors that govern the process were derived.

On the basis of the results obtained a choice could be made of the most convenient decontaminating processes and the materials least likely to retain radioactive products on their surfaces could be selected.

282. R. D. Weed, Inhibition Studies in Reactor Decontaminants, HW-SA-2080, General Electric, Richland, WA, January 1961.

Dibasic ammonium citrate solutions were shown to have promise as decontaminants for high-temperature water recirculating systems when preceded by an alkaline-permanganate solution. The ammonium citrate solutions, when used at the effective conditions, gave corrosion rates which are above the maximum desired rate in a nuclear reactor system containing carbon steel piping and other materials. A number of organic compounds were evaluated as inhibitors in solutions designed for decontamination of nuclear reactor systems. Of the compounds tested, tri-n-propylamine and tri-n-dodecylamine indicated the best inhibition at 85°C.

283. M. E. McMahan, "New Decontamination Chamber," American Nuclear Society Trans., vol. 4, General Electric, Richland, WA, 1961.

A spray-type decontamination chamber was installed in the Hanford Radiometallurgy Laboratory which reduced the radiation exposure, airborne contamination, cleaning time, and assault mask time.

284. L. J. King and J. C. Bresee, Plutonium Release Incident at Oak Ridge National Laboratory, CF-60-9-57, Oak Ridge National Laboratory, Oak Ridge, TN, January 1961.

A nonnuclear explosion involving a radioactive pilot plant evaporator occurred at Oak Ridge National Laboratory on November 20, 1959. Plutonium was released to the environment. Contamination was bonded to the nearby street and building surfaces with tar, paint, roofing compound, or masonry sealer. The pilot plant building except for the processing cells was 95% decontaminated by September 1, 1960.

285. A. M. Potesta and R. M. Watkins, "Proposed Water Cooled Reactors Decontamination System," Energia Nucleare, vol. 8, no. 2, Fiat General Atomic, February 1961.

A proposed decontamination system for water cooled reactors is described. The system is designed to be used before maintenance operations in the primary system if biological radiation tolerances would be exceeded. The decontamination procedure involves the oxidation of the corrosion product film by an alkaline-permanganate solution followed by the removal of the oxidated film by an ammonium citrate solution.

286. L. J. King and W. T. McCarly, Plutonium Release Incident of November 20, 1959, ORNL-2989, Oak Ridge National Laboratory, Oak Ridge, TN, February 1961.

A more complete report was made of the decontamination activities following a nonnuclear explosion at Oak Ridge National Laboratory which occurred November 20, 1959. See Reference 284.

287. S. J. Rodgers and W. A. Everson, Decontamination of Radioactive Components, MSAR-61-34, Westinghouse Electric, Pittsburgh, PA, March 1961.

A study was undertaken to provide information for a handbook of a decontaminating procedure being prepared by BuShips as a guide to vendors in decontaminating nuclear power plant components. Topics covered include an industrial survey of decontamination techniques and evaluations of decontaminating solutions, crevice decontamination, electrolytic methods, mechanical aids, component decontamination, and methods of decontaminating contaminated waste solutions.

288. J. Pattison and G. N. Walton, Distribution of Radioactive Materials in a Circuit, AERE-R-3661, UKAEA, Harwell, England, April 1961.

Equations were developed for the distribution in a circuit of material which is both rapidly deposited on the walls of the system, and also slowly removed from the walls by the circulating fluid. Solutions of the equations

are compared with the results obtained for the transport of activated corrosion products in a high temperature pressurized water loop. The results show that deposition and emission for uncorroded surfaces are faster than those for corroded surfaces. Estimates are made of the effective corrosion rate and of the "residence time" of material deposited on surfaces.

289. T. L. Hoffman and G. S. Adams, Corrosion of Alloys in Various ICPP Decontamination Solutions, IDO-14506, Phillips Petroleum Company, April 1961.

Corrosion studies were conducted on stainless steel type 347 and Carpenter-20, Monel, titanium 55A, and tantalum in decontamination solutions. These solutions are: 10% nitric acid, 10% citric acid, 10% sodium hydroxide - 2.5% tartaric acid, 10% oxalic acid, 0.003M periodic acid in 0.05M nitric acid, 3% sodium fluoride - 20% nitric acid, Turco 4501 and Turco 4502, and 0.25M phosphoric acid. Boron stainless steel type 304L was studied in 10% sodium hydroxide - 2.5% tartaric acid, 10 and 60% nitric acids, Turco 4501 and Turco 4502.

The two austenitic stainless steels are acceptable construction materials for handling each of the decontamination solutions except 3% sodium fluoride - 20% nitric acid. Special limitations are defined for Monel, titanium 55A, and tantalum when exposed to decontamination reagents.

290. R. D. Weed, Decontamination of the GEH P-7 Loop After the Sixth Rupture Test, HW-69557, General Electric, Richland, WA, May 1961.

The actual decontamination of the GEH P-7 loop is reported in log form beginning with the discharge of the ruptured element and noting the items of importance as the decontamination procedes. Also included are special limitations required for the safe containment of the contamination.

291. L. D. Perrigo, Study of Radionuclide Adsorption in the K Recirculation Loops, HW-69612, General Electric, Richland, WA, May 1961.

An intensive study of radionuclide adsorption in high-temperature recirculation systems was made at Hanford. The objectives of this work were

to identify the adsorbed species, to determine the build-up characteristics and to discover the surface distribution of radioactive species on metal surfaces. In a period of 3 years, the identity, build-up behavior and surface distribution of adsorbed species were determined in carbon and stainless steel loop systems operating with a high pH coolant. Preliminary adsorption information is given for low and neutral pH coolant systems. The source of the activated corrosion product materials in these pressure tube systems was found to be the out-of-reactor portion of the loop. Particulate matter as dissolved species appear responsible for transporting radioactivity throughout the recirculation loop systems.

292. L. D. Perrigo, Corrosion Phenomenon Observed Following Several Decontamination of a Pressurized Water Reactor Prototype, HW-SA-2163, General Electric, Richland, WA, May 1961.

A test was made to determine the corrosive effects of the APACE process on an out-of-reactor test loop composed of carbon and stainless steels.

293. L. F. Donovan, SM-1 R and D Program Decontamination of SM-1 Primary System Task XVI-Phase I, APAE-87, Alco Products, June 1961.

A method is reported to decontaminate the SM-1 steam generator. Special plugs were inserted in the reactor outlet nozzle and the casings of both primary coolant pumps. The plugs isolated the steam generator from the remainder of the primary system and allowed for introduction and removal of the decontamination solutions. Radioactive deposits were removed by circulating a solution of caustic permanganate followed by a water rinse, ammonium citrate-citric acid - Versene 9 solution and several more water rinses.

294. R. D. Weed, Evaluation of Reactor Decontamination, HW-SA-2218, General Electric, Richland, WA, June 1961.

Tests began with the laboratory beaker scanning studies and progressed through dynamic loop scanning, grossly contaminated system studies, cyclic

corrosion evaluations and in-reactor loop decontamination tests. A typical process is described in which a compound consisting primarily of sulfamic acid is evaluated. Typical results are given for this process as it is evaluated in the various stages.

295. SL-1 Recovery Operations January 3 through May 20, 1961, IDO-19301, Combustion Engineering, Idaho Falls, ID, June 1961.

A nuclear excursion occurred in the SL-1 plant at the Nuclear Reactor Testing Station on January 3, 1961. Three operators who were assembling the control rod and drive mechanism following a 10-day plant shutdown were fatally injured. For a week following the excursion, a NRTS disaster plan was effected for recovery of the three casualties and for assessment of the SL-1 reactor shutdown condition. A plan for decontamination of the SR-L reactor, the removal of the case, razing of the reactor buildings and decontamination of the support facilities is included. The plan is separated into two tasks: 1) high level decontamination by remote techniques and 2) low level decontamination by direct personnel effort.

296. A. B. Meservey, Minutes of Third Meeting of Reactor Decontamination Information Exchange Group at ORNL June 1-2, 1961, CF-61-7-82, Oak Ridge National Laboratory, Oak Ridge, TN, July 1961.

An AEC-sponsored Reactor Decontamination Information Exchange Group met June 1-2, 1961. This report summarizes the research on decontamination at nine reactor installations which was accomplished in the preceding 6 months.

297. L. D. Perrigo and R. G. Moles, Cyclic Corrosion Testing of an Inhibited APACE Decontaminating Process in TF-14, HW-71211, General Electric, Richland, WA, September 1961.

The long-term corrosion effects resulting from the use of an inhibited APACE Decontamination Process were studied by alternating high-temperature loop operation with chemical defilming. Carbon steel, stainless steel, Zircaloy-2, welded carbon and stainless steels, and stress specimen corrosion

losses were low. The greatest attack occurred on carbon steel welded to stainless steel. Localized penetration on these specimens at the weld ranged from 3 to 4 mils after eight cycles. The use of alkaline manganate for the film conditioning step produced a dendritic attack on Stellite alloys but generally this penetration was less than 2 mils. Stellites were found, however, to have honeycomb-type voids that the alkaline manganate solutions could enter and cause severe localized corrosion.

298. J. R. Parrott, Decontamination of Cells 6 and 7, Building 3019, Following Plutonium-Release Incident, ORNL-3100, Oak Ridge National Laboratory, Oak Ridge, TN, September 1961.

As a result of the evaporation explosion in the Radiochemical Processing Pilot Plant on November 20, 1959, two cells were contaminated with plutonium to a transferable level of 10^8 d/m/100 cm^2. The area involved measured 40 by 20 by 27 ft high with a total surface area, including equipment, of 10,000 ft^2. The cells were decontaminated by a factor of 1000 in 5 months by removing loose equipment, debris, and shielding blocks and flushing with 430,600 ℓ of various decontaminating reagents. The remaining contamination (10^4 -10^5 d/m/100 cm^2) was fixed to the surface with three coats of paint. The general beta-gamma radiation background was decreased from 2000 to 30 mrad/hr and the long-lived alpha contamination in the air was reduced from 2 x 10^{-10} to 8 x 10^{-13} $\mu c/cm^3$. Approximately 141 g of plutonium was flushed from the cell surfaces.

299. P. S. Lawson, Decontamination Studies, ORNL-TM-6, Oak Ridge National Laboratory, Oak Ridge, TN, September 1961.

The decontamination of mild steel, stainless steel, and aluminum from cerium, europium, americium, ruthenium, cesium, and iodine was studied in several possible decontamination reagents. Several of the contaminants were deposited from helium gas at elevated temperatures. Iodine was one of the nuclides most difficult to decontaminate completely. The pretreatment of metals with small amounts of cold iodine prior to exposure to radioactive iodine may be of value in decreasing residual activity.

300. R. G. Robins, Oxidation of Uranium Dioxide in Water at Elevated Temperatures and Pressures, AERE-M-937, UKAEA, Harwell, England, October 1961.

A series of autoclave experiments have been carried out in which both uranium dioxide powder and single crystals have been subjected to prolonged exposure to water at temperatures from 200°C to 500°C and pressure of 20,000 and 30,000 lb/in.^{2}.

The aim of these experiments was to investigate the possibility of growing single crystals of UO_2 hydrothermally, but the extremely low solubility of UO_2 in water up to 500°C and 30,000 lb/in.^{2} made this impracticable. However, the resistance of UO_2 to oxidation by high-temperature - high-pressure water and several measured solubility figures were considered noteworthy.

301. A. B. Meservey, Decontamination of EGCR and PBR, Revised Procedures, ORNL-TM-55, Oak Ridge National Laboratory, Oak Ridge, TN, November 1961.

Revisions have been made in the tentative proposals first suggested in October 1960 for solutions and methods for the decontamination of the EGCR and PBR. Significant improvements in the oxalate-peroxide solution include greater stability, effectiveness, and economy, with considerable simplification of the waste disposal problem. Corrosion results are summarized.

302. A. B. Meservey, Summary of Decontamination Studies at Oak Ridge National Laboratory June 1, to December 1961, ORNL-TM-58, Oak Ridge National Laboratory, Oak Ridge, TN, November 1961.

A semiannual summary of ORNL decontamination studies, with a guide to published papers, is presented for expanded discussion at the November 30-December 1, meeting of the RDIEG at Savannah River.

303. A. Cook, Principles and Recommended Practice for Decontamination of Radioactive Areas and Equipment, AHSB-SR-32, UKAEA, Risley, England, December 1961.

Principles in plant design and operation which will reduce contamination and aid in decontamination procedures are considered. Various decontamination methods are also covered.

304. J. Neil, "Steam Detergent Decontamination," Health Physics, vol. 6, Atomic Energy of Canada, Ltd., Chalk River, 1961.

A steam-detergent decontamination gun has been designed and used successfully on many occasions.

305. D. D. Busch and R. M. Watkins, Decontamination Studies at General Atomics, GAMD-2657, General Atomics, San Diego, CA, December 1961.

Decontamination studies have been made at General Atomics for gas-cooled reactor components, in particular the HTGR. Work involved decontamination tests of in-pile loop helium circulator parts, removal of radioactive oxide films from metals, and installation and testing of a decontamination test chamber.

1962

306. R. D. Weed, Decontamination of Pressurized Water Systems, HW-SA-2548, General Electric, Richland, WA, 1962.

This Master's thesis on decontamination of pressurized-water systems evaluates a decontamination procedure involving the following solutions: a peroxide-bicarbonate solution, an alkaline-permanganate solution, and a dibasic ammonium citrate solution. The procedure evaluated was determined to be effective for decontamination of stainless steel, carbon steel, or mixed carbon steel-stainless steel systems.

307. P. Cerre, et al., Surface Decontamination by Use of Ultrasonics, CEA-2209, Centre-Detudes-Nucleaires-De-Saclay, 1962.

This report (in French) details the use of ultrasonics as a surface decontaminate.

308. V. B. Schmidt et al., "Dekontamination 32-P Verunreinigter Glasgerate mit Ultraschall," Atompraxis, vol. 8, Germany, 1962.

The removal of ^{32}P contamination from glass apparatus using ultrasonic cleaning is compared to other decontamination methods. Ultrasonics was found to be a very effective method for decontamination of glassware.

309. W. S. Bush, "Permissible Levels of Surface Contamination," Reprinted from Radiation Accidents and Emergencies on Medicine, Research and Industry by Lawrence H. Lanzl et al., AECL-2115, Atomic Energy of Canada, Ltd., Chalk River, 1962.

The relationship is shown between contamination level and radiation hazard considering factors such as inhalation hazard and external radiation.

310. A. B. Meservey, Corrosion Inhibition by Hydrogen Peroxide in Decontamination Solutions, ORNL-TM-120, Oak Ridge National Laboratory, Oak Ridge, TN, January 1962.

Under controlled conditions, hydrogen peroxide was found to be an effective corrosion inhibitor for mildly acidic decontamination solutions used in contact with carbon steel.

311. R. M. Watkins and D. D. Busch, Decontamination of High-Temperature Gas-Cooled Reactor Components, GA-2912, General Dynamics, February 1962.

Several decontamination solutions were tested for use in decontamination of high temperature gas-cooled reactor components.

312. A. P. Larrick et al., Compilation of Decontamination Data, Supplement to HW-67937 and HW-71259, HW-71260, General Electric, Richland, WA, February 1962.

This compilation, prepared as a detailed reference to supplement summary progress reports of decontamination studies at Hanford, contains tables and figures which were excluded from the summary reports. This compilation is to be used by those who require more details of the decontamination test results than presented in the summary progress reports. It is designed to be used only in conjunction with those reports.

313. J. A. Ayres et al., Decontamination Studies for HAPO Water-Cooled Reactor Systems, September 1, 1960 through September 1, 1961, HW-71259, General Electric, Richland, WA, February 1962.

An intensive decontamination program was conducted at the Hanford Atomic Products Operation to determine the effectiveness of prospective processes for decontamination of: 1) high-temperature, recirculating, water-cooled, and 2) low-temperature, single-pass water-cooled nuclear reactor systems. Candidate processes were also being evaluated to determine their corrosion characteristics.

The general decontamination procedure involves an oxidizing solution for fission and rupture product dissolution, an alkaline-permanganate

solution for film conditioning, and an acidic solution for film removal. Several variations of this general procedure are being evaluated for application in specific situations.

314. Minutes of Fourth Meeting of Reactor Decontamination Information Exchange Group at SRP, November 30 through December 1, 1961, DPST-62-162, DuPont de Nemours, Savannah River, GA, February 1962.

Summaries were prepared by members of the Reactor Decontamination Information Exchange Group on decontamination procedures and research.

315. D. Grosvenor et al., Contamination and Decontamination Studies Related to Boiling Water Reactors, TID-15779, Argonne National Laboratory, Argonne, IL, March 1962.

A boiling water reactor with a defective fuel element was simulated with a closed loop in order to evaluate the spread of radioactive particles. Experiments were also performed to evaluate in situ chemical decontamination.

316. R. S. Hart, Distribution of Fission Product Contamination in the SRE, NAA-SR-6890, Atomics International, Canoga Park, CA, March 1962.

In the safety analysis of sodium-cooled reactors, a remaining area of significant uncertainty has been the fate of various fission products that may be released to the coolant in the event of a fuel element failure. During the recovery procedures following the fuel element damage that occurred at the Sodium Reactor Experiment (SRE) in July 1959, the opportunity was provided for obtaining such data on a full-scale basis. As a consequence, the collection and analysis of pertinent information from this incident was undertaken as part of the objectives of a concurrent project which involved experimental investigation into the solubility of certain fission products in sodium.

317. A. B. Carlson, Contamination and Decontamination of Low Temperature, Water-Cooled Reactors, DP-682, DuPont de Nemours, Savannah River, SC, April 1962.

The deposition from aqueous buffer systems of dissolved ^{60}Co, ^{51}Cr, ^{54}Mn, ^{59}Fe, ^{106}Ru-^{106}Rh, and ^{95}Zr-^{95}Nb on stainless and mild steel surfaces was investigated at 25 to 60°C for exposure times up to 8 days. This work, a part of a decontamination studies program, shows that the direct deposition of dissolved radionuclides on steel surfaces is not the predominant mechanism by which low temperature coolant systems become contaminated.

318. L. R. Wallis, The Hanford Decontamination Facility, HW-SA-2881, General Electric, Richland, WA, May 1962.

The reclamation of contaminated equipment through decontamination is reported. The cost of decontamination was very small in comparison to the cost of replacement of equipment.

319. C. A. Meyer, Decontamination of Reactor Heat Exchangers, Savannah River Plant, DP-703, DuPont de Nemours, Savannah River, SC, May 1962.

A program of decontamination of reactor heat exchangers built of type 304 stainless steel has been undertaken at the Savannah River Plant to expedite repairs on the heat exchangers. The bases for the selection of a decontaminating agent, the equipment and procedures used for decontamination, and the results of the operation are given in this report. Decontamination of the heat exchangers has been successfully carried out to the desired result, which was the reduction of radiation levels to permit an 8-hr work day on the heat exchanger tube sheets.

320. H. F. Jensen, Chemical Decontamination Activities 105 Reactors During the Period April 1960 through June 1962, HW-56001, General Electric, Richland, WA, July 1962.

This Interim Report from the series of reports previously issued summarizes the general activities which have been pursued in the Irradiation

Processing Department for chemical decontamination of the 105 Reactors and supporting efforts by the Hanford Laboratories in the screening of new chemicals.

321. W. J. Jenkins, Dissolving Plutonium Metal in Sulfamic Acid, DP-737, DuPont de Nemours, Savannah River, SC, July 1962.

Plutonium metal was found to dissolve readily in sulfamic acid and in mixtures of sulfamic and nitric acid. This method of dissolution is convenient in a plant process for the recovery of off-standard metal.

322. H. J. Blythe, Decontamination at Harwell, AERE-R-4307, UKAEA, Harwell, England, August 1962.

The historical background, decontamination facilities and practices at the Harwell reactor are outlined. The practices include chemical reagents, abrasive decontaminates and ultrasonics.

323. A. B. Carlson, Contamination and Decontamination of Low Temperature, Water-Cooled Reactors, DP-788, DuPont de Nemours, Savannah River, SC, October 1962.

The deposition from aqueous buffer systems of dissolved ^{60}Co, ^{51}Cr, ^{59}Fe, ^{106}Ru-^{106}Rh, and ^{95}Zr-^{95}Nb on aluminum surfaces was investigated at 25°C.

1963

324. A. B. Meservey, Peroxide-Inhibited Decontamination Solutions for Carbon Steel and Other Metals in the Gas-Cooled Reactor Program, November 1959 through July 1962, ORNL-3308, Oak Ridge National Laboratory, Oak Ridge, TN, January 1963.

A search for solutions suitable for dissolving uranium dioxide powder or lumps and yet noncorrosive enough to be used for decontaminating the carbon steel EGCR charge and service machines resulted in the development of buffered oxalate solutions of controlled temperature and pH, with hydrogen peroxide added to act as corrosion inhibitor, UO_2 oxidizer, and decontamination aid. Hydrogen peroxide acts either as a corrosion promoter or inhibitor, depending on factors such as its concentration, the ratio to other ingredients, acidity, temperature, the presence of complexing agents, and the ferric ion content of the solution.

In general, oxalate-peroxide solutions for fission product decontamination from metal surfaces were superior to more conventional decontaminating solutions and had attractively low corrosion rates on carbon steel (less than 0.01 mil/hr). Solution instability, initially a serious drawback, was largely overcome. Of nearly 100 formulations studied, the one having the best combination of long life, low corrosivity, high solvency for UO_2, decontamination power, safety, and ease of waste disposal was an aqueous solution of 0.4 M oxalic acid, 0.16 M ammonium citrate, and 0.34 M H_2O_2, adjusted to pH 4.00 with ammonium hydroxide and used at 85 to 95°C. Similar solutions at lower pH, with increased H_2O_2 concentration to maintain noncorrosiveness, were successful decontaminants at 60°C when contact times were increased to several hours. Contaminated stainless steels heated to 500°C in helium resisted decontamination in noncorrosive reagents.

325. A. Cook, editor, Decontamination, A Symposium Held at Risely on March 20, 1963, AHSB-S-R-57, UKAEA, Risley, England, March 1963.

This is a collection of papers on decontamination which were delivered to a symposium held at Risley March 20, 1963. The first two papers concern

the provision of decontaminable surfaces and how their decontaminability can be tested for comparison purposes. A method of decontamination employing "DETEX," a latex solution, is the subject of the third paper. The remaining papers describe experience in design and operation of decontamination facilities, one at Harwell and the other at Dounreay.

326. A. P. Larrick et al., Investigation of Chemical Cleaning and Startup Operations Proposed for N Reactor, HW-77356, General Electric, Richland, WA, March 1963.

The startup phases of the Hanford N Reactor, with its predominately carbon steel coolant systems, present numerous precleaning, corrosion, and water quality problems. Tests designed to provide information on cleaning a newly constructed carbon steel system, water quality during operation following the cleaning, and corrosion penetrations during both periods, were conducted in the K-1 in-reactor, carbon steel test loop. The effects of layup on subsequent water quality were also investigated.

327. R. D. Weed, Single Step Reactor Decontaminant Following Uranium Fuel Cladding Failures, HW-76867, General Electric, Richland, WA, March 1963.

The effectiveness of the oxalic-peroxide-gluconic solution when used as a decontaminate following uranium fuel cladding failures is reviewed.

328. R. D. Weed, Dendritic Pitting of Stellite by Alkaline-Permanganate Solutions, HW-SA-2954, General Electric, Richland, WA, March 1963.

This report examines the dendritic pitting incurred by decontaminating Haynes Stellite Alloys.

329. A. B. Carlson, Contamination and Decontamination of Low Temperature, Water-Cooled Reactors, Part 3 Decontamination of Specimens of Reactor Piping, DP-793, DuPont de Nemours, Savannah River, SC, March 1963.

In laboratory decontamination tests, phosphoric acid effectively decontaminated specimens of AISI type 304 stainless steel from the coolant

(moderator) and blanket gas systems of production reactors at the Savannah River Plant. Purification effluent piping and piping that contained stagnant coolant were more difficult to decontaminate than tubing and core rods from heat exchangers. The presence of alumina in the crud film probably causes decontamination to be more difficult than would be predicted for a film formed at the low temperature of the SRP reactors.

330. R. D. Weed, Decontamination Experience with High Temperature In-Reactor Test Loops, HW-SA-3021, General Electric, Richland, WA, April 1963.

The decontamination procedures for the Hanford KE-Reactor recirculating loops, the results of the decontaminations and recommendations for decontamination of stainless steel reactors and reactor loops are specified.

331. W. Lechnick, Decontamination of the Allis-Chalmers Volute, WAPD-PWR-TE-148 REV, Westinghouse Electric, Pittsburgh, PA, April 1963.

The relative effectiveness of Alconex scrubbing, electrolytic "Johnny-mop" decontamination, and alkaline-permanganate ammonium citrate (APAC) decontamination was investigated during decontamination of the Allis-Chalmers volute at PWR.

332. R. H. Smith, Chemical Decontamination - IPD Reactors, HW-77519, General Electric, Richland, WA, May 1963.

Activities performed in the Irradiation Processing Department for the decontamination of the 105 Reactors, and the effect on personnel exposure, manpower ceilings, and cost are summarized.

333. P. J. Peterson et al., A Recirculating Wet Vacuum Cleaning and Scrubbing System for Decontamination, LAPC-5775, Los Alamos Scientific Laboratory, NM, May 1963.

A recirculating wet vacuum cleaning system was developed for decontamination of the DP-west plutonium hot cells at Los Alamos.

334. R. L. Robb, Ammonia Cleaning of a Sodium Heat Exchanger at the Hallam Nuclear Power Facility, NAA-SR-8314, Atomics International, Canoga Park, CA, May 1963.

This project was initiated to clean a sodium-to-sodium shell and tube heat exchanger. The object was to remove any metallic sodium remaining after the heat exchanger was removed from the heat transfer system. Internal cleaning was necessary to allow opening of the heat exchanger to atmosphere for investigation and subsequent repair work required as the result of a tube failure in the exchanger.

335. Civil Defense Manual for Radiological Decontamination of Municipalities, AD-416493, Curtiss-Wright Corporation, Caldwell, NJ, August 1963.

Radiological defense consists primarily of protection from fallout. This manual covers the Operational Recovery Phase of radiological defense, which is concerned with decontamination of structures and areas made dangerous or lethal by fallout. It assumes that no significant damage has been sustained in the area due to blast or fire.

The purpose of the manual is to furnish information and planning techniques which will enable Civil Defense Planners to formulate and implement plans of action for Operational Recovery from nuclear attack in areas subject to radioactive fallout. The manual is written for Municipal Planners and Engineers, and for special groups, such as equipment operators and medical doctors, to whom individual chapters will be of particular value and interest.

336. T. J. Boardman and T. A. Paulett, HNPF Retirement Disposition of Sodium, AI-AEC-MEMO-12736, Atomics International, Canoga Park, CA, September 1963.

The Hallam Nuclear Power Facility was retired and emphasis given to removal of the sodium from the system and the chemical reaction of the residual sodium remaining in the system (including process lines, tanks, and the reactor vessel).

337. H. K. Rae, Behavior of Uranium and Aluminum in the NRU Heavy Water System, AECL-1840, Atomic Energy of Canada, Ltd., Chalk River, October 1963.

The behavior of uranium and aluminum in the NRU heavy water system is detailed.

338. L. D. Perrigo, Methods for Evaluating Corrosion Resulting from Repeated Chemical Cleaning, HW-SA-2333 REV, General Electric, Richland, WA, November 1963.

This decontamination operation involves a chemical cleaning of the reactor's coolant system with a certain corrosive effect upon the components of the system. To determine these corrosive characteristics, a procedure simulating the cyclic filming and defilming in the pressurized water system is employed. Special equipment is needed to simulate reactor conditions and to allow evaluation of decontamination methods. Such equipment is described and some of the latent corrosion effects discovered in such testing are noted.

339. A. B. Carlson, Decontamination of Low Temperature, Water-Cooled Reactors, Part 4, Deposition of Radionuclides from Reactor Coolant, DP-829, DuPont de Nemours, Savannah River, SC, November 1963.

The deposition of radioactivity from coolant on stainless steel and aluminum in the production reactors at the Savannah River Plant was investigated at exposure temperatures of 30 and 85°C. Data from decontamination tests were used to aid in developing the mechanisms of deposition. The buildup of activity on stainless steel was associated with the deposition of a crud film that was comprised principally of alumina. The buildup of activity on aluminum was associated with the in situ development of the corrosion film on the metal surface and, therefore, was related to the corrosion rate of aluminum.

1964

340. Equipment Decontamination Studies, ORNL-3452, Chapter 20, and Fuel Shipping Studies, ORNL-3452, Chapter 21, 1964.

The decontamination of stainless steel with such chemicals as oxalic acid, fluoride, hydrogen peroxide and ammonium oxalate is reported.

341. L. Gemmell, Decontamination Methods, Equipment and Materials, BNL-7665, Brookhaven National Laboratory, Upton, NY, February 1964.

This report outlines different contamination problems in various areas and how to cope with them. Also, decontamination methods, equipment and materials are listed.

342. J. L. Meredith et al., Cold Weather Decontamination Study, McCoy IV Part 1, NDL-TR-58 PT1, Nuclear Defense Laboratory, MD, April 1964.

The specific objective of this phase of the project was to determine better methods for decontaminating specific surfaces; effectiveness was based on amount of contamination removed and the effort expended. This project tested additional types of surfaces and conducted multiple-effort experiments to supplement previous work.

A series of tests were conducted at Camp McCoy, Wisconsin, to determine the effectiveness of maintenance, snow-removal, fire-fighting, and manual equipment to decontaminate snow, ice, frozen and thawing ground, paved surfaces, and roofs.

343. J. L. Meredith et al., Cold Weather Decontamination Study, McCoy IV Part 2, NDL-TR-58 PT2, Nuclear Defense Laboratory, MD, April 1964.

See Abstract for Reference 342.

344. F. E. Harrington et al., Laboratory Study of Zirconium-Uranium Processing Equipment Contamination and Decontamination, ORNL-TM-837, Oak Ridge National Laboratory, Oak Ridge, TN, April 1964.

Samples of 304L and 347 stainless steel were exposed in STR (HNO_3 - HF) and Modified Zirflex (NH_4F) dissolver solutions spiked with ^{95}Zr-Nb,

^{144}Ce-Pr, ^{106}Ru-Rh and ^{137}Cs to determine which of these fission products deposited on the metal specimens. Similar metal samples were also contacted with spiked HNO_3 solution for comparison. The contaminated metal specimens were then decontaminated with nitric acid and oxalic acid-H_2O_2 or with ammonium oxalate-ammonium-citrate-H_2O_2 at 90 to 95°C. The contamination on both the exposed and decontaminated specimens was determined by gross gamma counting and gamma scanning.

345. N. Michael, Experimental Evaluation of Decontamination Procedures for the Pressurized Water Loop, GEAP-4532, General Electric, San Jose, CA, May 1964.

Decontamination tests were performed on test coupons which had been exposed in the Pressurized-Water Loop for 18 months (5,500 effective fuel power hours) under loop coolant conditions of 345°F, 1200 psi, pH 9.5 to 10.0, and 50 ppb dissolved oxygen. Radioactive contamination was found to include uranium, fission products, and corrosion products.

Decontamination treatments were evaluated and involved three steps. With stainless steel the first step was a treatment with nitric acid solution. The second and third steps were the same for both materials, an alkaline-permanganate treatment followed by acid sulfate (Wyandotte 5061).

346. M. V. Cammarano et al., Prototype Civil Defense Manual for Radiological Decontamination of Municipalities, vol. 2, Decontamination Operations, NP-14208, Curtiss Wright Corporation, Caldwell, NJ, May 1964.

This report contains practical, operational information on the decontamination of radioactive fallout. This includes the types of surfaces that will be encountered, the methods best suited to their decontamination, and the special considerations required by cold weather. The three basic principles of fallout decontamination, cleaning the surface, removing the surface, and covering the surface, are noted. The various methods for achieving decontamination are categorized as wet or dry methods, and

are detailed individually. Team make-ups, equipment requirements, and operational procedures are covered. The pages devoted to each method are organized as separate, specialized Decontamination Team operation handbooks.

347. L. D. Perrigo and W. E. Taylor, Autoradiography, Tool for Investigating Reactor Coolant System Contamination Mechanisms, HW-SA-3355, General Electric, Richland, WA, June 1964.

This report outlines the practicality of using high contrast X-ray film to determine the contamination of reactor cooling systems.

348. P. Loysen, "Economics of Building Decontamination," Presented at the International Symposium on Surface Contamination, Gatlinburg, June 12, 1964, CONF-555-14, Health and Safety Laboratory, New York, NY, June 1964.

A description of five decontamination situations is presented for the purpose of providing actual cost data for a wide range of conditions. This may be useful in the planning of future building decontamination work and in examining the costs and procedures with respect to possible reductions and improvements.

349. R. T. Brunskill, "The Relationship Between Surface and Airborne Contamination," Proceedings Surface Contamination Symposium, Gatlinburg, TN, Health and Safety Department, Windscale and Calder Works, UKAEA, June 1964.

The relationship between different types of surfaces and airborne contamination is described.

350. Decontamination Capabilities, HW-SA-3539, General Electric, Richland, WA, July 1964.

Several equipment decontamination facilities and procedures developed at Hanford are described.

351. G. E. Raines et al., Experimental and Theoretical Studies of Fission-Product Deposition in Flowing Helium, BMI-1688, Battelle Memorial Institute, Columbus, OH, August 1964.

Fission product deposition in flowing helium was studied both experimentally and theoretically.

352. H. C. Copeland, Reactor Plant Deactivation Decontamination Guide, HW-84269, General Electric, Richland, WA, September 1964.

The intent of this guide is to define in general the extent of decontamination, fixing of contamination, and radiation shielding for layaway of the reactor plant and its supporting facilities.

353. A. P. Larrick, Effects of Reactor Decontaminating Solutions on Intergranularly Corroded Type 304 Stainless Steel, HW-SA-3628, General Electric, Richland, WA, October 1964.

Severely localized intergranular corrosion was discovered in 304 stainless steel reactor heat exchanger tubing. A study was undertaken to examine the effects of various decontamination solutions on this corroded tubing. Solutions tested were one of NaOH - $KMnO_4$, two of a sulfamic acid mixture, and one bisulfate solution. The solutions appeared to be suitable to use in decontamination.

354. H. F. Jensen, Reactor Deactivation - Contamination Control, RL-REA-99, General Electric, Richland, WA, December 1964.

Two recommended methods for decontaminating the reactor piping internally and externally and containing the contamination present in the storage basins are explained.

355. R. L. Kathren and J. B. Huff, "Decontamination Following a Nuclear Excursion," Health Physics, vol. 11, Lawrence Radiation Laboratory, Livermore, CA, 1965.

A concrete vault, designed for critical assembly experiments, was highly contaminated by a nuclear excursion. The excursion was approximately 3.8×10^{17} fissions, and was followed by a localized fire in the immediate area of the critical assembly. The incident and subsequent health physics activities are described.

356. G. A. West and C. D. Watson, Gamma Radiation Damage and Decontamination Evaluation of Protective Coatings and Other Materials for Hot Laboratory and Fuel Processing Facilities, ORNL-3589, Oak Ridge National Laboratory, Oak Ridge, TN, February 1965.

Protective coatings and other plastic materials were evaluated by irradiation in a gamma source and by decontamination tests as an extension of previous tests and for possible use in hot laboratories and fuel processing facilities and other process environs at Oak Ridge National Laboratory. Materials used may be subjected to gamma exposures of 10^4 to 10^5 r/hr and neutron exposures of 4.2×10^4 to 2.1×10^5 neutrons/cm^2/sec.

357. Chemical Decontamination of Cell No. 2 - Steam Generator N Reactor Plant, RL-NRD-336, Douglas United Nuclear, Richland, WA, April 1965.

A chemical decontamination of the N Reactor primary system steam generators and their connecting piping was completed on March 17, 1965. Decontaminating chemicals used were Turco 4502-D and Turco 4306-D. Decontamination results were less than anticipated because of dilution of chemical concentrations by water in-leakage.

358. R. A. Winship, DR Plant Radiation Zones, Final Status Report, RL-REA-1071, General Electric, Richland, WA, April 1965.

The approach to radiological control for post-deactivation at DR was to reduce the radioactive contamination in the open areas to a nominal

level and to seal off those locations and systems where decontamination was impractical. It is believed reasonable to assume that adequate radiological control can be maintained with minimum surveillance during the post-deactivation period if the work and traffic in the open areas are kept to a minimum and the sealed-off systems are not disturbed. This report summarizes the results of this decontamination and containment effort and relates radiological conditions of the various zones before decontamination work was started.

359. H. D. Raleigh, Radioactive Decontamination, Literature Search, TID-3535-SUP1, Technical Information Service, Oak Ridge, TN, April 1965.

Included are 336 references to unclassified publications on physical and chemical methods for the removal of radioactive contamination. The references cover the period from July 1959 through December 1964. Subject, author and report number indexes are provided.

360. A. A. Walls, Fire Protection System in Cell A, Bldg. 3026D, Test and Operation, ORNL-TM-1309, Oak Ridge National Laboratory, Oak Ridge, TN, October 1965.

A CO_2 fire protection system was installed in Cell A of the Dismantling Cells, Building 3026D, in preparation for the disassembly of irradiated Sodium Reactor Experiment (SRE) fuel elements. The tests and modifications of the system which were necessary before it was acceptable for operation are described. The SRE elements contained NaK, and several steps of the disassembly were performed under flammable oil.

361. G. Herman, Radiological Status Report Deactivation Status - F Plant, RL-REA-2502, General Electric, Richland, WA, November 1965.

This report describes the radiological status of deactivated buildings and systems at 100-F Area; provides a record for use in post-deactivation surveillance and future salvage of material and equipment; and includes the reactor and water plant buildings, but not the office

and separate shop buildings which will continue to be in use. The portions of the effluent system which are outside of the 105-F exclusion area will be included in a separate report entitled, Underground Radioactive Materials in 100-H and F Plants.

362. G. Herman, Radiological Status Report Deactivation Status - H Plant, RL-REA-2501, General Electric, Richland, WA, November 1965.

See Abstract for Reference 361.

1966

363. A. P. Veselkin and D. Y. Shakh, Effect of a Decontamination System on the Buildup of Active Corrosion Products in Pressurized Water Cooled Reactors, Soviet Atomic Energy, vol. 20, 1966.

The process of formation, buildup and transfer of active corrosion products in pressurized water reactors and the effect of purification systems are indicated. The efficiency of the decontamination system has been shown to have a considerable effect on the activity of the water and the corrosion deposits in the reactor system.

364. J. A. Ayres, Decontamination of Nuclear Reactor Systems, Materials Protection, vol. 5, Battelle-Northwest, Richland, WA, 1966.

Chemical cleaning and decontamination problems of nuclear reactor systems are summarized. Emphasis is on cleaning of a reactor's primary system. Chemical cleaning of a reactor is usually done to reduce radiation levels rather than to remove thick scale or deposits. Cleaning in most cases is unsatisfactory unless the entire film is removed. Consequently, more corrosive reagents than those normally used in a chemical cleaning operation may be required.

365. C. S. Abrams and E. A. Salterelli, editors, Decontamination of the Shippingport Atomic Power Station, WAPD-299, Westinghouse Electric, Pittsburgh, PA, January 1966.

Chemical decontamination of a reactor plant was performed at the Shippingport Atomic Power Station in March 1964 as a part of the plant modifications associated with installing PWR Core 2.

366. L. D. Perrigo et al., Plutonium Recycle Test Reactor Decontamination Following a MgO-PuO_2 Fuel Element Failure, BNWL-SA-636, Battelle-Northwest, Richland, WA, March 1966.

The decontamination of the Plutonium Recycle Test Reactor after a MgO-PuO_2 fuel element rupture is described.

367. J. A. Ayres and L. D. Perrigo, Studies on Procedures for Reactor Decontamination, September 1965 to May 1966, BNWL-SA-666, Battelle-Northwest, Richland, WA, April 1966.

Studies were done on procedures for reactor decontamination using the modified AP citrox procedure, which had been successfully tested at Idaho Falls.

368. M. J. Blythe, editor-in-chief, Proceedings of the First International Symposium on the Decontamination of Nuclear Installations Held May 4-6, at the Atomic Energy Research Establishment, Harwell, England, 1966.

Papers on the decontamination of nuclear installations using chemical reagents, ultrasonics, electrolysis, and mechanical methods are presented.

369. L. R. Wallis and C. D. Corbit, Radiological Aspects of the Deactivation of Hanford Production Reactors, DUN-SA-14, General Electric, Richland, WA, August 1966.

Certain aspects of the deactivation of the Hanford production reactors are summarized including plant site, plant equipment, reactor deactivation, and reactor layaway.

370. Hallam Nuclear Power Facility Retirement Plan Revision 4, NAA-SR-MEMO-12209, Atomics International, Canoga Park, CA, October 1966.

The plan for decommissioning (retirement) of the Hallam Nuclear Power Facility is detailed in several memos and reports.

371. Hallam Nuclear Power Facility Retirement Plan, NAA-SR-MEMO-12340 REV, Atomics International, Canoga Park, CA, February 1967.

See Abstract for Reference 370.

372. T. J. Boardman and S. Sudar, Reaction of Residual Sodium in HNPF Primary Sodium Systems, NAA-SR-MEMO-12268, Atomics International, Canoga Park, CA, May 1967.

The activity specification covering reaction of residual sodium in the HNPF primary system requires the residual be converted to essentially a chemically inactive form.

Processes for reacting the residual sodium and procedures for reacting and/or removing the residual sodium in conformance with the HNPF Retirement Plant are presented. The recommended reaction procedure and removal procedure for the primary system are outlined.

373. R. E. Bardsley and L. G. Merker, Plutonium Laboratory Decontamination Experience, Battelle-Northwest, Richland, WA, September 1967.

On Monday, August 23, 1965, there was an explosion and fire in a glove box, which resulted in a contamination spread of UO_2-PuO_2 material, in the Plutonium Fuel Laboratory (308 Building) at Battelle-Northwest.

The purpose of this report is to describe the decontamination of the Battelle-Northwest facilities so that others may benefit, where applicable, by this experience. The general plan, some of the detailed procedures, special decontamination efforts, and recommendations are included.

1968

374. A. P. Larrick and R. D. Weed, Nuclear Reactor Systems Decontamination, Materials Protection, vol. 7, Battelle-Northwest, Richland, WA, 1968.

Alkaline-permanganate is used in the decontamination of piping of a water-cooled reactor.

375. L. B. Brinkman, B Reactor Deactivation, DUN-3898, Douglas United Nuclear, Richland, WA, February 1968.

Pursuant to the decision of the Atomic Energy Commission to deactivate the B Reactor, engineering studies were initiated to determine the scope of work required to effect the shutdown of B Reactor and its associated support facilities and systems, and to effect optimization of those facilities and systems in 100-B Area required to continue in operation in support of the C Reactor. It is the purpose of this report to present recommendations to the deactivation group responsible for implementing the deactivation activities. This report encompasses recommendations for mechanical facility and system modifications and supplements the recommendations for electrical supply and distribution system changes proffered in DUN-3824.

376. R. D. Weed, Decontamination of the Plutonium Recycle Test Reactor (PRTR) Primary System, BNWL-711, Battelle-Northwest, Richland, WA, March 1968.

The Plutonium Recycle Test Reactor primary system was successfully decontaminated in late December 1965. An improved decontamination process consisting of alkaline-permanganate followed by an inhibited oxalic-citrate mixture was used. The decontaminating solutions effectively removed more than 31 Ci of radioactivity with an effective primary system decontamination factor of 24. Corrosion of carbon steel and stainless steels during the decontamination process and development data for the decontamination process are also involved.

377. R. R. Eggleston, editor, Piqua Nuclear Power Facility Surveillance and Recovery Program, AI-AEC-12696, Atomics International, Canoga Park, CA, June 1968.

The brief description of Piqua Nuclear Power Facility includes a history of its operation up to the time coke formation in the core was discovered. The subsequent engineering evaluation and recovery program are summarized including descriptions of coolant technology work and the Surveillance Program. Finally, the status of the plant and of the Recovery Program effort at the time of the PNPF Program cancellation is noted.

378. R. R. Eggleston, editor, Retirement of the Sodium Reactor Experiment, AI-AEC-12572, Atomics International, Canoga Park, CA, August 1968.

The SRE plant and post-operational programs are briefly described. The retirement program is detailed together with the alternative plans that were considered. The current status of the plant is described and the means presented whereby the plant will be maintained in its present condition. The time and cost schedule to accomplish the retirement is included. Also, recommendations are made that would be useful to future retirement efforts.

379. B. F. Ureda, HNPF Retirement, AI-AEC-12744, p. 149, Atomics International, Canoga Park, CA, July-September 1968.

This report includes the project objectives, the accomplishment in FY-1969 and the progress made during the report period on the HNPF retirement.

380. R. A. Hewson, PNPF Retirement Safety Analysis Reevaluation of Residual Nuclides, AI-AEC-MEMO-12708 Sup. A, Atomics International, Canoga Park, CA, January 1969.

Analyses of samples of concrete from the Piqua Nuclear Power Reactor biological shield were made. The neutron flux levels were discovered to be lower than the previous calculated values. New calculations were made on the flux levels to obtain better agreement with the experimental results. This was used to re-analyze the radioisotope sources which were to be left at the PNPF site.

381. B. F. Ureda, HNPF Retirement, AI-AEC-12721, p. 309, 1968 Fiscal Year, January 1969.

Progress is reported for the retirement of the Hallam Nuclear Power Facility during FY-1968.

382. G. B. Zwetzig, Survey of Fission- and Corrosion-Product Activity in Sodium- or NaK-Cooled Reactors, AI-AEC-MEMO-12790, Atomics International, Canoga Park, CA, February 1969.

Data has been assembled and summarized on fission-product distributions and resulting radiation levels from release of radioactive particles to sodium- or NaK-cooled reactor coolant and cover gas. General trends and patterns are discerned.

383. W. D. Bainard, "Decontamination of N Reactor Stainless Steel Steam Generators," Reprinted from Proceedings 25th Conference, National Association of Corrosion Engineers, Douglas United Nuclear, Richland, WA, March 1969.

The first, second and third attempts to decontaminate the N Reactor steam generators are described.

384. O. C. Schroeder, "Deactivation of Hanford Reactor Facilities," DUN-SA-114, Conference on Reactor Operating Experience in San Juan, Puerto Rico, CONF. 691009-3, October 1-3, 1969.

The deactivation of Hanford facilities is documented including a series of slides of the deactivations.

385. J. P. Homrok and W. P. Innis, Metal Cleaning, Metal Finishing Guidebook, 38th Edition, MacDermid, Inc., Waterbury, CT, 1970.

Metal cleaning using solvents, detergents, acids, electrolysis, and ultrasonics is described.

386. L. C. Brinkman, K Through-Reactor Decontamination Engineering Report, DUN-6664, Douglas United Nuclear, Richland, WA, January 1970.

The purpose of this document is to present the basic engineering requirements for a through-reactor decontamination system at one of the K reactors. The feasible method is a step-wise method which will decontaminate a group of five to eight crossheaders and associated process tubes at one time using a Turco 4528-F solution.

387. C. W. Wheelock, Retirement of the Piqua Nuclear Power Facility, AI-AEC-12832, Atomics International, Canoga Park, CA, April 1970.

The approved dismantlement, decontamination, and protective construction in the decommissioning of the Piqua Nuclear Power Facility was completed.

388. Retirement of Hallam Nuclear Power Facility, AI-AEC-12709, Atomics International, Canoga Park, CA, May 1970.

The decommissioning of the Hallam Nuclear Power Facility (sodium-cooled graphite-moderated power demonstration reactor) is completely documented.

389. J. A. Ayres, Decontamination Studies for N-Reactor, BNWL-CC-2659, Battelle-Northwest, Richland, WA, May 1970.

A solution of DTPA, citric acid, and hydrazine at pH 8 was used to decontaminate carbon steel with high efficiency and low corrosion rates. At 85°C, samples were clean in 1 to 2 hr, and at 70°C in about 6 hr. EDTA, and presumably its homologues, are relatively stable to radiation. In

measurements, 10^6 R of gamma radiation decomposed about 22 mmol of EDTA/ℓ of solution. Hydrazine inhibited the decomposition of EDTA.

390. J. A. Ayres, editor, Decontamination of Nuclear Reactors and Equipment, The Ronald Press Company, New York, NY, 1970.

The book presents general information about decontamination operations, especially the decontamination of nuclear reactors. Unsuccessful as well as successful experiences are described to demonstrate how some factors of seemingly minor importance have affected results.

391. Boiling Nuclear Superheater Power Station Decommissioning, Docket-1154-2, Puerto Rico Water Resources and United Nuclear Corporation, September 1970.

The decommissioning of the BONUS facility, Puerto Rico, is described. Included are the following sub-titles: Description of Entombment System, Description of the External Systems, Area Radiation Survey, Program Quality Assurance, Time Capsule, and Post-decommissioning Surveillance Program.

392. R. H. Guymon, MSRE Procedures for the Period Between Examination and Ultimate Disposal, ORNL-TM-3253, Oak Ridge National Laboratory, Oak Ridge, TN, February 1971.

This document describes the condition of the MSRE and specifies procedures to be followed after the post-operation examinations and before the ultimate disposal of the fissile and radioactive material in the reactor. The fuel salt will be kept frozen in the sealed drain tanks, within secondary containment which only has an opening through filters to a stack. Surveillance will consist of remote monitoring and daily visits by X-10 plant personnel. Personnel access will be controlled by the security fence around the reactor building. The MSRE Procedures specify remedial actions for abnormal conditions. Also specified are procedures and responsibilities for maintenance, modifications, and removal of surplus equipment.

393. D. C. Nelson et al., Hanford Radiochemical Site Decommission Demonstration Program, ARH-2075, Atlantic Richfield, Richland, WA, April 1971.

A decommissioning demonstration program is proposed for implementation at the Hanford Radiochemical Site. Methods of decontamination would be evaluated by use on Hanford facilities. These facilities are of many different types such as waste storage tanks and fuel reprocessing plants. Possible decontamination procedures are reviewed.

394. M. J. Szulinski, compiler, Preliminary Problem Definition Decommissioning the Hanford Site, ARH-2164, Atlantic Richfield, Richland, WA, April 1971.

The purpose of this document is to determine preliminary cost and time requirements for alternative actions that would be required to decommission the Hanford site. Alternatives include preparation for safe shut down status with either unrestricted or limited release of some or all of the land area.

395. F. E. Adcock, ATMX-600, Railcar, A New Concept in Radioactive Waste Shipments, RFP-1590, Dow Chemical Company, Golden, CO, April 1971.

The Dow Chemical Company, Rocky Flats Division has been shipping plutonium-contaminated waste to Arco, Idaho, in unique railroad cars known as the ATMX-600. Six cars have been in service since April 1969. All operating experience has been favorable.

ATMX-600 cars have removable roof sections to permit loading the 9 x 9 x 50-ft cargo area. Useful load is 101,000 lb; maximum gross weight is 220,000 lb. Waste is packaged in plywood crates or steel drums. These in turn are stowed in 8 x 8 x 20-ft steel cargo containers to permit rapid loading of the railcar.

An engineering evaluation shows that the railroad transportation environment is favorable, the relative hazard potential of waste shipments is low, and that the ATMX car's performance meets the requirements for Type B packaging.

396. J. A. Ayres, Equipment Decontamination with Special Attention to Solid Waste Treatment, Survey Report, BNWL-B-90, Battelle-Northwest, Richland, WA, June 1971.

Information is summarized on methods for radioactive decontamination of equipment that have been used at a nuclear installation. The methods covered include scrubbing, soaking, electrolytic procedures, ultrasonics, foams and coatings, solution spraying, abrasive spraying, cleaners, and defilmers-descalers.

397. Results of Initial Radiation Survey, Elk River Reactor, Rural Cooperative Power Association, June 1971.

The results, measurement methods, and procedures used in the initial radiation survey at the Elk River Reactor facility during the months of April and May 1971 are documented.

398. Health and Safety Manual, vol. I, Health Physics, vol. II, Safety Standards, vol. III (revised November 1973) Emergency Procedures, RCPA Elk River Reactor, July and August 1971.

A manual was prepared setting forth the rules and procedures of radiation safety that should be followed at the Elk River Reactor Facility. These rules and procedures cannot cover all cases; however, they do provide a general basis for working safely with radiation and deal specifically with the operations presently expected to be the most hazardous.

This manual includes: 1) radiation protection standards, 2) radiation-detection equipment, 3) control of hazards, 4) dismantlement procedures, 5) waste disposal, 6) transportation of radioactive materials, and 7) personnel monitoring.

399. Dismantling Plan, Docket 1151-46, AEC Elk River Reactor, August 1971.

A plan for dismantling the Elk River Reactor was prepared.

400. AEC Elk River Reactor Dismantling Plan, Docket 1151-47, SS-836, October 1971.

The plan for dismantling the Elk River Reactor was revised.

1972

401. D. McConnon, Internal Dosimetry of Personnel Engaged in Elk River Reactor Dismantling, 1972.

The Elk River Reactor Health and Safety Program was designed to prevent internal deposition of radioactive and toxic materials during dismantling of the reactor. However, to provide an independent check on the adequacy of engineered safeguards and monitoring programs, an internal dosimetry program was established.

402. W. J. Manion, Dismantling of the Elk River Boiling Water Reactor, Gulf United, Elmsford, 1972.

Dismantling of the Elk River Reactor requires the extensive use of remotely operated tooling. This tooling includes mechanical and flame cutting equipment. The flame cutting method selected for the work is the plasma arc technique which develops temperatures greater than 24,000°K and will be performed underwater and in air. This high temperature permits single pass cutting of the thickness of metal involved, i.e., up to 3 in. Because of the high radiation levels, positioning and translation of the torch over the work is done automatically.

403. J. A. Ayres, Contamination and Decontamination of Concrete, A Preliminary Survey of the State of the Art, Unpublished Draft, Battelle-Northwest, Richland, WA, January 1972.

Methods for the decontamination of concrete under three different conditions are presented. The three conditions are: 1) the concrete is protected by some paint or other stripable film, 2) the concrete is bare and a spill occurs, and 3) the concrete is bare and has been exposed over a long period to contaminated solutions, solids, or vapors.

404. SEFOR Reactor Decommissioning, Docket 50-231, REV, March 1972.

An application was made for authority to decommission the Southwest Experimental Fast Oxide Reactor (SEFOR) to the U.S. Atomic Energy Commission. The decommissioning plan to be employed is presented.

405. Decommissioning Saxton Reactor, Docket 50-146, April 1972.

The plan for decommissioning the Saxton Reactor Faility is documented. Also, safety analysis demonstrates that the facility will be placed in a status which will not be inimical to the health and safety of the public.

406. Environmental Statement, Elk River Reactor Dismantling, WASH-1516, Elk River, MN, May 1972.

An environmental statement was written on the Elk River Reactor dismantling including a description of dismantling activities.

407. D. McConnon, "Health Physics Planning for Dismantlement of Elk River Reactor," Seventeenth Annual Meeting of the Health Physics Society, Las Vegas, NV, June 11-15, 1972, United Power Association, May 1972.

The general approach planned for dismantling of the Elk River Reactor is reported. Planned engineering safeguards and procedural controls to limit personnel exposure, internal disposition of radionuclides, and release of radioactive materials to the work areas and the environment are outlined for each removal phase.

408. Saxton Reactor License Amendment No. 8, Docket 50146-111, August 1972.

The technical specifications of the license to dismantle the Saxton Nuclear Reactor are given.

409. Status of Deactivated Elk River Reactor, Amendment No. 1, Docket 1151-58, August 1972.

This report on the status of the Elk River Reactor includes the major activities of the dismantlement from May 1, 1972 to August 1, 1972, and a section on waste management.

410. J. R. Divine, Decontamination of Plutonia-Contaminated Thermal Reactor Systems, BNWL-SA-4361, Battelle-Northwest, Richland, WA, October 1972.

The N Reactor dissolution of mixed oxide fuels was reviewed with consideration of past experience and potentially useful decontamination solutions. At this date the most suitable decontamination agent of mixed oxides was a solution of buffered oxalic acid/hydrogen peroxide/gluconic acid (OPG).

411. Transmittal Letter for Amendment No. 36, Docket 50270-54 and 50287-49, October 1972.

A letter from the Duke Power Company to the AEC requested that an amendment to cost proposal be accepted. Brief decommissioning procedures of the Duke Power Plant are also outlined.

412. Pathfinder-Inspection Report, Docket 50130-15, November 1972.

The findings during an inspection of the dismantling procedures at the Pathfinder Reactor are summarized.

413. Elk River-Inspection Report, Docket 1151-61, December 1972.

This report refers to an inspection of the dismantling of the Elk River Reactor.

414. D. McConnon and R. Wonacott, "Respiratory Protection Program for Dismantling Elk River Reactor," Respirator Symposium for AEC Contractor and Licensee Health and Safety Personnel, Los Alamos, NM, February 6-8, 1973, United Power Association, January 1973.

A radiation protection program was developed for the dismantling personnel at the Elk River Reactor.

415. D. McConnon, "Operational Health Physics During Dismantling of the Elk River Reactor," 18th Annual Meeting of the Health Physics Society, Miami Beach, FL, June 17-21, 1973, United Power Association, May 1973.

The Elk River Reactor, a 58 MW (th) boiling water, was operated for 4 years and shut down in 1968 for economic reasons. The facility is now being dismantled such that the reactor site will be returned to approximately the same condition that existed prior to installation of the reactor. Removal operations and radiological conditions during dismantling of the highly radioactive portions of the reactor are described.

416. J. F. Nemec, "Radioactive Operations in the Dismantling of Elk River," 19th Annual Meeting of the American Nuclear Society, Chicago, IL, June 10-14, 1973, United Power Association, May 1973.

The Elk River Reactor, a 58 MW (th) boiling water, was operated for 4 years and shut down in 1968 for economic reasons. It is now being dismantled with the objective of returning the reactor site to normal usage. Discussed is the distribution of radioactivity between the reactor components and how each component was dismantled, transferred and loaded for shipping. The methods used in this project proved to be safe, efficient and capable of preventing the spread or release of contamination.

417. T. R. Haddad, Design Criteria, Mining Phase - Mining, Packaging, and Storage, Contaminated Soil Removal Facility, ARH-2651, Atlantic Richfield-Hanford, Richland, WA, June 1973.

The design criteria for the mining, packaging, and storage of pluton contaminated soil from the 216-Z-9 trench at Hanford is presented. This is the initial phase of a two phase plan; the second phase is planned to be the leaching of plutonium from the contaminated soil.

418. H. T. Fullam, High Temperature Methods for Disposal of Contaminated Metal Equipment, BNWL-B-277, OUO, Battelle-Northwest, Richland, WA, July 1973.

Three high temperature processes for simplifying the disposal of contaminated metal equipment were investigated: 1) fused salt decontamination; 2) metal meltdown under a fused inorganic slag; and 3) metal meltdown under an inert atmosphere.

419. J. L. Swanson, Nature of Actinide Species Retained by Sediments at Hanford, BNWL-B-296, OUO, Battelle-Northwest, Richland, WA, August 1973.

Work on a program to characterize the behavior of actinide species in soil was initiated. Samples were taken from a trench at Hanford which was used as a low-level radioactive waste receiver, and experiments were conducted on the samples.

420. R. M. Beckers et al., Remotely Operated Plasma Torch, A Tool for Nuclear Reactor Dismantling, CONF.-731105-2, November 1973.

The Elk River Reactor facility was dismantled in order to return the site to unrestricted use. The highly radioactive components - the reactor internals, the pressure vessel, and the outer thermal shield - have been cut up and shipped to a burial ground. Approximately 10,000 Ci of radioactive metal was removed without significant release of activity and without any overexposure to personnel. The dismantling was accomplished with a remotely operated plasma torch system. The design of the system, the results obtained, and evaluation of this technology are given.

421. "Decommissioning of Nuclear Facilities," Atomic Energy Review, vol. 12, no. 1, IAEA, Vienna, 1974.

At the end of their useful lives it will be necessary to decommission nuclear facilities to provide radiological protection of the public and to release the site for further use. Stages of decommissioning have been defined, experience and techniques available have been discussed and specific operations have been reviewed. Development and assessment efforts required have been identified. The responsibilities of the owners/operators and the public authorities have been examined. International collaboration in decommissioning was concluded to be fruitful.

422. Vendors Catalog, Decon Reference Chart, Turco Products, Carson, CA, 1974.

A catalog was distributed by Turco Products giving information and data for their Decon chemicals, coatings, penetrants, cleaning chemicals, decontamination equipment turbulators and general procedures for decontaminating concrete and power reactors.

423. P. R. Moore, Decontamination of a Highly Radioactive Chemical Processing Facility, DPSPU-74-30-10, du Pont de Nemours, Savannah River, SC, 1974.

Five modules of the highly radioactively contaminated "hot canyon" in one of the chemical processing plants for irradiated fuel at Savannah River Plant were successfully decontaminated for installation of a new process. Decontamination was completed in about 1 year at a cost of about $150,000. The various techniques employed, equipment used, and the overall job plan are described.

424. Retirement of the Enrico Fermi Atomic Power Plant, Power Reactor Development Company, March 1974.

This report details the activities undertaken by Power Reactor Development Company (PRDC) to retire the Enrico Fermi-1 nuclear power plant. The retirement program, implemented through a series of technical specification changes to DPR-9, Provisional Operating License, Docket 50-16, consisted of the following seven major elements:

1. Shipping all fuel and blanket elements offsite
2. Shipping all bulk radioactive and nonradioactive sodium offsite
3. Disposing of all other contaminated or irradiated materials by shipment offsite or placement in restricted areas with access limited only to authorized personnel
4. Securing such reactor building penetrations as piping, ventilation, personnel, and equipment penetrations
5. Sealing the primary system comprised of the reactor vessel, primary sodium piping, primary shield tank, machinery dome, primary sodium service system, and secondary sodium system extending out to welded pipe caps, and passivating the residual sodium therein
6. Revising the site boundary to a narrow site definition which includes only those areas containing radioactivity
7. Implementing a postretirement surveillance plan.

425. D. McConnon, Experience in Decontamination/Decommissioning of the Elk River Reactor, United Power Association, Elk River, MN, April 1974.

See Abstract for Reference 415.

426. J. F. Nemec and K. G. Anderson, "Demolition of Radioactive and Contaminated Concrete Structures by Use of Explosives," 1974 Annual Meeting of the American Nuclear Society, Philadelphia, PA, June 23-28, 1974, United Power Association and Herbst and Sons Construction Company, April 1974.

The technique used for removal of radioactive or contaminated concrete structures located within the Elk River Reactor building through the use of explosives is described. The prime considerations during the planning for this effort were the control of radioactive contamination and optimization of removal rates.

427. K. J. Anderson, Work Plan for P-11 Facility Cleanup, ARH-2939 REV., Atlantic Richfield, Richland, WA, May 1974.

This report outlines the work plan for the cleanup of the plutonium-contaminated P-11 facility to be accomplished during FY-1974 and -1975, with completion expected in July 1974. The objective is to restore the area so that it will not pose an environmental hazard to people or animals and will allow alternative uses of the land area.

428. Guidelines for the Interim Storage of AEC-Generated Solid Transuranic Wastes, LA-5645, H-Division Staff Environmental Studies Group Waste Management, Los Alamos Scientific Laboratory, University of California, June 1974.

Guidelines have been developed to provide a basis against which to judge the adequacy of techniques and methods for the retrievable storage of AEC-generated transuranic-contaminated solid wastes. These guidelines apply to operations for packaging, handling, and storage of such wastes. Each guideline has been fully reviewed with emphasis on the reasoning behind the guideline statement, problems that should be considered in developing a storage facility, and methods currently in use at AEC installations.

429. M. N. Raile, P-11 Facility Cleanup Summary Report, ARH-ST-106, Atlantic Richfield-Hanford, Richland, WA, December 1974.

This document describes methods, techniques, and equipment employed at Richland, WA for the cleanup, dismantling, and decommissioning of plutonium-contaminated facilities.

LIST OF SUBJECTS CROSS-REFERENCED
TO BIBLIOGRAPHY NUMBERS

DECOMMISSIONING

REACTORS

66, 153, 223, 336, 352, 370, 371, 374, 377, 378, 384, 387, 388, 391, 392, 393, 394, 399, 404, 405, 406, 409, 411, 412, 417, 420, 421, 424, 425

DECONTAMINATION

GENERAL PROCEDURE MANUALS

REACTORS

56, 80, 98, 103, 132, 138, 185, 192, 207, 211, 247, 249, 274, 281, 285, 294, 295, 304, 332, 337, 352, 365, 368, 370, 375, 377, 378, 382, 390, 393, 397, 398, 401, 402, 407, 414, 415, 416, 421, 425, 426

CHEMICAL PROCESSING PLANTS

47, 106, 121, 262, 281, 423

OTHER BUILDINGS

33, 257, 286

FACILITIES FOR DECONTAMINATION

51, 79, 94, 110, 196, 221, 247 250, 257, 303, 304, 305, 318, 350, 393

ACCIDENTS

41, 49, 59, 80, 85, 109, 221, 284, 286, 295, 373

AFTER NUCLEAR EXPLOSIONS

145, 335

BIBLIOGRAPHIES

45, 62, 63, 81, 86, 125, 130, 185, 222, 224, 255, 274, 276, 359

MATERIALS

METALS

Carbon Steel

93, 101, 120, 126, 127, 142, 159, 171, 188, 195, 203, 206, 210, 212, 216, 217, 218, 225, 226, 227, 239, 242, 244, 248, 254, 263, 266, 268, 269, 271, 273, 275, 276, 281, 282, 291, 292, 294, 297, 302, 305, 306, 314, 326, 330, 338, 345, 347, 364, 374, 376, 389, 391

Stainless Steel

2, 4, 6, 7, 11, 13, 15, 24, 27, 36, 37, 38, 39, 40, 48, 53, 54, 55, 56, 57, 65, 67, 75, 77, 87, 88, 89, 90, 93, 100, 101, 103, 107, 108, 112, 113, 115, 120, 122, 124, 127, 131, 133, 138, 139, 141, 142, 147, 151, 154, 160, 169, 178, 179, 181, 186, 188, 191, 194, 195, 202, 205, 206, 207, 210, 212, 213, 216, 217, 218, 224, 225, 226, 227, 229, 233, 234, 238, 240, 241, 244, 248, 250, 258, 262, 263, 264, 265, 266, 268, 270, 271, 273, 275, 276, 277, 281, 285, 288, 289, 291, 292, 294, 296, 297, 299, 305, 306, 312, 314, 315, 317, 319, 325, 329, 331, 338, 339, 340, 344, 345, 347, 353, 356, 367, 368, 374, 376, 391

Aluminum

6, 13, 15, 22, 36, 37, 99, 144, 147, 155, 160, 207, 212, 224, 248, 250, 265, 268, 269, 271, 296, 299, 301, 305, 314, 323, 339, 368,

Nickel

22, 84, 179, 182, 194, 233, 268,

Other Metals

4, 6, 13, 15, 27, 30, 36, 56, 71, 77, 107, 113, 114, 118, 122, 160, 175, 179, 181, 194, 202, 212, 213, 224, 225, 229, 233, 240, 244, 248, 263, 269, 275, 288, 289, 305, 306, 313, 314, 317, 327, 328, 367, 368, 391

CONCRETE

6, 7, 11, 13, 25, 29, 40, 56, 71, 101, 122, 174, 304, 342, 346, 356, 423, 426

SOIL

140, 304, 346, 419

Crops

260, 346

SOLUTIONS

201, 232, 252

PORTABLE EQUIPMENT

51, 60, 303, 368, 380

PROTECTIVE COATINGS

11, 12, 13, 15, 16, 21, 25, 29, 30, 40, 42, 56, 58, 61, 64, 97, 101, 118, 122, 160, 208, 254, 268, 325, 356, 368

PLASTICS-GLASS

1, 6, 11, 13, 15, 19, 21, 25, 27, 29, 30, 35, 36, 40, 97, 101, 160, 208, 254, 268, 269, 325, 368

CLOTHING

11, 35, 40, 74, 79, 91, 146, 160, 250, 303, 304, 325, 368

SKIN

6, 11, 13, 23, 35, 40, 59, 269, 368

AIR

20, 102

NOZZLES, PIGTAILS, CROSSHEADERS

132, 147, 150, 157, 158, 162, 170, 173, 187, 199, 200, 204, 214, 241, 261, 265, 281

COOLING LOOPS

65, 71, 103, 104, 124, 126, 131, 137, 181, 184, 195, 203, 206, 217, 226, 236, 239, 241, 242, 243, 259, 264, 272, 276, 288, 290, 291, 292, 306, 313, 314, 315, 330, 345, 367, 368, 374

PIPES, VALVES

44, 46, 96, 139, 155, 170, 203, 205, 219, 224, 245, 246, 261, 264, 296, 357

OTHERS - WOOD

6, 7, 13, 15, 40, 145, 325,

OTHERS - RUBBER

6, 29, 91, 160, 250, 269

METHODS

WASH

Turco Process

120, 132, 135, 147, 149, 150, 151, 152, 154, 155, 156, 157, 158, 159, 161, 162, 168, 170, 169, 171, 172, 173, 176, 177, 178, 181, 183, 184, 186, 187, 189, 190, 195, 198, 199, 200, 202, 204, 210, 213, 214, 216, 217, 218, 219, 220, 225, 226, 227, 237, 239, 241, 242, 253, 261, 268, 269, 276, 281, 289, 305, 311, 314, 319, 320, 329,

Alkaline Permanganate

46, 70, 90, 129, 142, 171, 181, 190, 191, 192, 205, 206, 210, 211, 216, 218, 224, 226, 231, 236, 238, 239, 245, 246, 263, 266, 276, 278, 281, 282, 287, 292, 296, 297, 305, 306, 313, 314, 315, 319, 328, 330, 331, 338, 345, 364, 374, 376

Other (Wash)

14, 15, 18, 21, 23, 40, 53, 55, 58, 68, 89, 91, 182, 196, 216, 225, 250, 268, 287, 303, 304, 325, 334, 391

ULTRASONICS

69, 90, 95, 133, 138, 144, 194, 196, 207, 251, 252, 260, 268, 281, 283, 287, 303, 307, 322, 368, 391

ELECTROLYSIS

43, 61, 84, 87, 88, 93, 196, 207, 276, 287, 303, 331, 368

MECHANICAL

15, 33, 36, 51, 61, 67, 71, 85, 100, 127, 196, 215, 250, 252, 263, 267, 268, 276, 281, 287, 303, 322, 325, 331, 333, 339, 342, 346, 368

HEAT

114, 212, 418

ALUMINUM TURNINGS

201, 232

CLAY

119

FILTER

198

CORROSION FROM DECONTAMINATION METHODS

METALS

STAINLESS STEEL

30, 38, 39, 48, 54, 55, 71, 77, 87,
90, 100, 112, 113, 116, 117, 177,
188, 194, 207, 216, 218, 231, 233,
244, 248, 252, 266, 273, 275, 288,
296, 297, 313, 338, 353, 364, 367,
368, 374, 376

ALUMINUM

22, 152, 155, 167, 177, 248, 275,
301, 302, 323, 339, 368

CARBON STEEL

22, 97, 171, 177, 188, 216, 218,
231, 239, 244, 248, 266, 273, 275,
282, 293, 297, 302, 310, 326, 338,
364, 368, 374, 376, 389

OTHERS (METALS)

22, 48, 77, 117, 175, 194, 244,
248, 275, 313, 314, 328

ALPHABETICAL LIST OF AUTHORS
CROSS-REFERENCED TO BIBLIOGRAPHY NUMBERS

DISTRIBUTION

No. of Copies

OFFSITE

UNITED STATES

1 ERDA Chicago Patent Group
9800 South Cass Avenue
Argonne, IL 60439

A. A. Churm

2 NRC Directorate of Licensing for Fuels and Materials
4915 St. Elmo Avenue
Bethesda, MD 20014

Deputy Director Fuels and Materials

S. H. Smiley

Chief, Technical Support Branch for Fuels and Materials

R. B. Chitwood

1 ERDA Division of Biomedical and Environmental Research
Earth Sciences Branch
Washington, DC 20545

W. G. Belter

1 ERDA Division of Production and Materials Management
Washington, DC 20545

F. P. Baranowski

2 ERDA Division of Reactor Research and Development
Washington, DC 20545

Assistant Director for Reactor Technology

E. E. Sinclair

Chief, Fuel Recycle Branch

W. H. McVey

No. of Copies

10 ERDA Division of Waste Management and Transportation
Washington, DC 20545

G. H. Daley
J. C. Dempsey
H. Glauberman
A. F. Perge
F. K. Pittman(3)
R. W. Ramsey
R. D. Walton
R. A. Wolfe

1 ERDA Idaho Operations Office
P.O. Box 2108
Idaho Falls, ID 83401

K. K. Kennedy

2 ERDA Oak Ridge Operations Office
P.O. Box X
Oak Ridge, TN 37830

E. H. Hardison
O. T. Turmelle

1 ERDA Savannah River Operations Office
P.O. Box A
Aiken, SC 29801

R. L. Chandler

215 ERDA Technical Information Center

2 Aerojet Nuclear Company
550 2nd St.
Idaho Falls, ID 83401

W. W. Hickman
J. Commander

1 Atomics International
P.O. Box 309
Canoga Park, CA 91304

W. F. Heine

No. of
Copies

3 Allied Chemical Corporation
550 - 2nd Street
Idaho Falls, ID 83401

J. A. Buckham
B. C. Musgrave
C. M. Slansky

1 Allied-Gulf Nuclear Services
P.O. Box 847
Barnwell, SC 29812

A. Schneider

2 Argonne National Laboratory
9700 South Cass Ave.
Argonne, IL 60439

N. M. Levitz
M. J. Steindler/L. D. Trevorrow

2 Brookhaven National Laboratory
Research Library, Reference Section
Information Division
Upton, Long Island, NY 11973

J. J. Reilly
R. H. Wiswall

1 Combustion Division
Combustion Engineering, Inc.
Windsor, CT 06095

J. Parry

3 Dow Chemical Company (ERDA)
Rocky Flats Division
P.O. Box 888
Golden, CO 80401

B. Owen
M. A. Thompson
D. L. Ziegler

No. of
Copies

2 duPont Company, Aiken (ERDA)
E. I. duPont DeNemours and Co.
Savannah River Laboratory
Aiken, SC 29801

C. H. Ice
A. S. Jennings

1 duPont Company, Wilmington (ERDA)
E. I. duPont DeNemours and Co.
Wilmington, DE 19898

A. A. Johnson

2 Electric Power Research Institute
3412 Hillview Avenue
P.O. Box 10412
Palo Alto, CA 94304

M. Levenson
E. Zebroski

1 Environmental Protection Agency
Parklawn Building
5600 Fishers Lane
Rockville, MD 20852

C. G. Meyers

1 Environmental Protection Agency
P.O. Box 15027
Las Vegas, NV 89114

B. Mann

1 Environmental Protection Agency
5555 Ridge Avenue
Cincinnati, OH 45213

R. E. Landreth

1 General Electric Company
175 Curtner Avenue
(M/C 160)
San Jose, CA 95125

R. G. Barnes

No. of Copies

1 General Electric Company
Vallecitos Nuclear Center
Vallecitos Road
Pleasanton, CA 94566

W. H. Reas

1 Gulf Energy and Environmental Systems
P.O. Box 81608
San Diego, CA 92138

L. H. Brooks

2 Los Alamos Scientific Laboratory (ERDA)
P.O. Box 1663
Los Alamos, NM 87544

C. W. Christenson
H. S. Jordan

2 Monsanto Research Corporation Mound Laboratory
P.O. Box 32
Miamisburg, OH 45342

C. J. Kershner
P. Lamberger

1 National Lead Company
111 Broadway
New York, NY 10006

S. Brown

1 National Academy of Sciences
Committee of Radioactive Waste Management
National Research Council
2101 Constitution Avenue
Washington, DC 20418

D. Cyrus Klingsberg,
Technical Secretary

No. of
Copies

2 Nuclear Fuel Services, Inc.
P.O. Box 124
West Valley, NY 14171

J. P. Duckworth,
Plant Manager

6000 Executive Blvd., Suite 600
Rockville, MD 20852

E. D. North, Director of
Technical Administration

1 NYS Atomic and Space Development Authority
230 Park Ave., Rm. 2425
New York, NY 10017

J. G. Cline, General Manager

4 Holifield National Laboratory (ERDA)
Central Research Library Document Reference Section
Central Research Library, ORNL
Laboratory Records Dept., ORNL
Laboratory Records Dept.,
ORNL-RC

5 Union Carbide Corporation (HNL)
Chemical Technology Division
P.O. Box Y
Oak Ridge, TN 37830

J. O. Blomeke
D. E. Ferguson
E. H. Kobisk
K. H. Lin
W. C. McClain

3 Sandia Laboratories
Albuquerque, NM 87107

W. P. Bishop
R. L. Hagengruber
A. C. Zuppero

No. of
Copies

FOREIGN

1 EURATOM
Health Physics Division
29, Rue Aldringer
Luxembourg, BELGIUM

Rene Amavis

1 Atomic Energy Research Establishment
Harwell, Didcot,
Berks, ENGLAND

K. D. B. Johnson

1 United Kingdom Atomic Energy Authority
Risley, ENGLAND

D. W. Clelland

1 Centre de Marcoule
B.P. 106
30 - Bagnols S/Ceze
FRANCE

R. Bonniaud

3 Centre d'Etudes Nucleaires de Fontenay-aux-Roses
Boite Postale 6
92 - Fontenay-aux-Roses
FRANCE

P. J. Regnaut
J. Sauteron
Y. J. Sousselier

2 Institut für Chemische Technologie
Kernforschungsanloge
Julich GmbH
D517 Julich
Postfach 365
GERMANY

E. R. Merz
K. H. Rattay

No. of Copies	
1	MGH/GWK/Wiederacifurbeitung - Sanlage/WAK Karlsruhe, GERMANY W. A. Issel
1	Nuclear Research Center Waste Management Dept. D75 Karlsruhe Weberstr. 5 GERMANY H. Krause
2	CNEN Directtore di Programma Eurex Del CNEN Saluggia "Vercelli", ITALY Giacomo Calleri Laboratorio di Ingegneria Sanitaria Via Anguillarese km 1 + 300 Roma, ITALY Willy Bocola
2	Bhabha Atomic Research Centre Waste Treatment Division Trombay, Bombay, INDIA N. S. Sunder Rajan K. T. Thomas
2	International Atomic Energy Agency Kartner Ring 11 P.O. Box 590 A-1011, Vienna, AUSTRIA
1	Dr. H. F. Ramdohr c/o Firedrich Uhde GmbH 46 Durtmund Deggingstr. 10-12 GERMANY

No. of Copies

ONSITE

3 ERDA Richland Operations Office

O. J. Elgert
R. D. Fogerson
R. B. Goranson

9 Atlantic Richfield Hanford Company

G. D. Barnhill
H. H. Hopkins, Jr.
T. R. McKenzie (3)
N. Raile
R. C. Roal
D. D. Woodrich
R. A. Yoder

2 United Nuclear Industries, Inc.

T. E. Dabrowski
J. Dorian

1 Westinghouse Hanford Company

R. B. Hall

17 Battelle-Northwest

C. H. Allen
J. P. Corley
J. R. Carroll
R. L. Dillon
H. T. Fullam
K. M. Harmon
J. H. Jarrett
C. E. Jenkins
W. S. Kelly
J. C. King
P. L. Koehmstedt
M. R. Kreiter
S. R. Mandell
B. W. Mercer
A. M. Platt
J. M. Selby
L. D. Williams