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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555
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MEMORANDUM FOR: Charles B. Bartlett, Chief
Systems Performance Branch, SAFER, RES

FROM: Donald E. Solberg
Systems Performance Branch, SAFER, RES

SUBJECT: SUMMARY OF MEETING WITH PNL PERSONNEL TO DISCUSS PROJECT "DECONTAMINATION EFFECTS ON RADWASTE SYSTEMS," (FIN #B-2281) RRG

On October 16, 1978, members of the Pacific Northwest Laboratories (PNL) and the NRC met to discuss the results on the subject project obtained during the last quarter. Attendees at this meeting are identified in Enclosure 1. The visual materials presented by PNL personnel are presented in Enclosure 2.

The meeting opened with a discussion of possible follow-on work in addition to that originally planned for this project. DOE has placed manpower ceilings on the laboratories effective July 1, 1978. NRC was concerned that personnel associated with this project would not be available to conduct appropriate follow-on work unless NRC identified at an early stage the detailed plans for this follow-on work. Contractor recommendations are contained later in the discussion.

The material contained in pages 1-10 of Enclosure 2 are largely self-explanatory and a repetition of material presented in the previous quarterly meeting. Since there was no discussion on this material no comments are required here. On page 11-15 of Enclosure 2 are presented slides that were prepared immediately before the meeting by the PNL personnel. A considerable body of information in addition to that shown was presented by PNL. This information will be summarized herein.

On page 11 is given an outline of the material presented in the following slides relative to the site visits.

Page 12 - Decontamination

(1) Definition - Decontamination in this study includes decontamination of all parts of the system whether done separately or together and includes mechanical methods, chemical methods, and also includes any system operating changes which would lead to changes in the radioisotope inventory in the system (nature, location, etc.).

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(2) Need - PNL expressed the belief that it would be necessary to decontaminate reactors at some time during their lifetime in order to limit personnel exposures, especially if components such as steam generators need to be repaired or replaced. All vendors are undertaking decontamination efforts under the broad definition given previously although they frequently do not refer to these as decontamination procedures. There has been a great deal of concern among those interviewed on site visits about licensing impact and what will have to be done to satisfy those who regulate decommissioning. Mr. O'Connor indicated that only a limited pool of personnel are available to the utilities to perform operations involving personnel exposure, thus as total man-rem increases to perform these operations, decontamination will be one of the mechanisms utilities will probably use to limit exposure of these personnel to acceptable limits.

(3) Development - PNL has noted little difference between the solutions used in studies during period 1962-1964 and the work in progress in 1978. Clean-up is accomplished by combinations of oxalic acid, citric acid, and by proprietary inhibitors. Canadian utilities are very actively involved in reactor decontamination both in the design phase as well as personnel training. PNL cautioned however that decontamination procedures that work on Canadian reactors will not necessarily be the best for U.S. reactors because of differences in design. For example, in the Canadian reactors the principal dose is obtained from carbon-steel pig-tails on the reactor vessel coolant nozzles and this dose rate is reduced by removing a small layer of the steel together with the contamination. It was noted that U.S. reactors almost without exception have stainless steel piping and the only other materials in contact with the primary coolant are the zircaloy fuel clad and the inconel steam generator tubes. Thus, the nature of decontamination required for U.S. reactors is not the same as for Canadian reactors.

Under the classic definition of decontamination with strong and weak solutions only one utility in the U.S. is actively involved in decontamination at the present time. This is Commonwealth Edison and the work that they are doing at Dresden. It was reported that Westinghouse has a forced oxidation and mechanical decontamination method utilizing hydrogen peroxide. Use of the forced oxidation at the Trojan Plant removed approximately 1500 curies of cobalt-58 that had a negligible effect on dose rates immediately following the decontamination although it could be postulated that this might lead to some reduced dose rates later during reactor operation.

(4) Timing - The on-line dilute process for decontamination is applied for a short duration, such as two days, and is done frequently, for example every two years. The questions to be answered are: When during the outage should the decontamination be performed, and how often, as for example, at every outage?

(5) Cost - Utilities are estimating that decontamination with concentrated process would be charged with about 3 months of reactor down-time. Rationalization for this figure was not clear and the utilities were not willing to share their methods for establishing costs for decontamination. PNL suggested that this information would be very useful and might be obtained at the decontamination meeting scheduled later for Idaho. The Germans used a two step concentrated process which required only a few days to complete. PNL believes that one month or less would be required for decontamination if the process was well organized, and this includes time required for refueling.

Page 13 - Design

(1) Materials - One of the design objectives should be to minimize the number of different materials in the reactor system. This is desirable since the decontamination solutions chosen must be compatible with all materials in the reactor system in order to insure against design degradation. For example, Dresden had 30 different alloys designed to 100 or more specifications. Reactor systems currently use approximately 10 different materials of construction. The Canadians are paying a premium for low cobalt steel in their plants in order to minimize the production of ^{60}Co.

(2) Layout - Architect engineers and utility operating personnel recognize the desirability of providing more space in the plant for maintenance (including decontamination) to minimize personnel dose rates and to accomodate design modifications. In addition, inclusion of valves at key locations within the system would facilitate decontamination of particular parts of the plant separate from other parts. Utility corporate personnel tend to take the opposite point of view in order to minimize the plant costs. More communication between these two groups appears appropriate in order to minimize personnel exposure and long term facility costs.

Page 14 - Pre-Operational Activities

(1) Decontamination Planning - PNL expressed the opinion that it was not sufficient to simply design the reactor to accomodate decontamination. There must be active decontamination program planning. It is particularly recommended that one person or group at each site be assigned responsibility for keeping current on the developments and the needs. Although they have not seen any instances where these functions exist in U.S. utilities they do however use this approach in Canada.

(2) Radiation Measurements - No information currently exists on good shutdown radiation measurements which would identify the status of the radioactive material inventory at many points within the system. This would involve use of Cutie-Pies as well as spectral measurements for isotope identifications. This information would be useful in determining the need for decontamination. PNL indicated that EPRI had a program which was supposed to address this problem and also Combustion Engineering is doing this type of work at the Milstone site.

(3) Cleaning - PNL expressed the opinion that there is a correlation between care in pre-operational cleaning, such as getting rid of debris and chemical cleaning of metal surfaces, and the amount of radioactive contamination and personnel dose rates during operation of the plant.

Page 15 - Radwaste Systems

(1) Adequacy - PNL has observed that none of the current systems are designed to accomodate decontamination, especially storage requirements. PNL estimated that approximately five primary coolant volumes of coolant storage are required, approximately half of which would have to be shielded.

(2) Layout - PNL observed that there was no space provided for storage or shielding requirements resulting from decontamination. Close packing of systems resulted in doses from many sources as a result of having to service a single unit. They also noted that work had been done on remote handling in the fuel reprocessing studies several years ago which might be applicable to reactor decontamination.

(3) Waste Disposal and Storage - Dresden estimates that their decontamination will produce 3000 curies of ^{60}Co and 3000 barrels of waste materials. It is believed that this material will provide doses so high that it will not be acceptable for low level waste storage, so the utilities believe that they will be forced into on-site storage until the material has decayed to acceptable levels. Thus, two problems associated with waste material developed as a part of decontamination are providing shipping containers with appropriate shielding, and the acceptability of these materials for disposal at low level waste sites.

(4) Exposure - Decontamination is expected to result in ion-exchange resins with extremely high dose rates, since these resins beds are not shielded at the present time.

(5) New Techniques - Because of the volumes of material involved as well as the levels of radioactivity associated with decontamination solutions, it is appropriate to adapt processes not previously used in radwaste systems or to combine processes currently in use in ways not usually used in the normal radwaste systems.

(6) Penal Syndrome - PNL observed the apparent belief among utility personnel that operators of the radwaste system are on the lowest technical level of the utility organization and therefore it is difficult to entice good people into this important area in dealing with decontamination.

A final item not shown in the slides is that dilute solutions require the least modification to radwaste system especially if that system currently uses ion-exchange and has a capability of remote removal of the resin and storage.

The material presented under significant findings on page 17 and 18 are largely self-explanatory. A summary of some of the discussion topics associated with that are presented below.

Mr. O'Connor noted that there is insufficient information to support industry claims that radiation levels in operating plants will level off after some unidentified number of years of operation. Additionally, experience indicates that more frequent maintenance and inspections are being required, so total man-rem will increase even if dose rates do not. Thus, the combination of increased hours of exposure plus likely continued increasing dose rates will provide impetus for decontamination.

The remainder of the information presented in Enclosure 2 is believed to be self-explanatory and since there was very little discussion they are not discussed further here. Particular attention is directed to recommendations for follow-on work on pages 25-27. These recommendations should be studied carefully be the NRC's cognizant personnel in order to present a recommendation to NRC management for potential additional funding. It was further noted that it would be beneficial to the NRC to have an on-call body of expertise to address problems arising relative to decontamination. The team currently doing research on this project at PNL could constitute such a body of expertise. If this is appropriate then it is the NRC's responsibility to provide funding to these personnel so that they have time available as required to work on NRC problems as well as to keep current on decontamination developments.

Donald E. Solberg
Systems Performance Branch, SAFER, RES

Enclosures:
1. Attendees
2. Visual Materials, PNL

cc w/enclosures: J. T. Collins, NRR
L. Barrett, NRR
G. Cwalina, NRR

cc w/o enclosures: Attendees

ENCLOSURE 1

MEETING ATTENDEES

DECONTAMINATION EFFECTS OF RADWASTE SYSTEMS

(FIN No. B-2281)

October 16, 1978

D. E. Solberg, NRC/SPB

P. W. O'Connor, NRC/ORB2

J. Y. Lee, NRC/ETSB

J. L. Minns, NRC/RAB

L. D. Perrigo, PNL

J. R. Divine, PNL

THE IMPACT OF DECONTAMINATION PROCESSES ON LWR RAD WASTE TREATMENT SYSTEMS

JULY-~~AUGUST~~ SEPTEMBER 1978 QUARTERLY REPORT BY

LYLE D. PERRIGO AND JAMES R. DIVINE

Battelle

CONTENTS

- PROJECT DESCRIPTION
- PROGRESS
- SCHEDULES
- BUDGET AND COSTS
- FOLLOW ON PROJECTS
- SUMMARY

PROJECT DESCRIPTION

- SCOPE
- TASK EFFORTS

SCOPE

. . . ACQUIRE AND EVALUATE INFORMATION TO DETERMINE THE IMPACT OF DECONTAMINATION ON RAD WASTE SYSTEMS SO THAT FUTURE SYSTEMS CAN BETTER ACCOMMODATE CLEANUP OPERATIONS. . .

SCOPE

The current scope of work is directed toward the acquisition and evaluation of information on existing radwaste treatment systems. Although formal action has not been initiated, the scope will be expanded to include: 1) safety, 2) exposure considerations, 3) an extra utility visit and attendant investigation and 4) direct contact with architect-engineering organizations. The first three are in response to requests by NRC while the fourth is by recommendation of PNL.

TASK EFFORTS

I — DATA ACQUISITION

II — EVALUATION

III — COST CONSIDERATIONS

IV — EXPOSURE CONSIDERATIONS

V — SAFETY CONSIDERATIONS

VI — REPORT PREPARATION

VII — PROJECT MANAGEMENT

PROGRESS

- INFORMATION SOURCES
- CONTACTS
- SITE VISITS
- SIGNIFICANT FINDINGS

INFORMATION SOURCES

- LITERATURE
- CONTACTS
- SITE VISITS

CONTACTS

NUMBER / TYPE	DIRECT	OTHER
VENDORS	GE, WE, CE, B&W ONTARIO HYDRO	GE, WE, CE, B&W ONTARIO HYDRO
SERVICE COMPANIES	DOW UNI HALLIBURTON	DOW UNI HALLIBURTON
AE GROUPS	STONE & WEBSTER DUKE ONTARIO HYDRO	STONE & WEBSTER DUKE ONTARIO HYDRO
UTILITIES	BALTIMORE GAS & ELEC DUKE COMMONWEALTH EDISON UNI BOSTON EDISON ONTARIO HYDRO PORTLAND GE	BALTIMORE GAS & ELEC DUKE COMMONWEALTH EDISON UNI BOSTON EDISON ONTARIO HYDRO PORTLAND GE VIRGINIA ELEC. & POWER

CONTACT SUMMARY

NUMBER / TYPE	DIRECT	OTHER
VENDORS	5	5
SERVICE COMPANIES	3	3
AE GROUPS	3	3
UTILITIES	7	8

SITE VISIT

- DECONTAMINATION
- DESIGN
- PREOPERATIONAL ACTIVITIES
- RADWASTE SYSTEMS.

DECONTAMINATION

- DEFINITION
- NEED
- DEVELOPMENT
- TIMING
- COSTS

DESIGN

- MATERIALS
- LAYOUT
- CONTROL GROUP

PREOPERATIONAL ACTIVITIES

- DECONTAMINATION PLANNING
- RADIATION MEASUREMENTS
- CLEANING

RADWASTE SYSTEMS

- ADEQUACY
- LAYOUT
- WASTE DISPOSAL / STORAGE
- EXPOSURE
- **NEW** TECHNIQUES
- PENAL SYNDROME
-

SIGNIFICANT FINDINGS

- INDUSTRIAL PERCEPTIONS
- STATE-OF-THE-ART
- REACTOR DESIGNS
- RADWASTE SYSTEM DESIGNS
- NEEDS

SIGNIFICANT FINDINGS

- Industrial Perceptions. Many utilities have adopted a "wait and see" approach to primary system decontamination and the disposal of decontamination wastes. There continues to be a belief that good water chemistry control will avoid the need for decontamination and/or undesirable buildup rates will eventually decrease/level out so that extremely high exposures will be avoided. All utilities maintain that cleaning will be undertaken for economic reasons.

- State-Of-The-Art. Many of the people who might have or recognize the possible need for primary system decontamination are not aware of the decontamination work done in the 1950's and 1960's. Some results now being reported for supposedly new findings merely confirm information discussed and published 15 years ago. A major contributor to this lack of appreciation of earlier work is believed to be a result of the computerized literature search techniques that are common today. Such searching techniques frequently limit the search to the last 5 or 10 years. Since most of the most definitive work in the field ended in the mid 1960's, this earlier information would not show up when these computer techniques are used.

- Reactor Designs. No reactors have been found that have designs that will immediately accommodate decontamination. If on-line processes were to be used, minor modifications and the addition of ion exchange systems would be required. The use of concentrated solutions would require significant modifications. Many are inclined to believe that concentrated processes will be required for reactors that have been in operation for appreciable periods of time. There is a hope that on-line processes, when used before substantial buildup has occurred, may be sufficient for reactors now starting operation.

- Radwaste System Design. Except for Dresden no reactor radwaste treatment system was found to be designed that could accommodate decontamination with a concentrated solution process. The most serious deficiency is in solution storage capacity. Five to 10 primary system volumes will likely be needed, and most radwaste systems have a maximum 1-2 system volumes of such capacity.

- Needs. There are two categories of needs to overcome current deficiencies in decontamination: 1) development of procedures to clean nuclear fuel and 2) creating a broader awareness of decontamination experience, planning, and need. Projects to provide needed results are described later in this presentation.

SCHEDULES

- MILESTONES
- REPORTS

SCHEDULES

Milestones. The milestone schedule being used by PNL and a statement of progress toward achieving these milestones follows:

- Data Acquisition - May-December 1978; running about two weeks behind schedule. Will be completed on October 17, 1978. No major impact anticipated at this time on completing the project on schedule.

- Evaluation - October-December 1978; changed from October-November 1978 when safety task added to project. Work has started; on new schedule.

- Cost Analysis - Complete by January 31, 1979; changed from December 1978 when safety task was added to project.

- Report Preparation - dates changed to accommodate the addition of a safety task to the program.

  - Forward comment draft to NRC - 3/2/79
  - NRC comments to PNL - 3/15/79
  - Revise report - complete by 3/30/79
  - Publish and distribute - 4/30/79

The schedule for report reviews, revision and publication is tight; it will be watched closely to avoid delays in so far as possible.

Reports

- An ERDA 536 form is being prepared to support the September 1978 monthly report. Because of the manner and timing of receipt of funds, expenditures are shown as all occurring in September.

- PNL suggests that the quarterly report for the period October-December 1978 be presented to D. E. Solberg and other interested NRC personnel at Richland. This will provide an opportunity for NRC to conduct a more detailed review of work than might be undertaken at Silver Springs. Such a detailed review is desirable so that surprises can be avoided or their number reduced at the time a final report draft is forwarded to NRC.

- PNL suggests substituting a review of the final report draft with NRC for the preparation and delivery of a quarterly report for the period January-March 1979.

BUDGET AND COSTS

- PROJECT BUDGET
- COSTS

BUDGET AND COSTS

Costs for the project through September 30, 1978 were $43,345. Total expenditures at the end of each month in the period June - September 1978 are listed below:

June	$15,900
July	$25,570
August	$39,459
September	$43,345

Arrangements are being made to modify the PNL 189 to NRC to request the following additional funds to cover requested and recommended additional work:

Extra Reactor	$ 6,000
Exposure Assessment	20,000
Safety Analysis	10,000
Architect-Engineering Contacts	5,000
TOTAL	$41,000

FOLLOW ON WORK

- FUEL DECONTAMINATION PROCESSES
- DECONTAMINATION INFORMATION EXCHANGE
- INTERN/STAFF EXCHANGE PROGRAM
- DESIGN PRIMER
- TECHNICAL ASSISTANCE PROJECT

FOLLOW ON WORK

Five follow on projects to the current study entitled "The Impact of Decontamination On LWR Radwaste Treatment Systems" have been identified as being potentially needed by NRC to fully exploit results of work to date. These are described below:

- Fuel Decontamination Processes. With the recognition that concentrated solution decontamination will likely be required for most of the existing reactors operated by utilities at some time in the future and a part of those that will soon start operation will require similar cleaning operations, it is mandatory that procedures be developed to decontaminate fuel. Most of the radioactive corrosion products are on the surface of the fuel. If this inventory is not reduced, the external part of the primary system will become recontaminated at a much faster rate than desirable. On-line processes would normally be used to clean fuel so the concept of subjecting the fuel to chemical cleaning is already established.

- Intern/Staff Exchange Program. One of the findings of the current study is the gap between knowledge in the utilities and the research work being undertaken on decontamination. The Canadians have used an intern/staff exchange program to good advantage in overcoming such problems. Canadian utilities assign one

or more staff members to AECL - Chalk River for intensive work on decontamination for a year or more.

- Decontamination Information Exchange. Another method suggested for overcoming the lack of appreciation/understanding of decontamination in various systems of industry is the operation of an information exchange group. In concept such a group would be similar to the one sponsored by the AEC called the Reactor Decontamination Information Exchange Group. The group members from the national laboratories in Canada, United Kingdom and France meet twice a year and exchange information on research and decontamination operations. Care would be required in selecting the membership of such a group, but information exchanged should help stimulate interest in decontamination while serving as a means for promoting the transfer of technology.

- Design Primer. Existing reactors are not designed for decontamination. From what we know of future designs, these reactors are not designed for such operations either. The failure to provide designs for such operation arises for a lack of understanding of the importance of decontamination and a lack of appreciation of the techniques that can avoid or reduce the number of problems that can arise during decontamination. One way to help overcome this problem is to prepare a primer directed toward a design audience that clearly outlines the

need, establishes criteria, and gives a number of examples of how to make systems easier to decontaminate.

- Technical Assistance. With a growing need to consider decontamination, it appears to PNL that one way for NRC to maximize the benefits of the current study is to provide technical assistance funds for Hoenes, Divine, and Perrigo to they can help interpret utility decontamination needs and radwaste treatment system developments. Such assistance could include site visits of a more limited nature.

SUMMARY

- PROJECT BACKGROUND DISCUSSED
- MAJOR FINDINGS PRESENTED
- FOLLOW ON WORK IDENTIFIED
- SCHEDULE & COSTS DISCUSSED