Refinishing Contaminated Floors in Spent Nuclear Fuel Storage Basins

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

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Refinishing Contaminated Floors in Spent
Nuclear Fuel Storage Basins

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ABSTRACT

The floors of the K Basins at the Hanford Site are refinshed to make decontamination easier if spills occur as the spent nuclear fuel (SNF) is being unloaded from the basins for shipment to dry storage. Without removing the contaminated existing coating, the basin floors are to be coated with an epoxy coating material selected on the basis of the results of field tests of several paint products. The floor refinishing activities must be reviewed by a management review board to ensure that work can be performed in a controlled manner. Major documents prepared for management board review include a report on maintaining radiation exposure as low as reasonably achievable, a waste management plan, and reports on hazard classification and unreviewed safety questions. To protect personnel working in the radiation zone, Operational Health Physics prescribed the required minimum protective methods and devices in the radiological work permit. Also, industrial hygiene safety must be analyzed to establish respirator requirements for persons working in the basins. The procedure and requirements for the refinishing work are detailed in a work package approved by all safety engineers. After the refinishing work is completed, waste materials generated from the refinishing work must be disposed of according to the waste management plan.

1. INTRODUCTION

Uranium fuel in the K Basins located on the Hanford Site is surrounded by a protective cladding of zirconium alloy; it is stored in water in the basins and remains stable so long as the metal cladding is not broken. Spent nuclear fuel (SNF) discharged from the N Reactor at the Hanford Site has been stored in the K Basins (KB) for two decades. Mechanical damage to the fuel cladding has caused some of the fuel to corrode; as a result, radionuclides -- plutonium, cesium, strontium, uranium, and tritium -- have contaminated the basin water, which has leaked into the soil beneath the basin.

The SNF in the basins has been scheduled for removal to dry storage. Because the average radiation level in the transfer bays of the basins is high, increased activity related to fuel removal in the basins will result in higher worker exposures to radiation. Thus dose reduction projects have been developed to make decontamination easier and to minimize radiation exposure. The projects include hydrolasing or removing circulation piping and refinishing the transfer and chiller bay floors. Hydrolasing can reduce dose rate while refinishing the floors will clean up crevices and make decontamination easier if spills occur during fuel removal.

As several SNF project activities will be underway in the basins simultaneously, activity interfaces present problems; therefore, it was necessary to establish a procedure to identify and correct potential problems. One efficient process involved formation of the management review board (MRB) to provide information and reviews at selected points during project development. The activities involved in refinishing the basin floor are reviewed by the MRB to minimize impacts on schedule and cost. These activities must meet the dose management and as low as reasonably achievable (ALARA) requirements for radiological control. Such requirements will minimize human and environmental exposures to radiological hazards or conditions during modifications to the facility.

2. BASIN ENVIRONMENTS

The K East (KE) and K West (KW) Basins were constructed in 1951 to store the SNF discharged from the 100 K Area single-pass production reactors (SPR). Each basin is 38 m long, 20 m wide, and 6.4 m deep. Water levels have been maintained at a nominal depth of 5 m to remove decay heat until the fuel could be transferred to the Plutonium Uranium Extraction (PUREX) Facility. In the 1970's, the K reactors and PUREX were shut down, but N Reactor continued to operate to provide electricity. One result was the need for significantly more storage space than was available in the N Reactor Basin; thus, the irradiated fuel of N Reactor was transferred to the K Basins for temporary storage. Although PUREX was restarted in 1983 to process the N Reactor fuel, its shutdown again in 1988 left approximately 2,100 metric tons of N Reactor SNF and a small amount of SPR SNF in the K Basins.

In years past, railroad wellcars were used to transport the SNF. However, a trailer is now being designed to replace the wellcars, the crevices and recesses along the railroads will be filled, and the floors will be refinished to provide a hard, smooth surface for a new transportation system. For trailer operations, the mezzanines and piping in the transfer bay area need to be removed. The SNF elements will be loaded in a container called the multi-canister overpack (MCO) [1], which then will be placed in a cask for shipping to the Canister Storage Building.

All of the fuel in KW is in sealed containers, but fuel in KE is in open canisters that expose the spent fuel directly to the water. Those fuel rods with broken metal skins have allowed the uranium to corrode and release radioactive material into the water in the KE Basin. In addition to the SNF, approximately 50 to 70 m3 of sludge and large quantities of debris such as SNF canisters and SNF storage racks have accumulated in the K Basins over the years. This sludge and debris will be transported to the Tank Waste Remediation System and Solid Waste Storage.

3. PROJECT REVIEW PROCESS

Every SNF project activity must be assessed for its readiness to be performed safely as

planned. Because several activities are planned to accomplish the SNF project, activity interface problems are to be dealt through management reviews. A management review board (MRB) has been formed to review whether newly developed activities or significant modifications to other activities have identified requirements specific to the K Basins and to ensure that adequate documentation and controls are in place so that work can be performed in a controlled manner. The MRB members have sufficient broad-based knowledge of K Basin operations, their design basis, manpower, schedule, and other requirements to approve the interface provisions for the basin activities. All MRB members are responsible for reviewing project documents to prevent potential design problems and potential noncompliance with basin requirements, safety analysis issues, and to deal with other problem issues. The members also ensure that the project presented does not affect the basin activities adversely.

The review of K Basin projects considers separately those upgrade projects that support continued operations of the K Basins and those SNF engineering and "path forward" projects that are coordinated through the Fuel Handling Operations manager. A project must go through four stages in the review process to get MRB approval: these are identified as KR-0, KR-1, KR-2 and KR-3 reviews. In this graded approach, stages may be deleted or combined by the MRB for activities that require minimal design. The review activities for each stage are described below.

3.1 Scope Definition

This KR-0 review focuses on the definition of project scope and goal. Information that must be presented to the MRB includes schedule, network logic, and cost estimate. The time frame for the project activities has to fit in with other KB and SNF integrated schedule activities and cannot interfere with these activities in any significant way. The MRB chair authorizes the work action items that must be resolved prior to the next review stage.

3.2 Functions and Requirements

In this KR-1 review, the functions and requirements of a project must be established and

presented to the MRB. If equipment needs to be procured for the project, equipment parameters have to be clearly defined in functions and requirements documentation. For example, one of the dose reduction projects involved coating the concrete perimeter and the sides of the divider walls in the K East Basin with an epoxy coating material. The four sides of the basin and the long sides of the two divider walls were coated with a durable product that can be decontaminated easily. The coating equipment had to be capable of coating above the present water line.

The functions and requirements documentation must describe the basin facility and problems briefly and provide details of facility constraints. For example, the coating equipment had to be designed to be used under specific facility conditions. Some gratings above the fuel pool needed to be removed for equipment access and operation. Lifting hoists hanging from monorails that run throughout the basin area once were used to lift and transport equipment; the coating equipment has been designed to use these devices. Documentation for this project carefully describes obstructions on the basin walls, as well as the operating, setup, and storage spaces. In addition, information on the available utilities had to be detailed for vendors. A conceptual design review was conducted by a committee comprising personnel representing Buyer Engineering, Operations, Health Physics, Quality Assurance, Industrial Safety, Nuclear Safety, and Environmental Safety. After fabrication, the seller must conduct an acceptance test to demonstrate to the buyer that the equipment met the requirements outlined. On receipt of the equipment and documentation at the Hanford Site, the seller must conduct a demonstration to verify that the equipment is ready for deployment into the basin and submit a plan for training Hanford operating personnel.

Documentation also must include administrative requirements such as access, training, badging, dosimetry, reporting, and document transmittal requirements; technical requirements such as drawing and design criteria; and operational requirements, safety, ALARA, waste, quality assurance, and warranty requirements. Additionally, the KR-1 review stage checks the project work plan for adequacy in the control of basin interfaces.

3.3 Conceptual Design Phase

This stage of project review (KR-2) centers on the evaluation of potential failures and the impacts of such failures. It is intended to identify any problems stemming from design and any additional work necessary for readiness determination. The conceptual design and detailed schedule with SNF project logic ties, functional interface control, results of ALARA plan, hazard classification, and criticality review as required must be presented to the MRB for review at this stage. The ALARA plan must clearly demonstrate that the exposure incurred is justified and should document engineering controls used to minimize the spread of contamination. Other items included in this review are K Basin operating conditions for the equipment used, training plans with KB input, and emergency responses to be identified for anticipated accidents.

3.4 Definite Design Phase

This final management review (KR-3) requires the following documents to be completed and signed off: ALARA plan, USQ determination, waste management plan (WMP), hazard classification, notice of construction, specifications, engineering change notices (ECN), drawings, acceptance test procedures, and budget and milestones. In addition, the work package must be nearly complete, all procedures reviewed, and training underway. This review determines whether the detailed design meets those KB interface and functions and requirements agreed to in the preceding reviews.

The KR-3 review considers the following (1) whether the detailed design has ALARA planning and KB input and meets KB loading, operational, environmental, and safety requirements; (2) whether all physical interfaces have been rechecked for operability and the construction plan is in place in the KB; (3) whether development test objectives have been met; (4) whether schedules are reasonable for coordinating with KB schedules and manpower, and meet other facility limitations; (4) whether emergency response changes are in place; and (5) whether housekeeping, including waste management, tools and equipment storage, and general area cleanup, is planned.

4.0 RADIOLOGICAL CONTROL

As required by Code of Federal Regulations, 10 CFR 835, "Occupational Radiation Protection," the Hanford Site has established a program to maintain radiation levels ALARA. A graded system of administrative control levels to control worker doses is specified in the Hanford Site Radiological Control Manual (HSRCM) [2]. All Hanford Site radiological activities including the 105K SNF Project are required by the HSRCM to apply ALARA principles.

4.1 ALARA Review

The ALARA review considers the following requirements: Work in radiation zones must satisfy radiological criteria to ensure safety and maintain radiation exposures ALARA. Whether the work is construction or maintenance, the design and planning processes should incorporate radiological considerations in the early planning stages. Both administrative requirements and design features are considered equally important to maintain exposures ALARA. In the K Basin projects, maintenance and modification plans and procedures must be reviewed by line management and the Radiological Control Organization to ensure that they incorporate radiological requirements. The K Basin ALARA Committee is a multi-disciplined committee comprising personnel from various major functions at the K Basins. According to the HSRCM, one of the Hanford Site "triggers" for review and approval by the ALARA Committee is any task for which estimated individual or collective dose is projected to exceed 1000 person-mrem. In the case of the floor refinishing project at K Basins, the first step of the ALARA review process was a dose assessment on the work area in the basins. Dose rate and contamination level at various locations on the transfer bay floor in the basins had to be surveyed. The number of workers, types of workers, and the total hours for each worker to spend in the basin refinishing the floor had to be estimated. From these data the ALARA support team calculated the total collective dose and analyzed radiological conditions against the established trigger levels. Dose rates and contamination levels were measured at 80 points on the transfer bay floors of the KW and KE. In the KW, the dose rates are an average of 0.2 mrem/h, and most of the contamination levels are

< 1,000 dpm/100 cm² with a maximum of 10,000 dpm/100 cm² (ā-ā) and < 22 dpm/100 cm² (ā).

With the number of workers including painters, laborers, health physics technicians, etc., and the time spent on floor refinishing work estimated to be 1,000 person-hours, the total collective doses were calculated to be 200 person-mrem for the KW and > 1000 person-mrem for the KE. The ALARA support team reviews the radiation exposures that workers are subject to and prepares an evaluation document.

As estimated above, floor refinishing activities would exceed the trigger levels in the KE Basin, but not in the KW task. Tasks with the potential to exceed trigger levels must undergo a formal ALARA review for approval. The review considers provisions for the reduction of radioactivity and time in the work area, use of engineering controls to minimize spread of airborne radioactivity contamination, temporary shielding, maximization of prefabrication work, and provisions for waste minimization and disposal. Major tasks with high associated collective doses must include a detailed, documented evaluation. The basin floor refinishing work would commence only after the ALARA plan was reviewed and approved in the KR-3 review (Section 3.4) by the ALARA committee.

4.2 Protection Against Contamination

Personnel working in radiation zones can be protected from surface contamination through (1) proper facility design, (2) use of protective equipment and procedures, and (3) care in the performance of work. Items (2) and (3) must be used together to prevent the spread of contamination to other parts of the facility and other persons. The minimum protective methods and devices required for work in a radiation zone are prescribed in an RWP by Operational Health Physics.

Airborne radioactive materials generated during floor cleaning and preparation for coating would be minimized by (1) use of high-temperature pressure decontamination equipment to clean floor, (2) a high-efficiency particulate air (HEPA) vacuum with a minimum flow rate of 2,266 L/m (80 ft³/m) to remove debris from crevices, (3) a HEPA ventilation unit with a flow rate of 8,496 L/m (300 ft³/m) for decontamination of drain interiors, and (4) lightly wet sanding the existing coating for

application of paint primer. During floor cleaning, the health physics technician (HPT) would survey the dose rate and take air samples to ensure that contamination levels were below 10,000 dpm/100 cm² α - α and 2,000 dpm/100 cm² β . The HEPA filters in any equipment would not be changed without supervision by the HPT.

5.0 FIELD TESTS ON COATING MATERIALS

The KB floors are to be refinished without removing the contaminated existing coating. Several epoxy coating materials used in the nuclear industry have been investigated for possible applications on the K Basin floors. These floor areas will be used as truck loadout areas to load and ship SNF with a total gross weight of 45,360 kg. The coated floor surfaces must tolerate heavy loads and abrasive traffic and resist impacts and corrosive chemicals. A smooth floor surface also makes decontamination easier.

5.1 Material Testing

Field tests were performed on coating materials to qualitatively evaluate their adhesive strengths and the integrity of their laminating properties. An area of the K West Basin transfer bay 0.3 m by 1.2 m near the wall was selected for paint testing. Existing loose paint was removed and the adherent coating on the floor was scrubbed with a general-purpose cleanser prior to applying the proposed coating materials. Both primer and finish coats of the four paint products were applied in accordance with instructions from the manufacturers. Two primers of one paint product were tested for one finish coat; one of the four products required no primer. Five test coupons were used, 10 cm by 25 cm each. The adhesives were allowed enough time to set up and reach the recommended cure for testing. Test procedures are briefly described below. Details of the test procedures used are available in ASTM D4541 and ASTM D3359 [3].

An adhesion tester was used to obtain the numerical values of pull-off strength for the coating materials. The loading fixture of the tester was carefully connected by the central grip of the detaching

assembly of the tester. The fixture was loaded smoothly until failure occurred. The force attained at failure or the maximum force applied was recorded. From the results, the failure modes of the adhesive to the existing paint were determined.

Tape test also was used to have a quick screening on the coating materials. The qualitative test method requires that a sharp knife be used to make two cuts in the film; the two cuts intersect at an angle of approximately 30 deg (Method A). For films thinner than 5 mil, the cuts are made at 90 deg to form a grid (Method B). A pressure-sensitive tape is placed at the inter-section of the cuts or over the grid. The adhesive properties can be evaluated by inspecting ease of separation from the adhesive and the failure type.

Because the contaminated paint on the basin floor cannot be removed, the main purpose of the tests was to compare the properties of the new coating materials in adhering to the old paint. However, other failure modes also were evaluated: cohesion, adhesion to concrete substrate, integrity of laminated coating, etc. Individual as well as collective failure modes were considered in selecting from among the tested coating materials.

Both Methods A and B of ASTM D3359 were used to assess the adhesion of new coating films to the existing floor paint. An X-cut with an angle of 30 deg and grid-like cuts 2 mm apart were made on the top part of each film on each the five test coupons. Test results showed that there was no peeling at the cut intersections on any of the coating materials, and the edges of the grid were completely smooth, except for a small flake of the coating found detached in the film of the #3 paint. The results of the tape tests indicated that the adhesion of the proposed coating materials to the floor was good. The tape test was not capable of discriminating adhesive strengths among the epoxy products tested. Pull-off tests were performed on three spots for each coating material. Figure 2 shows tests results for the pull-off strength of each paint product. After each test was completed, the plug of coating material bonded to the bottom of the dolly was examined; the plugs pulled from the existing coat and from the top coat were measured and the sizes compared. The size of the plug pulled from the existing coat indicated a better binding between the old and new coating materials. Some of

the tested materials had not bonded to the dolly completely; the film size of the detached existing coat was compared to the film size of the new coat pulled off. Results are plotted in Figure 3.

5.2 Material Selection

As Figures 2 and 3 show, the overall pull-off strengths and the adhesive strengths between the existing and top coats increase in the order of the paint number. Results clearly show that paints #1 and #2 were not suitable for covering the transfer bay floor in the K Basin in areas where the existing coat would not be removed. Paint #3 was the only non-hazardous material among the proposed materials, but its adhesive properties were only moderate. One dolly pulled off a small piece of old paint (15.2 %) together with a small area of paint #3 top coat. The strength with which it adhered to the existing coat is greater than that of paint #1 but lower than that of either #4 or #5. Because the top coat of paint #3 is glazed, the manufacture suggested that the floor be finished with a non-skid surface by broadcasting grit in the finished coat. However, this kind of floor surface is difficult to decontaminate and could not be the choice for the basin transfer bay where radioactive material shipping, loading, and traffic are expected to be heavy.

Both paints #4 and #5 appeared to be suitable for application to the existing coat of the K West transfer bay floor. The former requires no primer per manufacturer's suggestions because, although a primer penetrates into bare concrete to provide a better binding of finish coat to concrete, it does not help bind a new coat to an existing coating. Although test results for paint #4 were acceptable, a primer would still be needed for some small areas of the floor where the old coat is loose or missing. Because it was noted that the existing coat film on one of the paint #4 samples is broken and a small piece of the film is missing, paint #4 was not the first choice.

Comparisons of tests results among the coating materials led to the conclusion that the #5 epoxy products were suitable for coating the floor of the K West transfer bay area. Paint #5 is cycloaliphatic amine cured epoxy, 100% solid.

6.0 FLOOR REFINISHING

6.1 Work Plans

Before the floor refinishing work could start in the radiation zone, work plans had to be written and reviewed by safety engineers, environmental scientists, industrial hygienists, HPTs and operation personnel. The work package was saved in an electronic job control system (JCS) for electronic review and approval. The contents of the computer file include applicable documents, permits and special procedures, descriptions of materials and equipment required, prerequisites, work instructions and controls, and restoration activities.

The material safety data sheets (MSDS) for all of the paint products used are listed in the "applicable documents" section. The WMP and screening and evaluation of USQs also appeared on the list. The RWP is another important document listed in the "permits and special procedures" section. Work instructions on floor coating are described only briefly; the details of work steps must be given in the "Work Release for Construction/Service Organizations" forms (WRCOSF) on daily basis. In contrast, every step of the radiological control process was detailed in the package, with several hold points to allow HPTs to verify that the requirements of the HEPA vacuum and ventilation unit were met and the contamination levels at floor areas were below the required levels (see Section 4.2).

6.2 Preparation of Floor Surfaces

The success of any paint application depends on surface preparation, film thickness, method of application and conditions during application and cure. Floor surfaces must be carefully prepared to maximize the bond strength of the coating to the floor surfaces. Debris had to be removed from track crevices and other crevices with a HEPA vacuum. After loose paint and concrete were removed, the area had to be surveyed to ensure that the contamination levels were below required levels; otherwise, the areas would have to be decontaminated. The drain covers had to be cleaned, and their interiors decontaminated. A fixative would have to be applied if the contamination levels inside the drain

covers proved difficult to reduce.

The floor general area was spray-vacuumed with decontamination equipment that is an assembly of five major components combining a low-volume, pressurized spray of superheated water with a powerful, HEPA filter wet vacuum system. The components are (1) the "main unit," which supplies the superheated water under pressure to the decontamination tools; (2) the "vacuum power unit," which provides the source of vacuum for the decontamination tools; (3) the "demister/HEPA filter unit," which contains a high-efficiency demister and a high-capacity HEPA filter in a bag-in, bag-out stainless steel housing; (4) the "cyclone liquid separator," which consists of a lightweight, portable cart with a stainless steel cyclone-type separator to remove the waste water and any large particles or trash vacuumed up during system operation; and (5) the "spray-vacuum decon tools," which contain the spray nozzles inside a vacuum shroud supported by roller bearing wheels. The equipment requires 480 volt, 3-phase, 30- and 60-amp power supplies to operate with an output temperature below 149 oC and a pressure below 2 Mpa. If the differential pressure drops significantly in the system the filter may need to be changed, at which point the cleaning operation would have to cease and an HPT contacted for direction. Most areas of the transfer bay floor could be cleaned with the decontamination equipment; the floor surface areas inaccessible to the equipment had to be cleaned manually.

Following the cleaning and decontamination of the floor surfaces, all holes, crevices, recesses along the rails, and damaged concrete had to be filled with filler that is one part putty and one part silica sand mixture. The putty has two components, with a two-to-one mix ratio, produced by the same manufacturer responsible for the paint. All cracks and openings in the floor, the curb sides, and top where water could stand had to be filled before the coating is applied. Also, the filler was applied to the interface between the floor and wall or curb to make a concave corner. The cure time for this filler is 12 hours at 25 oC.

6.3 Application of Coating Material

Once voids were filled the surfaces were wet sanded to produce a rough texture without generating airborne radioactive material. The floor surface was cleaned again with the decontamination equipment to ensure that all dirt, grease, loose paint, and foreign materials had been removed prior to applying primer.

The primer is a two-component epoxy with a mix ratio of 2 to 1. A paint tint was added to make the color of the primer different from the finish coat to facilitate identification of chipped or worn paint. One coat of primer with a thickness of 5 mil was applied on the floor areas.

The primed floor was cured for 12 hours at 25 °C before the finish coat, of two components with 2 to 1 mix ratio, was applied. The two parts of the finish coat had to be mixed uniformly because incomplete mixing produces soft spots and yellow patches. To ensure complete mixture, the sides and bottom of the container had to be scraped. Following the application of one coat of finish coat aluminum oxide, slag or grit may be broadcasted where a non-skid surface is desired. Discussions with health physics and safety personnel concluded that the basin transfer bay floors should not have a non-skid finish because the floors need to be smooth for easy, thorough decontamination and because there is only a slight risk that workers might slip. The smooth, dry floor is safe to walk on with rubber shoes.

A 0.9- by 3-m steel plate was installed in the south transfer bay to distribute the load of the trailer jacks. The 9.5-mm-thick steel plate was bolted to the concrete floor and supported by a 12.7-m-thick layer of grout. The purpose of spreading the grout underneath the steel plate was to avoid placing the plates on a surface that was not flat and risk damage to the floor from heavy loads. The corners of the steel plate and the grout platform were rounded off for the convenience of the trailer. To make the surface of the platform smooth for easy decontamination, the edge of the grout platform had to be free of holes and the steel plate sandblasted; they were coated with the same coating material used for the floor.

One coat of finish coat was applied on flat areas, the steel plate, and the hole-free edges of the

grout platform. The sloped surfaces such as the areas around the drain covers required two coats because the finish is self-leveling. The total dry film thickness of the coating had to be 0.70 to 0.84 mm for the concrete floor and 0.25 to 0.38 mm for the steel plate. It took a minimum of 12 hours at 25 °C for the finish coat to cure before traffic was allowed.

6.4 Safety Requirements

Fire hazard is the first potential problem when paint products are used. Paint primer is usually developed for application as a deep-penetrating anchor coat for finish coat; it promotes adhesion to damp concrete and works as a excellent sealer. Such a primer contains flammable anhydrous isopropanol, which reduces viscosity of the sealer, but its vapors can ignite by static sparks explosively; thus welding or cutting torches must not be used on or near containers. The limits on combustible liquid used or stored in the K Basins is 227 L, in accordance with NFPA [4]; only 38 to 57 L of flammable primer are needed to coat the transfer bay floor; therefore, the use of flammable primers presents no fire protection problems. However, flammable primer was judged to be not desirable in the K Basins. The primer selected does not contain anhydrous isopropanol and is not flammable liquid.

Because the contaminated floors of the SNF storage basins contain radioactive materials, the RWP requires protective equipment for workers to do refinishing work on the basin floors. Every worker in the basin is required to wear coveralls, boots, shoe covers, gloves, hood, and full-face respirator. HPT coverage is required for determining contamination and dose rate levels in the work area, and air samples are required periodically during work to verify that the work is not generating airborne contamination.

Another industrial hygiene concern is safety in using the paint products. To prevent inhalation of organic vapors, the craftsmen working directly with the paint products must wear at least half-face air-purifying respirators with a combination of organic vapor and HEPA filtration. Others working with the craftsmen such as escorts, HPT, and other crafts who are within 1.5 m of the recently applied

material must use the same kind of respirator. Others with occasional potential exposure, e.g., workers checking equipment or systems, will not be required to wear a respirator if they will not be associated with the recently applied material for more than 10 minutes. Nuclear safety was also analyzed for the radionuclide inventory on the transfer bay floors. On the basis of the radiological survey used for ALARA review (see Section 4.1 above), the activities and the proportions of various nuclides were evaluated. The ratio of the total activity to the sum of the Hazard Classification (HC) 3 threshold quantities is 1×10^{-5} for the KW and higher for the KE transfer bay floors. The activity of the KW transfer bay floor is more than 105 times less than the HC 3 threshold, an indication that little radioactivity is expected to be released as a result of floor surface preparation. The analysis shows that the floor refinishing work is less than Hazard Category 3 and is not considered unusually hazardous; thus the normal radiological and industrial safety controls are sufficient.

Another consideration was whether the water quality in the pool or the water treatment system would be adversely affected should the refinishing products be spilled accidentally. The paint products used in the basins have a higher density than water, are insoluble or only slightly soluble in water, and contain no decomposition products deleterious to basin water quality. Therefore, the use of these products for the basin floor coating is compatible with maintenance of water quality in the basin and will not adversely affect water treatment system operations.

7.0 WASTE MANAGEMENT

A WMP for storage and disposition of waste materials generated as a result of the floor refinishing was required before work on the contaminated floor of the SNF basin could begin. Two kinds of waste material are generated in the floor refinishing work: compactable low-level waste, e.g., torn personal protective equipment, plastic tape, plastic, paper, rubber, cloth, and glove bags, and leftover paint products, which are non-compactables. In general, compactables may be bagged and placed in an ATG container; non-compactables are placed in a plywood burial box 1.2 m by 1.2 m by 2.4 m.

Manual cleaning of the floor may require the use of rags to soak up water. These rags can be placed into the compaction receptacle if they are mixed with a cup of Radsorb mix and placed into a plastic bag. No hazardous material is to be placed into the plywood box or into satellite compaction receptacles. One example of a type of hazardous material is metal painted with lead-based paint or rags soaked with oils. This kind of hazardous material can be buried, under the provisions of the K Basins WMP, if the material is determined to be non-regulated by Operations Analysis and Waste Handling (OA & WH); otherwise, it is disposed of in accordance with guidance from QA & WH.

Disposition of the paint products used in the basin floor coating required a predetermination of the products for hazards, before use and after.

On the basis of chemical characterization for the paint ingredients, the predetermination indicated that all part A products (resin) of putty, primer, and finish coat are non-regulated, but all part B products (hardener) and paint tint are hazardous. After part A mixes with part B, the finish coat mixture is non-regulated while the primer and putty mixtures are hazardous waste in wet form, but are considered non-regulated once dried, as there are no volatiles present once these substances have dried.

Accordingly, only dry paint mixtures, dry paint rollers, bushes, rags can be packaged into wooden disposal boxes. The basic rules for handling paint products required that all paints be mixed outside the surface contamination area (SCA) and that workers could take into the area only what would be used and must use all paint products they took into the SCA. All leftover paint or paint containers outside the SCA were disposed of in a Satellite Accumulation Area. Disposal of waste materials not considered in the scope of the WMP required that OA & WH be contacted for guidance.

8.0 CONCLUSION

SNF storage basin floors are to be refinished for ease of decontamination to minimize worker exposures to radiation. As activities related to fuel removal in the basins escalate, exposure reduction resulting from easy cleaning of spills is expected to be significant. The refinishing work must follow the procedures established for activities performed safely in the high dose-rate basins. At first, field

tests on several epoxy coating materials used in the nuclear industry were conducted to select a suitable coating material. Before the floor refinishing work began, the total collective dose in terms of person-rem was estimated for ALARA committee review and approval. Details of the work plan including radiological controls during work were specified in a work package that required approval from all types of safety personnel. The safety requirements concerning protection from radiation contamination and industrial and nuclear hazards had to be addressed in formal documents. Also, the handling, storage, and disposition of waste materials generated as a result of the floor refinishing were incorporated into a formal WMP. All documents and controls were reviewed and approved by the "Management Review Board" before the refinishing work commenced. Refinishing then was accomplished successfully.

10.0 REFERENCES

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Figure 3 Ratio of existing coat and top coat areas detached
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