DECOMMISSIONING AND DECONTAMINATION SCIENCE AND TECHNOLOGY: DECONTAMINATION AND DISMANTLEMENT

Sponsored by the Decommissioning, Decontamination, and Reutilization Division

Session Organizer: James Rang (JS Rang Svc)

Papers/Panel

1. Oxy-Gasoline Cutting Torch Deployed in Nuclear D&D, *Milt Heft (Petrogen)*

INTRODUCTION

The Department of Energy established the Large Scale Technology Demonstration Project (LSTD) in order to investigate new technologies to help nuclear decontamination and decomissioning work to proceed with increased safety, speed, and economy. One of the selected technologies was the oxy-gasoline cutting torch, which was demonstrated at Fernald in October 1996. The tests were successfully completed to the great satisfaction of the DOE who called the torch a "Triumph" and a "Success Story." Since then, the torch has been deployed at most nuclear dismantlement sites and is being used by many DOE contractors.

DESCRIPTION OF THE ACTUAL WORK

In order to provide a ready labor force trained to operate the oxy-gasoline torch, the DOE has encouraged the Ironworkers', Laborers', and Carpenters' Unions to include the torch in their apprenticeship training programs. This is now being done in over 20 training locations in the United States. The DOE tests confirm that the gasoline torch lives up to all the manufacturer's claims for safety, performance, and economy.

The oxy-gasoline torch is safer because it uses liquid gasoline as the fuel. The gasoline remains liquid into the cutting tip, where it combines with oxygen and converts to a vapor. Because liquid gasoline cannot burn, it is impossible to blackflash the torch up the fuel line. Liquid fuel leaks are visible and are easily detected and fixed. A fast flow check valve in the ASME fuel tank can shut off fuel flow if the fuel hose ruptures.

Performance is superior because of the heaviness of the gasoline vapors, because of the high rate of heat release, and because of the 100% oxidizing quality of the oxy-gasoline flame. Steel is cut up to 4 times faster, straight holes are punched to 10 inches, and laminations are cut almost as easily as full blocks of steel. Surface contaminations are oxidized to a greater degree, lessening environmental pollution. All cuts are clean and need no grinding or further preparation.

Economy is delivered in many ways. To start with, gasoline costs 90% less per BTU than acetylene, and oxygen consumption remains the same. The superior performance of the torch results in less time and overhead for work done. Its superior safety translates into economy because safer work has fewer economic consequences. Greater fuel availability means less opportunity for costly downtime. The fuel, gasoline, is always available everywhere.

RESULTS

As a result of the DOE testing program, the gasoline torch has been deployed to many nuclear sites, among them Fernald, INEEL, Hanford, Pantex, Savannah River, Oak Ridge, Portsmouth, and West Valley, and to sites in Russia, Ukraine, Khazakstan, England, and Spain. DOE contractors using the torch include Fluor Daniel, Babcock & Wilcox, Lockheed Martin, Bechtel, MK Ferguson, Westinghouse, General Dynamics, BNFL, Nuclear Fuel Service, RS, GTS, and Philotechnics, among others. The torches are cutting rebar, tanks, pipes, plates, railroad rail, cooling towers, containment vessels—all at 2 to 4 times faster than acetylene. At West Valley, a 13-foot gasoline torch was used to cut down a highly contaminated overhead steel girder crane that could not be approached closer than 10 feet. At Fernald, the gasoline torch swiftly cut up an ammonia tank that had fallen behind removal schedule because of acetylene's slow pace of only 2 inches per hour.

The oxy-gasoline cutting torch system has proven to be of significant benefit in D&D work because of all its important advantages over baseline acetylene.

2. Establishment of Low Radiation Field in RPV by Chemical Decontamination, *Makoto Nagase (Hitachi RL–Japan), Kazumi Anazawa (Hitachi–Japan), Katsumi Tokunaga (JAPC, Fukui–Japan)*

Shroud replacement work has been conducted for preventive maintenance to increase the plant reliability in the Tsuruga Power Station Unit 1 of the Japan Atomic Power Company. A low radiation field in the reactor pressure vessel was needed before shroud replacement because human access to the vessel bottom area was planned. In order to establish a low radiation field, chemical decontamination, mechanical decontamination, and a radiation shield were conducted. This paper focuses on the dose rate reduction by chemical decontamination.

The aim of chemical decontamination was to remove the radioactive nuclides on the structural material surfaces to reduce

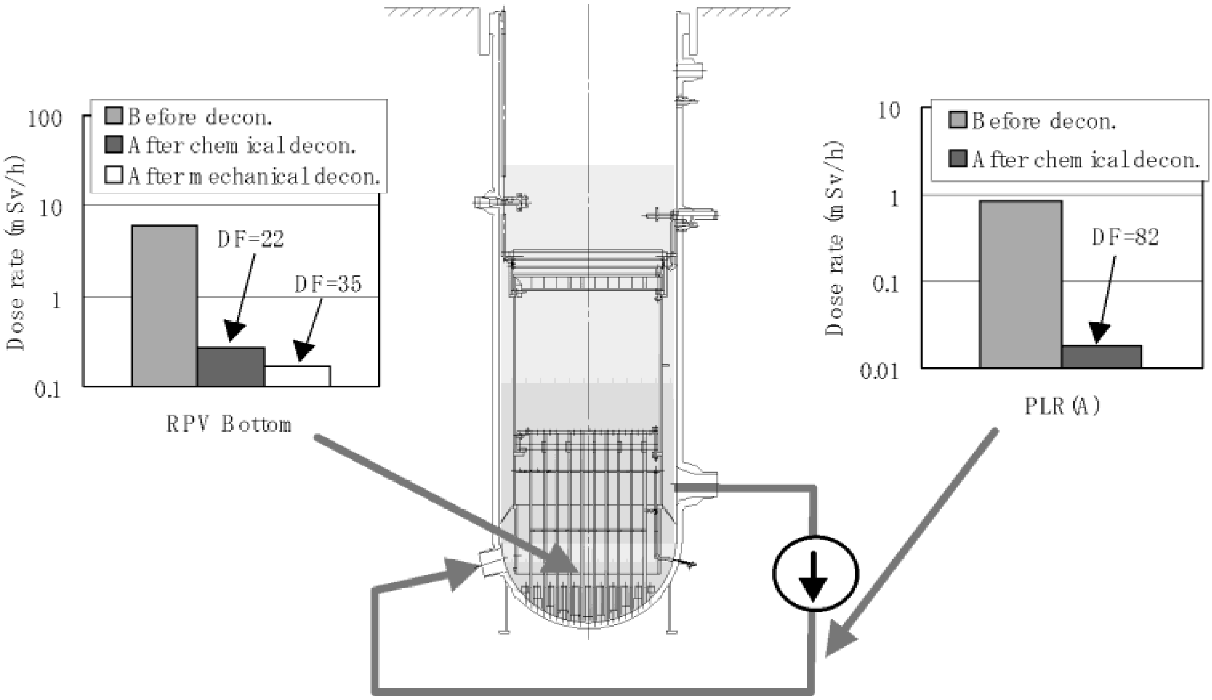

Fig. 1. Result of decontamination.

the radiation level and prevent it from being blown up as radioactive dust. For chemical decontamination, the Hydrazine, Oxalic acid and Potassium permanganate (HOP) method was used.

One feature of this method is to suppress the corrosion of structural materials such as carbon steel and sensitized stainless steel without sacrificing the decontamination effects by adding hydrazine to oxalic acid to control the pH of the reduction agent at 2.5. The corrosion amount of carbon steel under pH control was found to be about half of that under no pH control, that is, no hydrazine addition to oxalic acid, in the laboratory tests.

Another feature is the small amount of secondary waste. Residual permanganate ion is decomposed to manganese ion by adding the oxalic acid and is removed by ion exchange resin in the following reduction step. Oxalic acid and hydrazine are decomposed to carbon dioxide, nitrogen gas, and water by adding hydrogen peroxide in the catalyst column after the reduction step. Residual impurities are removed by ion exchange resin from the water. No liquid waste remains. So, only ion exchange resin and catalyst are the secondary waste.

As Tsuruga Unit 1 had been operated in hydrogen water chemistry (HWC) for two years before decontamination, laboratory tests to optimize the decontamination process were conducted. The test specimens were prepared from the removed stainless steel, which had made contact with the actual reactor water under HWC for one year. The test results showed that adding the oxidation step before the first reduction step had better decontamination effects than without the oxidation step in the first decontamination cycle. So, the actual decontamination started from the oxidation step.

As the result of chemical decontamination, about 5.0 TBq (135 Ci) of radioactive nuclide and 58 kg of metal were removed. After chemical decontamination, the decontamination factor (DF) was 22 at the vessel bottom and 82 at the PLR lines, as shown in Fig. 1, respectively. The reason for the small DF at the vessel bottom was the remaining sludge, which was undissolved metal oxide containing radioactive nuclide. This sludge was removed by mechanical decontamination after chemical decontamination on the planned schedule, and the DF was improved up to 35.

After the shroud removal, the radiation from the activated vessel was shielded by putting the radiation shield inside the reactor vessel around the core level. The combination of chemical decontamination, mechanical decontamination, and radiation shield had established the low radiation field in the lower vessel. The dose rate of the RPV bottom was 0.22 mSv/h (22 mrem/h), which was lower than the planned value of 0.3 mSv/h (30 mrem/h).

3. Surveys in Support of Partial Site Release, *J. J. Shonka, D. M. Debord, J. M. Newey, M. R. Marcial, R. E. Burns, R. E. Burmeister (Shonka)*

INTRODUCTION

Nuclear plants undergoing D&D often seek to release the non-industrial portion of the site for other uses. Following the successful release of the Forked River Site [1], the NRC issued guidance that provided two options for partial site release: indistinguishable from background or release criteria that were integrated with subsequent site release under 10 CFR 20 subpart E [2]. Following this guidance, a partial site release was performed at the Rancho Seco site using the criteria of “indistinguishable from background” [3].

Most surveys of large, outdoor areas utilize a traditional approach comprised of soil scanning with a gross gamma detector, fixed in situ measurements using a spectrometer, and soil sampling. In contrast, the survey of the Rancho Seco site used a scanning spectrometer system that eliminated the need for both gross and fixed in situ measurements. The scanning spectrometer measurements used in lieu of the gross and fixed in situ measurements enjoyed detection limits comparable to those for laboratory counting, while measuring large areas of the site. Soil samples

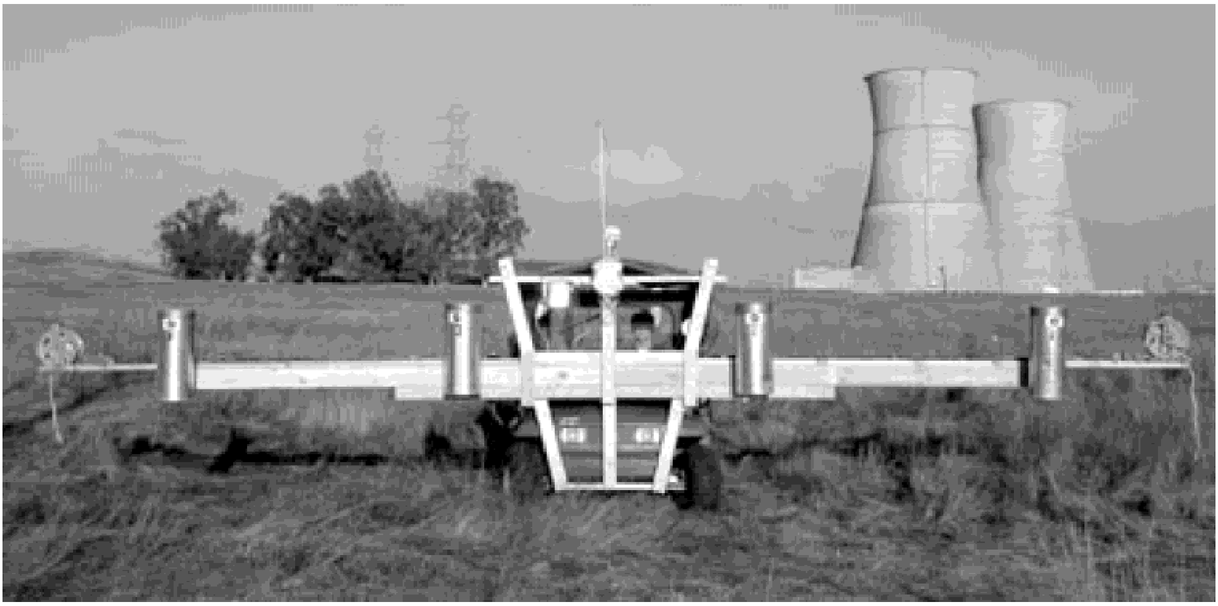

Fig. 1. Scanning spectrometer system.

Fig. 2. Map of survey blocks showing K-40 concentrations.

were retained as an independent measure of performance of the scanning spectrometer system.

DISCUSSION

Figure 1 shows the scanning spectrometer system in use at Rancho Seco. Four NaI(Tl) detectors are placed on two meter centers, located one meter above the ground. The system was capable of surveying 8100 m^2 (2 acres) per hour, at detection levels that are nearly two orders of magnitude lower than generic release criteria suggested by the NRC. This provided added assurance that there was no contamination distinguishable from background down to very low levels.

Figure 2 shows an example of data generated from the survey performed in support of the partial site release for the Rancho Seco plant. Each rectangular area in this image depicts a survey block. The K-40 concentration in each block is shown via colormapping. The survey was designed to provide a "checkerboard" pattern covering 50% of the surface in any area through which liquid effluents or plant runoff may have flowed, and 10% of the balance of the site. At the scan rate attained by the instrument, a 100% coverage survey would have increased the overall cost by less than a factor of three.

CONCLUSIONS

Figure 3 (see next page) shows a comparison of K-40 concentrations determined for the same survey blocks from soil samples analyzed in the onsite lab and from the scanning spectrometer system. Excellent agreement is attained for this low branching ratio nuclide, which was present in concentrations from 4 pCi/g to 8 pCi/g. The detection limit for typical power plant nuclides (which have larger branching ratios) would be substantially lower. This is significantly better performance than gross measurements typically used for land surveys, highlighting the utility of using a scanning spectrometer for surveys of large, outdoor areas in place of traditional methods.

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1. "Forked River Site: Scoping Survey Final Report," Shonka Research Associates/Millennium Services (July 1998).

2. "Rulemaking Plan—Standardizing the Process for Allowing a Licensee to Release Part of its Reactor Facility or Site for Unrestricted Use Before Receiving Approval of its License Termination Plan," U.S. Nuclear Regulatory Commission (May 2000).

3. "Rancho Seco Non-Industrial Area Survey Project, Final Report," Shonka Research Associates (Feb. 2001).

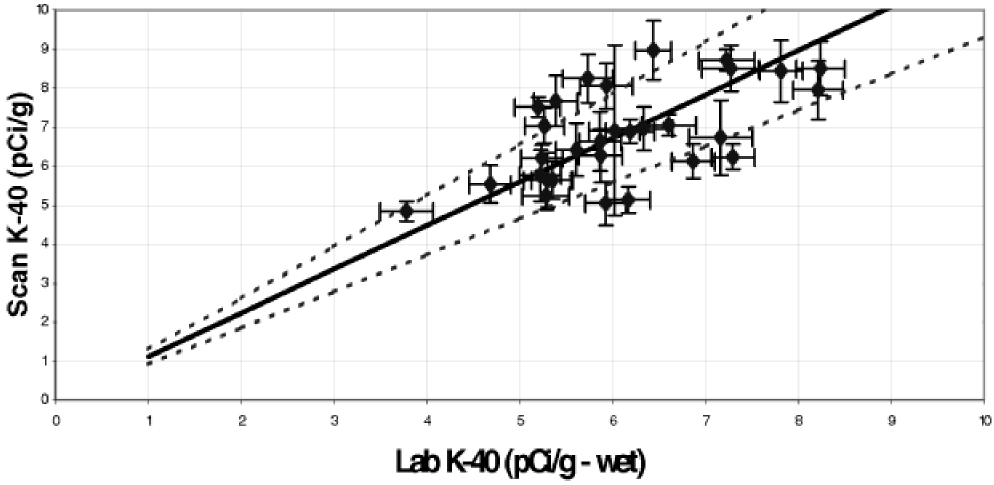

Fig. 3. Comparison between K-40 results from soil sampling and from the scanning spectrometer system. (Paper 3)

Panel Discussion

Paper authors and panel members from the nuclear industry, universities, and the U.S. Department of Energy will speak to current research and development being performed in the decommissioning and decontamination (D&D) area. Newly emerging D&D technologies that substantially reduce costs and risks will be described.

Invited Panelists: *John Pickett (Westinghouse SRC)*
Mark Morton (Bechtel, Richland)
Leo Lagos (Florida Int Univ)