SHIPPINGPORT STATION DECOMMISSIONING PROJECT ALARA PROGRAM

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ABSTRACT

Properly planned and implemented ALARA programs help to maintain nuclear worker radiation exposures "As Low As Reasonably Achievable."

This paper describes the ALARA program developed and implemented for the decontamination and decommissioning (D&D) of the Shippingport Atomic Power Station. The elements required for a successful ALARA program are discussed along with examples of good ALARA practices.

The Shippingport Atomic Power Station (SAPS) was the first commercial nuclear power plant to be built in the United States. It was located 35 miles northwest of Pittsburgh, PA on the south bank of the Ohio river. The reactor plant achieved initial criticality in December 1959. During its 25-year life, it produced 7.5 billion kilowatts of electricity. The SAPS was shut down in October 1982 and was the first large-scale U.S. nuclear power plant to be totally decommissioned and the site released for unrestricted use. The Decommission Project was estimated to take 1,007 man-rem of radiation exposure and $98.3 million to complete. Physical decommissioning commenced in September 1985 and was completed in September 1989. The actual man-rem of exposure was 155. The project was completed 6 months ahead of schedule at a cost of $91.3 million.

Key lessons learned in the application of ALARA at the Shippingport Station Decommission Project were:

- Incorporate sound ALARA practices and detailed man-rem estimates into the initial D&D planning.
- Include the requirement for ALARA practices and detailed man-rem estimates in all work activities.
- Monitor and enforce effective radiation control work practices.
- Establish an aggressive man-rem reduction program.
- Obtain the endorsement and continued full support of top management.

INTRODUCTION

ALARA planning for the Shippingport Station Decommissioning Project (SSDP) was integrated into all phases of the project. It began with the development of a detailed, twelve-volume SSDP Decommission Plan completed in 1983. A two-volume detailed cost and man-rem exposure estimate was also produced. The man-rem estimate was based on the estimated man-hours required to decommission the Shippingport Atomic Power Station (SAPS) and release the site for unrestricted use. The plan formed the basic requirement document

used by the U.S. Department of Energy for the selection of the SSDP Decommissioning Operations Contractor (DOC).

The total man-rem estimate for the Shippingport Station Decommissioning Project was 1,007 and included a one-year surveillance and maintenance period prior to the start of physical decommissioning work. Figure 1 represents the estimated man-rem exposure versus time. The estimated man-rem was based on the measured radiation dose rates that existed at the end of nuclear plant operations in 1982. Figure 2 is a typical radiation survey showing dose rates in the reactor compartment and equipment (boiler) chambers. The low dose rates are attributed to good water chemistry control and maintenance practices performed by the plant operator, Duquesne Light Company, during the 25 years of commercial nuclear power plant operation.

The actual SSDP total man-rem exposure during the Decommissioning Project (September 1984 through September 1989) was 155 man-rem which was less than 20% of the Decommissioning Plan estimate of 1,007 man-rem. This achievement was the result of an aggressive ALARA program which included good planning, management involvement, and worker endorsement. Figure 3 presents the cumulative personnel radiation exposure received during the Decommissioning Project.

THE ALARA PROGRAM

At Shippingport, management's policy was to maintain personnel radiation exposures at the lowest possible levels. To accomplish this, an aggressive ALARA program was implemented. Initially, management established a challenge goal to keep personnel radiation exposures two times lower than the Decommissioning Plan estimate of 1,007 man-rem. (See Figure 3.) The main elements of the ALARA program were:

- Positive management leadership and involvement at all levels
- Detailed ALARA planning and integration into all work procedures
- Effective ALARA training
- Strict procedure compliance
- Close monitoring of work practices and accumulated personnel exposures
- Program endorsement by the workers, management and supervision

ALARA was emphasized throughout the entire decommission process. It was considered during the initial development of the Decommissioning Plan. Good ALARA work techniques were specified during the preparation and review of detailed work procedures. ALARA practices were monitored during work performance by the Radiation Control Technicians, supervision, and management evaluation teams. At the completion of work activities, post-work critiques were conducted with the workers to identify improvements for future work activities. Frequent, formal reviews were performed of actual personnel radiation exposure data to measure the ALARA Program effectiveness.

The DOC ALARA Program requirements were applied to all subcontractors working in a radiation area. After contract award, but prior to the start of physical work, each subcontractor was required to develop detailed work procedures which included personnel exposure estimates. These procedures and man-rem estimates were reviewed and approved by the DOC. If necessary, the subcontractor revised the procedures prior to receipt of DOC approval if significant reductions in personnel radiation exposure could be realized.

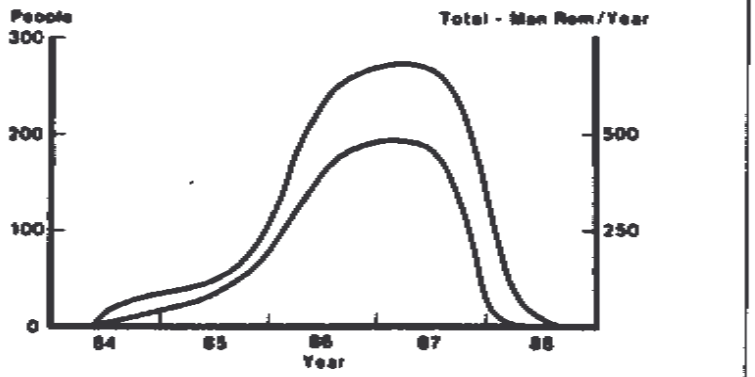

Figure 1. Manpower Loading and Exposure

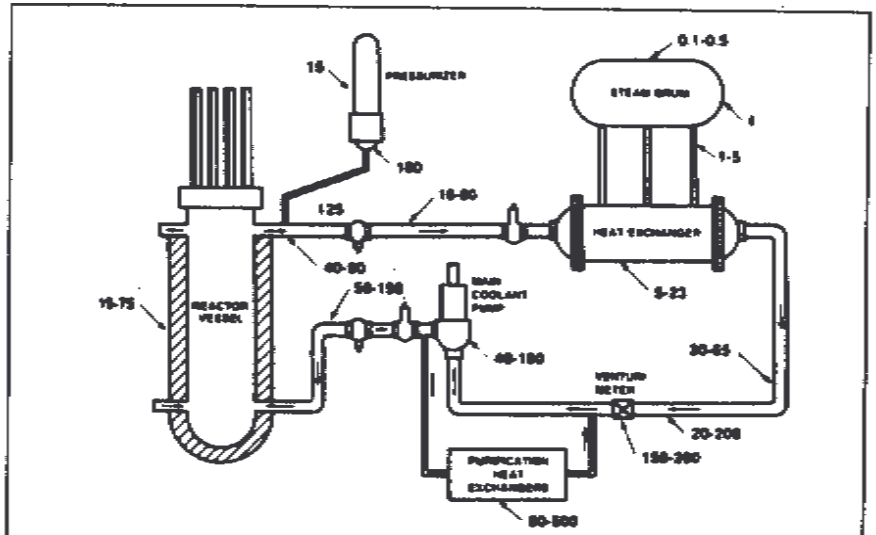

Figure 2. Shippingport Plant Primary System Radiation Survey - MR/HR

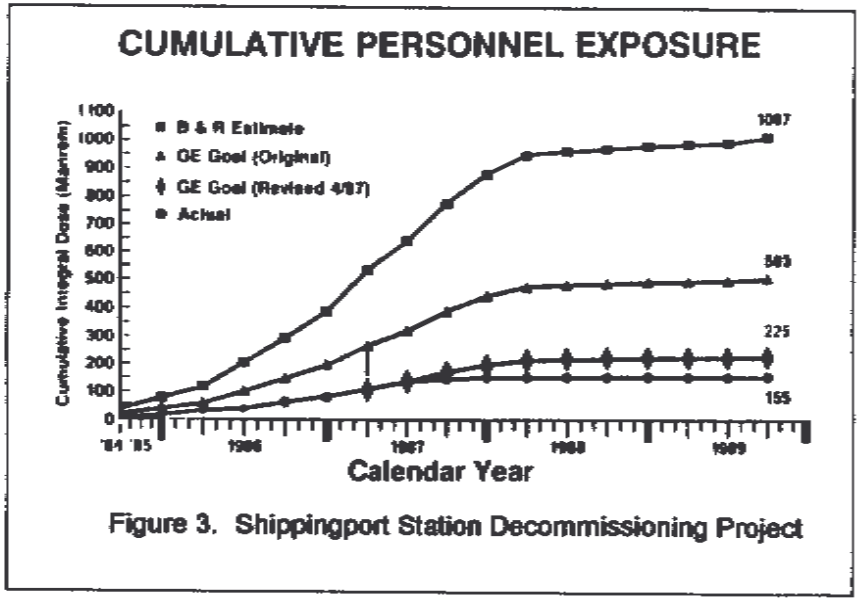

Figure 3. Shippingport Station Decommissioning Project

Detailed work procedures involving significant personnel radiation exposure were submitted to the DOC's Management Safety Committee (MSC) chaired by the DOC Project Manager. During these reviews man-rem estimates frequently were challenged as being too high. These procedures and estimates were revised based on technical guidance received from the MSC. When the procedure and new man-rem estimate was found acceptable, they were approved for use. During the performance of work, changing conditions were promptly addressed. If required, procedures were revised before work could continue. Frequent use was made of classroom and mockup training. The training included a review of the detailed work procedure followed by use of the procedure during mock-up training. Mock-up training helped ensure worker familiarity with the procedure, and the incorporation of good ALARA work practices.

SOME EXAMPLES OF GOOD ALARA PRACTICES

Removal of Radioactive Piping System

The original Decommissioning Plan required the removal of all radioactive piping systems in total containment. The practice of using total containment was simplified by the Decommissioning Operations Contractor's use of a vacuum system equipped with a HEPA filter. The first cut into the radioactive piping was made in total containment. All future cuts were made with the piping system under a negative pressure and exhausted through a HEPA filter. Therefore, containment was not required for subsequent cuts and personnel exposure for the installation and removal of local contaminates was eliminated. A further improvement of this technique was the use of a specially designed saddle valve. The saddle valve was used to drill a hole into a radioactive piping system prior to the first cut. This valve permitted the draining of any residual water left in the piping and provided an adapter so that a vacuum could be applied to the piping internal diameter. Therefore, the first piping cut could be made without containment.

Installation of the Reactor Pressure Vessel Head

When the DOC accepted responsibility for the Shippingport Atomic Power Station from Duquesne Light Company, the radioactive contaminated reactor pressure vessel head was in its storage pit. The reactor pressure vessel was left in a defueled condition, with the reactor internals in place and the pressure vessel full of water. In order to prepare the pressure vessel for removal from its containment chamber, it was necessary to re-install the pressure vessel head and bolt it to the pressure vessel. This operation was estimated to take 12 man-rem of exposure based on performance of this operation in the past.

The detailed procedure and man-rem estimate initially developed for installation of the reactor pressure vessel head was reviewed by the DOC Management Safety Committee. A challenge ALARA goal of 2 man-rem was established for the operation.

In the past, the pressure vessel head which was contaminated with loose surface radioactivity, was installed in total containment. The installation procedure was modified to "fix" the loose surface contamination with paint using a remotely operated, commercially available paint spray gun. The procedure, equipment, and personnel used to perform the painting and installation were trained on a full-size wood mock-up of the pressure vessel head. Once all training was completed, the pressure vessel head was installed successfully. The resulting exposure for the operation was less than the 2 man-rem goal.

Management Involvement

A key element for a successful ALARA program is the leadership and direction provided by management. Management and supervisory personnel's continued involvement in the program is essential to obtain the full endorsement of the workers.

Prior to the start of physical decommissioning, the DOC Project Manager established an ALARA challenge goal of 503 man-rem for the total decommissioning effort. This was one-half the 1,007 man-rem estimate established in the Decommissioning Plan. The new challenge goal was plotted versus time based on the sequence of work activities defined in the Decommissioning Plan. Through March 1987, total actual personnel exposure was maintained below the new challenge goal. In April 1987, a new challenge goal of 225 man-rem was established. The Shippingport Station Decommissioning Project was completed with a total man-rem exposure of 155. The curves of the original 1,007 man-rem estimate, the two challenge goals of 503 and 225 man-rem, and the actual man-rem exposures are shown in Figure 3.

Personnel radiation exposure was controlled at levels far below the SSDP Decommissioning Plan's original estimates. This is attributed to several elements: positive involvement of management, endorsement of the ALARA program by the workers, and the DOC's initial generation of strict radiation control standards and procedures. These elements when combined with innovative work practices will help keep personnel radiation exposures As Low As Reasonably Achievable.

KEY LESSONS LEARNED

Key lessons learned in the application of ALARA at the Shippingport Station Decommissioning Project were:

- Establish "stretch" ALARA goals
- Obtain the full endorsement and support of the ALARA Program by management, supervision and the workers.
- Implement an effective personnel training program
- Monitor compliance of work procedures and work practices
- Challenge the "status quo" of procedures and estimates for both new and repetitive operations.

CONCLUSION

The Shippingport Station Decommissioning Project was completed ahead of schedule and under budget. The Decommissioning Plan estimated 1,007 man-rem exposure. The actual man-rem exposure was 155. The decommissioning was completed without any significant radiological impact on the workers, the public, or the environment. This successful record was the result of an aggressive ALARA Program.

Author Biography

Frank P. Crimi has over 36 years of experience in the nuclear industry. He received his B.S. degree in Mechanical Engineering from Ohio University and joined the General Electric Company (GE) in 1955. He spent the first twenty-five years of his career at the Knolls Atomic Power Laboratory (KAPL) where he held management assignments in nuclear equipment and plant design, plant operations and maintenance, and facility decontamination and decommissioning. Mr. Crimi was responsible for developing and implementing the master plan for decommissioning KAPL's surplus nuclear facilities. Decommissioning projects included low level and high level radioactive waste storage facilities, reactor test facilities, and fuel fabrication shops. In 1981, he transferred to the General Electric Nuclear Energy Division. He was GE's Project Manager for

the decommissioning of the Shippingport Atomic Power Station, the nation's first large-scale commercial nuclear power station. In February 1992, Mr. Crimi joined the Lockheed Corporation and he is currently President of the Lockheed Environmental Company. Mr. Crimi is a member of ASME and ANS. He is Chairman of the Long Island Power Authority's Shoreham Decommissioning Independent Review Panel, and a member of the Public Service of Colorado's Fort Saint Vrain Decommissioning Oversight Committee. He is the author of numerous papers on nuclear facility decommissioning.

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DISCUSSION

Granados: I have three questions. One, were the chambers removed from the enclosures, or were they left in place?

Crimi: The chambers were all removed. We salvaged about 1,200 tons of steel. In order to that, we had to vacuum blast the paint, about the lower one-third, which was contaminated over the twenty-five years of service. Everything was removed. Nothing was left in the way of steel. The chambers and turn were inside massive concrete enclosures. Where there was contamination on the enclosures, those were also scabbled.

Granados: The second question is, over in the radioactive waste processing area, there were a lot of underground tanks. Did you find any leakage from them when you pulled those out?

Crimi: No. The plant was very conservatively designed. The tanks were also in concrete vaults which had sumps in them. There were small amounts of radioactivity, but no evidence of tank leakage. There were about 140 tanks that were removed from that project.

Granados: The last question is, over the years a lot of pipes were cut off and abandoned in place and backfilled with dirt. How did you go about finding all of those?

Crimi: The pipes that you are referring to were basically in pipe trenches, which were underground. We had to find where all the piping was located and remove it. As we excavated the ground we would find some electrical cables left over from construction, some pipes, and what not. Everything was done with radiation controls in place until we determined that the material was clean.

Mayfield: I'm not familiar with the term "hydrolasing." Could you describe this process for me?

Crimi: Basically it is a high-pressure water jet, like high-pressure cutting of steel, except done at a much lower pressure.