RADIATION PROTECTION PROGRAM

FOR

RECIRCULATION PIPING REPLACEMENT

AT

PEACH BOTTOM UNIT 2

DOCKET NO. 50-277

A001

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1.0 BACKGROUND

In July 1983, Philadelphia Electric Company (PECo) shut down Peach Bottom Unit 2 to perform a mid-cycle examination of recirculation piping welds. Indications of Intergranular Stress Corrosion Cracking were found, and PECo decided to weld overlay the flawed welds and prepare for complete recirculation system pipe replacement during the next refuel outage. While weld overlay and final inspections were underway, PECo hired General Electric Company (GECo) to design and procure the pipe and manage the installation; Chicago Bridge and Iron Company (CB&I) was selected as the installer. This outage was alsc used by GECo and CB&I to perform drywell surveys which form the basis of the ALARA program. GECo used the surveys to design spool pieces to minimize weld interferences with existing structures and restraints; CB&I used the surveys to identify interferences and to plan the removal and installation sequences.

2.0 ADMINISTRATIVE PROCEDURES AND CONTROL

2.1 Administrative Procedures

Because replacement of recirculation system piping will involve collective radiation exposure beyond that experienced by PECo plant workers in other routine maintenance work, CB&I is preparing and will implement specific ALARA instructions and controls for this piping replacement project. Key elements of the administrative portion of the program include:

- preparation of a general ALARA guidance document for pipe removal and replacement
- formation of a special ALARA group to supplement PECo personnel during pipe removal and replacement
- briefings/meetings prior to every shift to orient craft personnel on specific work to be performed
- development of a detailed task sequence and manhour estimate

- o development of a detailed exposure estimate for all work tasks
- o on-going exposure tracking and the implementation of corrective actions

These elements, combined with PECo's existing ALARA procedures such as detailed pre-work planning, radiation work permits and the authority to stop work which is not consistent with the ALARA goals, will ensure an effective ALARA program for the recirculation piping replacement program. In addition, PECo is planning to decontaminate the recirculation system before recirculation piping replacement and normal maintenance is initiated. Decontamination will not only reduce potential exposure during pipe replacement, but also reduce potential exposure during the normal maintenance tasks during the refueling outage. Removal of the decontaminated pipe will further reduce the radiation exposure of plant personnel performing normal maintenance associated with the refueling outage.

2.2 ALARA Group Authority and Control of Work

Work will be performed only after the issuance of the appropriate Radiation Work Permits (RWP's) by a qualified health physics representative. Each RWP receives an ALARA review of an appropriate level based on the estimated man-rem expenditure for the associated work. Work methods and dose reduction techniques suggested by contractor and outage planning personnel will be reviewed by the station ALARA coordinator and approved, or new dose reduction techniques will be recommended. Once approved by the station ALARA coordinator, a qualified representative of health physics prepares the RWP.

During the work, RWP summary sheets will be provided daily to the appropriate health physics and ALARA personnel as well as to the craft supervision. This will facilitate close monitoring of each job's progress in relation to the ALARA goals for that job. Qualified health physics and ALARA representatives will have the authority to stop work when conditions

exist that are contrary to the intent of the ALARA concept.

2.3 ALARA Procedures and Work Instructions

General and specific instructions and guidance documents have been implemented outlining the ALARA program.

Specialized procedures for activities unique to the piping replacement project are being developed so as to incorporate the principles of ALARA; these procedures will be revised as necessary to include additional ALARA improvements as the project proceeds.

2.4 Pre-Job Exposure Estimates Tracking/Corrective Actions

The process of estimating exposures prior to performing the task is an iterative process beginning with gross estimates based upon general experience and evolving into more refined estimates as the specific details of the various tasks and surveys become available. Tracking of the actual exposures and comparing actual with the estimated exposures through the project permit the identification and the implementation of corrective actions on an on-going basis.

3.0 PROGRAMMATIC AND PROCESS FEATURES

Substantial programmatic and process ALARA features are being implemented as a result of applying ALARA principles as an integral part of the design and pre-planning process. This approach assures that the intent of the ALARA philosophy is implemented throughout the piping replacement project.

3.1 Improved Design of Replacement Piping

The replacement piping has been designed to minimize the number and complexity of shop and field welds. This has been accomplished by the use of such features as long tangent elbows, induction bent risers, the use of forged fittings, the elimination of the header cross tie valves and the pump discharge bypass valve connections, and extensive study of drywell interferences and rigging paths to optimize pipe spooling. As a result of this design effort, there are approximately forty-eight less welds requiring In-Service Inspection (ISI) in the replacement recirculation piping than in the original piping. Welds have been designed to provide access for increased use of remote automatic welding and ISI equipment even though the access for installing the piping is much more restrictive than when the original piping was installed in an essentially empty drywell. Most of the recirculation systems piping will have a mechanically polished finished to minimize radiation build-up on the inside surface of the pipe. Crud traps have been minimized by eliminating the header end caps, the header cross tie valves, and the pump discharge bypass valve connections.

In summary, ALARA considerations have been an integral part of the design of the replacement piping and components, and this will result in a significant reduction, relative to the original design, in the man-rem exposure for piping replacement, for future in-service inspections of the recirculation system piping and other activities in the drywell.

3.2 Core Removal

Prior to initiation of work, the entire core will be off-loaded and stored in the fuel racks in the fuel pool.

3.3 Primary Coolant Radioactivity Reductions

After core off-load, the reactor water clean-up system will be operated to reduce, to the extent practical, the bulk reactor water activity level.

3.4 Optimally Positioned Control Blades

Control blades will be positioned in the vessel in such a manner as to minimize worker exposure. Control blade placement as well as shielding design will be based on General Electric experience and studies of in-vessel sources. Some peripheral control blades are planned to be removed to further reduce exposure. This will significantly reduce dose rates in the recirculation inlet nozzle areas.

3.5 Vessel Flooding

Previous BWR vessel safe end and piping replacement work has typically been done with the reactor pressure vessel drained. For the PBAPS piping replacement, recirculation suction plugs may be installed to allow flooding of the annulus to the level of the jet pump nozzles and the jet pump slip joints between the mixer and diffuser may be plugged to allow flooding of the core. Vessel and annulus flooding in combination with optimum placement of control rod blades and removal of some of the peripheral blades will result in a large reduction of dose rates in the recirculation inlet nozzle area where a substantial amount of work is anticipated.

3.6 Piping Decontamination

To significantly reduce occupational exposure to those involved with drywell piping modifications and other concurrent maintenance tasks, chemical decontamination performed by London Nuclear Ltd. utilizing their CAN/DECON solution will be performed to remove corrosion film buildup on the piping I.D. The primary objective of the process is to dissolve activated

corrosion product film and concentrate the dissolved material for off-site disposal.

Successful decontamination involves the removal of corrosion oxide film without harmful effects to material which will remain in service after decontamination. In order to perform the decontamination, PECo will cut and cap all recirculation risers, RHR Lines at (or near) the penetrations and all auxiliary lines. Chemical decontamination will be limited to the recirculation piping and the portion of the RHR piping to be replaced. Mechanical decontamination using water lances (hydrolaze) will be performed on vessel safe ends and thermal sleeves, inside the annulus and in identified crevices. The chemical decontamination process, including cutting and capping the recirculation and RHR piping, is expected to take approximately fourteen days of critical path time. Work activities inside the drywell will be minimized prior to completion of the chemical decontamination; work in the vessel (blade removal, plugging and core flooding) will be performed before cutting and capping the recirculation piping.

3.7 Preliminary Exposure Estimates

A preliminary estimate of radiation exposure during recirculation system piping removal and replacement was completed and forms one of the elements of the ALARA program. The decontamination factors (DF's) estinated to be achieved by the London Nuclear decontamination solution and the mechanical decontamination methods stated above in 3.6 were applied to three areas in the drywell: the shield wall area, the pump and valve area and shielded areas. Utilizing DF's of 5, 5 and 3 for these areas, respectively, the exposure was estimated at 1805 man-rem for a total time in the drywell of 70,600 manhours. Piping removal is estimated to require 669 man-rem (including cutting, capping and decontamination and interference removal); installation is expected to require 1136 man-rem. Following decontamination, due to the sensitivity of achievable DF's, drywell surveys will be performed to determine the actual dose rates which will exist in the drywell while the work is being completed. A

revised man-rem estimate for the entire job will be calculated and the objective of the on-going ALARA program will be to identify ways to reduce this estimated exposure.

CB&I is refining the identification of individual tasks and is attempting to define specific movements of personnel and their location and durations in the drywell. GECo is refining the sources in the drywell to better characterize radiation levels before decontamination, after decontamination and after removal of the decontaminated pipe.

3.8 Shielding

Shielding is being designed to minimize exposure during pipe removal and to minimize subsequent exposure during piping installation. Lead shielding is planned to be used in the annulus between the recirculation inlet and suction nozzles and the biological shield doors which will remain in place. Other sources contributing to personnel exposures during this work will also be evaluated for shielding. This will occur during the ALARA review of each RWP.

3.9 Remotely Operated Equipment

Remotely operated machining and welding equipment will be used. This equipment has been designed to minimize setup time, and hence, worker exposure. Setup of mounting fixtures on the nozzles will be done under vessel water level conditions that will minimize exposure. The equipment utilizes video cameras and monitors, and the equipment is monitored and operated from outside the drywell. Remote welding equipment does not eliminate the need for direct visual operation, but reduces the need for continuous visual operation. Use of this equipment will significantly reduce worker radiation exposure.

3.10 Mockups

Mockups are being utilized to assist in tooling design, welding and machining procedure development, and welding and machining operator training. Substantial ALARA benefits will be gained through practice with full-size mockups.

3.11 Work Areas, Identification and Support Services

Access routes and work areas will be well marked. Auxiliary services will be provided to speed work (e.g. communications, ventilation and lighting systems). Waiting and change-out areas will be located in low background areas. Video camera and monitors will be used to allow observation and supervision of work from outside the drywell. This will allow the worker performing the next operation and the supervisor to observe the preceeding operation.

3.12 Contamination Controls

Continuous housekeeping will be maintained to insure airborne contamination in ALARA. Special "boxes" will be installed around the pipe at cut locations during system removal. If necessary and feasible, additional HEPA ventilation units will be installed in the drywell to mitigate airborne activity levels.

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March 8, 1984

Docket Nos. 50-277

Mr. John F. Stolz
Operating Reactor Branch No. 4
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

REFERENCE: S. L. Daltroff, Philadelphia Electric Company to J. F. Stolz, USNRC, letter, March 2, 1984

Dear Mr. Stolz:

The reference letter forwarded Philadelphia Electric Company's plans for recirculation system piping replacement during the upcoming Peach Bottom Unit 2 refueling/modification outage.

In accordance with the draft generic letter discussed on December 1, 1983, between the NRC and licensees concerning pipe replacement, attached please find a description of our radiation protection program to be implemented during the Unit 2 piping replacement.

Very truly yours,

S. L. Daltroff

Attachment

cc: A. R. Blough, Site Inspector

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