U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Docket Nos. 50-387; 50-388

License Nos. NPF-14; NPF-22

Licensee: Pennsylvania Power and Light Company, Units 1 and 2
2 North Ninth Street
Allentown, Pennsylvania 18101

Facility Name: Susquehanna Steam Electric Station

Inspection At: Berwick, Pennsylvania

Inspection Conducted: April 15-19, 1991

Inspectors: J. Noggle 5/29/91
J. Noggle, Radiation Specialist, Team Leader — date
Facilities Radiation Protection Section

D. Mann 5/30/91
D. Mann, Radiation Specialist — date
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J. Noggle for 5/30/91
A. Markley, Radiation Specialist, R III — date

Accompanied by: B. Dionne, Brookhaven National Laboratory

Approved by: W. Pasciak 6-3-91
W. Pasciak, Chief, Facilities — date
Radiation Protection Section, DRSS

Inspection Summary: A routine radiological controls and ALARA initiative inspection was conducted on April 15-19, 1991 (Report No. 50-387/91-03 and 50-388/91-03)

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Areas Inspected: Areas covered in this inspection included a review of: previously identified items, instrumentation, housekeeping and radiological postings, vendor staff qualifications, and procedures associated with these areas. The ALARA inspection scope reviewed the following areas: ALARA background, station dose history, management involvement, training, ALARA goals, audits, initiatives and practices, planning, and ALARA program implementation.

Results: Within the scope of the radiological controls inspection, one non-cited violation was identified.

DETAILS

1.0 Personnel Contacted

1.1 Licensee Personnel

*K. Chambliss, Maintenance Production Supervisor
*T. Dalpiaz, Assistant Superintendent - Outages
*T. Fedder, Safety and Health Consultant
*J. Fritzen, Radiological Operations Supervisor
*M. Golden, Acting Technical Supervisor
*D. Hagan, Radiation Protection Supervisor
*E. Herstman, Corporate - ALARA
*C. Kalter, Corporate Radiological Group Supervisor
*R. Kichline, Project Licensing Specialist
*J. Lex, Nuclear HP/Chemistry Training Supervisor
*D. McGarry, Radiological Safety Consultant
*L. O'Neil, Supervisor Engineering - Nuclear
*R. Prego, Supervising Engineer - Audit and Assessment
*H. Riley, Health Physics - Supervisor
*M. Rochester, Senior Health Physicist
*D. Roth, Senior Compliance Engineer
*K. Roush, Supervisor - Nuclear Maintenance Services
*T. Ryder, Power Production Engineer
*R. Saccone, Reactor Engineering Group Supervisor
*M. Schelbner, Engineer
*G. Stanley, Superintendent of Plant
*T. Steingass, ISI Supervisor
*B. Veaju, Site Instrument and Control
*H. Webb, Supervisor Nuclear Maintenance Services

1.2 NRC Personnel

*G. Barber, Senior Resident Inspector
*W. Pasciak, Chief FRPS, Region I
*J. Stair, Resident Inspector

* Denotes those present at the exit interview on April 19, 1991.

Other licensee employees were contacted and interviewed during this inspection.

2.0 Review of Previously Identified Items

During a previous inspection, the inspectors questioned the respiratory protection fit test operator certification process. The inspectors observed that technicians were qualified to operate the Dynatech/Frontier Model 260 Fit Booth using a proceduralized certification process (NTP-QA-42.4 Rev. 1, Health Physics Contractor Technician Training and Certification Program). However, the technicians were qualified to operate the Dynatech/frontier Model 264 Portable Fit Test Instrument and Tent by On-Job-Training (OJT). The inspectors also noted that the Model 260 had an active OJT guide form that was not used in lieu of the more formal certification process.

The licensee agreed that technicians should be qualified to use the Model 260 by the formal certification process. Therefore, the licensee inactivated the OJT guide form for this instrument. The licensee also agreed that technicians should be qualified to use the Model 264 by a formal certification process. The licensee developed and implemented this process. Upon implementation of the Model 264 formal certification, the licensee inactivated the OJT guide form for this instrument. The licensee has recently begun using the TSI PortaCount, instead of the Model 260 or Model 264, to perform quantitative respirator fit tests. The licensee stated that they were using a OJT guide form to qualify the technicians to use this equipment. However, a procedure revision is underway to include a formal certification process into NTP-QA-42.4 Rev. 3. The OJT guide form will be inactivated when the formal certification process is instituted.

A review of this matter during the current inspection indicated that the licensee had successfully implemented the formal certification process in NTP-QA-42.4 Rev. 2 and deleted the OJT guide forms for both instruments. A procedure revision is underway to also include the TSI PortaCount Instrument. This item is closed (387/89-80-01 and 388/89-80-01).

3.0 Qualification and Training of Technicians

The licensee recently implemented HP-HI-014, "Screening and In-processing of Contract Health Physics Technicians". This procedure outlines the minimum qualifications required for a technician in accordance with ANSI N18.1-1971. Attachment A of this procedure specifies the methodology for evaluating the experience level of contractor health physics technicians. Some of the experience levels are in part as follows:

o Navy ELT

Time is counted one for one up to a maximum of 3 years. The technician must also have at least 6 months of commercial experience to be a senior technician.

o Shipyard Article 108 Qualified

Time is counted on a one for one basis with no time limit.

o National Laboratory

Time is counted on a one for one basis, up to a maximum of one year, when the description of duties performed are comparable to the duties encountered at a commercial power plant.

o Fuel Reprocessing Facility

Time is counted on a one for one basis, since the radiation and contamination levels encountered are comparable, if not more, than encountered at a commercial facility.

o Non-Power Reactors

Time is counted on a one for one basis up to a maximum of 1 year.

The inspector found this procedure to be excellent. A random sample of contractor technician resume's was reviewed to compare the experience levels indicated on the resume to those outlined above. Within the scope of this review, no discrepancies were identified. The licensee stated that approximately 70% of the contractor technicians had worked at the site during previous outages. Therefore, the technicians were very familiar with plant specific items and site personnel. The inspector found the licensee's practice of supplementing their outage staff with returning contractor technicians to be very good.

The inspector reviewed the lesson plans for the Health Physics Level I and Level II training and retraining. The inspector also reviewed the lesson plans for the respirator training and retraining. No discrepancies were identified.

The lesson plan HP-076 "SSES Health Physics Practices for Contractor Technicians" was reviewed. This course covered specific health physics practices such as responses to lost/offscale dosimetry and posting practices at SSES. Also included in this lesson plan were lessons learned through-out the industry. The inspector found the course outline to be very good.

Procedure NTP-QA-42.4, Health Physics Contractor Technician Training and Certification Program was reviewed. It was noted that Attachment 3 of this procedure contains a list of the certification forms required to be completed as a minimum for outage contractor health physics technicians. No discrepancies were noted.

The on-the-job training guide for "BWR Unique Systems for Contract Health Physics Technicians" was reviewed. The purpose of this guide is to provide contract health physic technicians, who are less familiar with the BWR steam cycle, to a brief introduction to selected BWR systems including the radiological concerns associated with each system. This guide was found to be very good.

4.0 Internal Exposure Controls

The inspector reviewed the operation and quality control of the Whole Body Counters (WBC). The licensee maintains a Canberra "FASTSCAN" and a Canberra "ACCUSCAN". The FASTSCAN consists of 2 4" x 4" x 16" sodium iodide (NaI) detectors behind a shadow shield and associated electronics. The ACCUSCAN consists of one 4" NaI detector, a moving bed, and associated electronics. A valid geometry is checked at several energies on a monthly basis to insure that the calibration efficiencies remain acceptable. This is required in procedure AD-00-740, Internal Dosimetry Program. A daily quality control check is performed to ensure counter stability over an 8 hour counting period. Quality Control charts are generated monthly to establish trends in counter performance. The inspector reviewed records of recent monthly and daily QC tests and noted that the WBC obtained acceptable results.

Procedure AD-00-740, section 6.1.5 states in part that non-routine bioassay's are to be performed when it is suspected that an individual may have received an internal deposition of radioactive material. In accordance with this, the licensee reviews Radiation Work Permit (RWP) data to select a pool of individuals who may have been exposed to airborne radioactive material. From this pool, individuals are randomly selected for whole body counts. The inspector reviewed one such random investigation and concluded that in this case appropriate measures were taken to prevent the bodily intake of radioactive material.

The inspector reviewed the MPC-hr evaluation forms for three (3) positive whole body counts. No discrepancies were noted.

The licensee used comparative fit-testing as the basis for accepting the TSI PortaCount fit-test system. The study demonstrated that the PortaCount system was comparable to the corn-oil systems. The inspector reviewed the hand calculation performed using ANSI Z88.2 methodology which verified that the TSI computer algorithm generated appropriate fit factors. The calculation demonstrated correlation factors of essentially one to one for fit factors less than 1,500. The inspector also noted that greater than 98% of the individuals tested achieved an acceptable fit factor.

The respirator maintenance and inspection program was reviewed. Within the scope of the review, no discrepancies were identified. The respirator issue program was reviewed and a spot check performed. Procedure HP-TP-761, Rev. 7, Issuance and Control of Respirators, section 9.1.4 states in part; "Determine if the individual is qualified using a current 'Qualified Respirator User List'." The inspector compared the "Respirator Issue Log" with the "Qualified Respirator User List". From this comparison, it was determined that at two control points, respirators were issued during the preceding 1-2 days using an outdated "Qualified Respirator User List". This was determined to be an isolated incident, was a low severity level, was not a willful violation, and was corrected immediately. It therefore meets the criteria in 10 CFR 2, Appendix C.V.A for issuing a non-cited violation.

5.0 External Exposure Controls

A review of portable survey instruments revealed that a source check is performed on all scales using a ^{137}Cs irradiator. The instruments are logged out on a paper log sheet. The information in the log is transferred to a card catalogue and also entered into a computer tracking system. This system is to track the instrument calibration due date. None of the instruments reviewed were found to be in use and out of calibration.

The instruments may be signed out for the duration of a job. Therefore, the

The licensee maintains a systematic review and concurrence chain from increasing levels of management to administratively extend an individual's quarterly exposure limit. A review of selected administrative exposure extensions was performed. The inspector noted that no administrative exposure extensions had been given for an individual to exceed 1500 mrem/quarter. Those exposure extensions reviewed showed the complete exposure history was on file and the concurrence signatures from the appropriate levels of management were correct.

The inspector reviewed the relocation of the permanent whole body thermoluminescent dosimetry (TLD). Procedure HP-TP-222 Rev. 5, Special Dosimetry Issuance and Criteria, section 9.1.5 states in part that placement of the relocated permanent whole body TLD for individuals shall be documented on the RWP sign-in-sheet when not specified by the RWP. This allows the technician covering a job to observe the work pattern and position of the workers in relation to a non-uniform source and then relocate the permanent whole body TLD to monitor the point of highest exposure if necessary. The inspector felt this was a good licensee program.

Reviewed the actions taken when an individual egressing from the protected area alarms the portal monitor. Procedure AD-00-720 Rev. 9, section 4.9.1 states in part that: The Supervisor of Security is responsible for "assuring in the event of a portal monitor alarms at the gatehouse, that personnel re-exit via the portal monitor, and, if a second alarm is activated, that the Health Physics Section is contacted and the person activating the alarm is detained until Health Physics arrival". The licensee stated that in each case where a portal monitor actually alarmed in the gatehouse, it was the result of the medical administration of a radioisotope.

6.0 Plant Tours

Tours of the licensee's facilities were conducted during the inspection. Areas toured included the Reactor, Turbine, and Radwaste buildings, the whole body counting, instrument calibration, and dosimetry calibration facilities. The tours showed housekeeping within these areas to be good. Postings and access control to the controlled areas were also found to be good.

7.0 Dose Evaluation

7.1 Collective Dose

The collective dose from 1986 to 1989 for SSES was compared with that for the average U.S. Boiling Water Reactor (BWR). SSES was consistently below the average throughout this time period.

Occupational Dose Comparison for
Pennsylvania Power & Light's Susquehanna Steam Electric Station
versus
Average U.S. Boiling Water Reactors (BWRs)

Collective Dose per Reactor (Person-rem/Year) (NUREG/CR-0713)					
	1986	1987	1988	1989	1990
Susquehanna 1, 2	414	313	258	352	220
Average BWR	652	513	529	439	
% of Average	-36%	-39%	-51%	-19%	*
Rank (Lowest)	11 out of 30	25 out of 33	11 out of 34	15 out of 36	*

* Data unavailable

7.3 Average Individual Dose

A review of the average individual dose was performed for the period 1986 to 1989, to again compare SSES exposure against other U.S. BWRs. SSES average individual dose was 34% below the average individual dose for BWR radiation workers (with measurable exposure) in 1986. This changed to 39% below the average BWR in 1987, 40% below in 1988, and 5% below in 1989.

Annual Individual Dose (mrem/year) (NUREG/CR-0713)					
	1986	1987	1988	1989	1990
Susquehanna 1, 2	276	243	270	341	280
Average BWR	420	400	450	360	*
% of Average	-34%	-39%	-40%	-5%	*

* Data unavailable

7.4 Daily Collective Dose

A review of the daily collective dose was performed to determine if the average daily dose being expended during non-outage and outage periods was lower than that at other BWRs. SSES daily dose per reactor was 139% higher than the average BWR during non-outage periods and 13% lower during outage periods.

Daily Collective Dose per Reactor (mrem/day) (Hinson, 1990)		
	Non-Outage Dose Rate	Outage Dose Rate
Susquehanna 1, 2 (1986-88)	1056	3460
Average BWR	441	4000
% of Average	+139%	-13%

The inspectors did not investigate the reasons for the apparently high non-outage doses to licensee staff. It is, however, an area the licensee may wish to review for potential reductions.

7.5 Exposure Rates and Dose Equivalent Rates

In an attempt to determine if the decreased collective dose was due to lower than average exposure rates, a comparison was performed of SSES radiation levels during shutdown with those radiation levels in the open literature for other BWRs. By comparing SSES with data published in Nuclear Technology, the contact and general area dose rates around major components and systems appear lower than those at other BWRs.

7.6 Repetitive High Dose Jobs

To further identify the potential causes for the lower collective doses, a review of repetitive high-dose jobs that were conducted during outages and during routine operations was performed. The collective doses for SSES repetitive high-dose jobs conducted during the first through fifth outages of Unit 1, and the first through third outages of Unit 2, were compared against the data for other GE BWRs report in NUREG/CR-4254. All of the collective doses reviewed for SSES high-dose jobs conducted during refueling outages were below the average values for GE-BWRs. In addition, the collective dose trend for these repetitive jobs appears to be decreasing instead of increasing with plant age.

7.7 Non-Repetitive High-Dose Jobs

A review of the non-repetitive high-dose jobs was performed to determine if a lower amount of non-routine radiological work resulted in the low annual collective doses. Because special maintenance activities typically constitute the largest percentage of the work category doses reported to the NRC in accordance with Regulatory Guide 1.16, the impact of the non-repetitive activities on SSES doses was examined. The collective doses per reactor were adjusted to exclude the dose reported during that year for special maintenance. The resulting collective dose per reactor excluding special maintenance is as follows:

Year	SSES Adjusted Collective Doses (person-rem)	U.S. BWR Adjusted Collective Doses (excluding special maintenance) (person-rem)
1986	405	378
1987	275	345
1988	218	-
1989	318	-
1990	199	-

8.0. ALARA Program/Organization

8.1 Background

The licensee first formally implemented a program to maintain occupational exposures as low as is reasonably achievable in 1978 during plant construction. The first corporate radiological engineer was hired in 1978, and shortly thereafter initiated the corporate ALARA committee. The ALARA policy statement, NDI-6.4.2, "ALARA Policy and Program," was approved by the senior V.P. nuclear on December 17, 1981. This nuclear department instruction established the responsibilities and the foundation of the SSES ALARA program. The first station ALARA specialist was hired in 1981, with the station ALARA Committee convening its first meeting on October 25, 1985. The ALARA job review procedure HP-AL-400 entitled, "RWP ALARA Evaluations," was first approved on August 15, 1980. The first ALARA design review was documented on April 16, 1985.

8.2 ALARA Program

As previously mentioned, SSES ALARA program was initiated during the construction phase and was in place for the first refuel outage on unit 1. As a result of this first outage being radiologically significant, the program has been continually strengthened and optimized. The current ALARA program is described in NDI-6.4.2, Rev. 3, "ALARA Policy and Program," and NSI-2.1.5, Rev. 1, "Implementation and Operation

of the PP&L ALARA Program." All the major elements of an ALARA program described in NUREG/CR 4254 were utilized at SSES. The implementation of these elements and their relative effectiveness will be described in the following sections.

9.0. Training

The various job-specific ALARA training programs were reviewed. This included a review of the lesson plans, discussion with the respective training instructor, tour of the training facilities, and selected review of the various attendance sheets. The types of job-specific ALARA training given at SSES included general employee (GET-01), radiation worker (HP001), radiation protection technician (HP010), administrator and supervisor (HP003), and design engineers (EG011).

9.1 General Employee ALARA Training

The current lesson plan for training new employees, which conforms with 10 CFR 19.12 requirements, is GET-01, General Employee Training, dated 2/11/91. A review of this lesson plan and discussion with the instructor indicated that the needed ALARA objectives were covered. For general employees, the ALARA concept is defined, the management policy for ALARA is stated, the function of the ALARA program is described, the workers' responsibilities towards ALARA are described, and they are informed not to enter areas bearing radiation symbols unless they have been trained and have radiation dosimetry. The ALARA aspects of this training program were considered adequate.

9.2 Radiation Worker ALARA Training

The current lesson plan for training radiation workers, which conforms with 10 CFR 19.12 requirements is HP002 Health Physics Level II dated 3/13/91. A review of this lesson plan and discussion with the instructor indicated that the needed ALARA objectives were covered. In addition to the information described above, radiation workers also receive training in methods to reduce dose such as time, distance, shielding, and contamination control (i.e., containment, filtration, ventilation, and decontamination). The ALARA aspects of this training program were considered adequate.

It should also be noted that the licensee has developed impressive mockup facilities for training workers in radiological areas and on specific components (e.g. CRD exchange, LPRM exchange, RWCU pump, undervessel shoot-out steel, SRM/IRM calibration, and MSIV mockups).

9.3 Radiation Protection Technician ALARA Training

The current training program for radiation safety technicians is documented in NTP-QA-42.1, Health Physics Section Training and Qualification Program, dated 9/16/88. This procedure describes the knowledge, skills, prerequisites, and qualifications needed to become a radiation safety technician. All health physics technicians receive ALARA training in one or all of the following: (1) HP003 - Health Physics Level III; (2) HP010 - Administrative Procedures for Health Physicists; or (3) HP621 - OTT RMS for ALARA Programs. Specialized ALARA training is given to the ALARA specialists in training module HP079, Job Spec ALARA specialist. These training modules are conducted by instructors in the Nuclear HP/Chemistry training group. The content of this ALARA training was considered adequate. A review of attendance records indicated all level II HP technicians had received the required ALARA training.

9.4 Administrator and Supervisor ALARA Training

The job-specific training requirements for administrators and supervisors in ALARA are specified in NDI-6.4.2, "ALARA Policy and Program," dated 1/14/91. This training is documented in HP003 Health Physics Level III, revised 8/13/90. This training is conducted by instructors from the Nuclear HP/Chemistry training group. A review of the ALARA training lesson plan and discussions with the training instructor indicated that the content and objectives were adequate. Topics covered included: (1) ALARA policy and management commitment; (2) procedural requirements for ALARA; (3) Supervisor's ALARA responsibilities; (4) dose and contamination reduction techniques; (5) ALARA job review process; and (6) practical applications. The ALARA training program developed for supervisors provides the needed motivation and knowledge to enable them to apply dose and contamination reduction techniques during the planning and implementation of their work in radiological areas.

A review of the attendance records for the maintenance department indicated that all but one supervisor attended the required HP003 ALARA training. This maintenance services supervisor should attend the required training.

9.5 Engineer ALARA Training

The current training requirements for design engineers in the ALARA concept is described in the training curriculum for Nuclear Plant Engineering (NPE), approved 8/10/90. This training matrix and NDI 6.4.2, "ALARA Policy and Program," dated 1/14/91, requires that all design engineers shall receive training that present design considerations, cost considerations, and methods to be used to minimize personnel exposures. This training is documented in instruction EGO11, "ALARA Design Training," revised July 20, 1989. This training is conducted by the Nuclear Training Department.

The ALARA Design training lesson plan was found to be thorough and of good scope. A review of the attendance records for EGO11 training indicated that not all the design engineers have received this training. The licensee should consider having all design engineers attend the ALARA design training course.

The licensee indicated that the various procedures and associated instructions that describe how ALARA reviews of modifications are performed are currently being revised. This revision was initiated as a result of the improvements being made by NPE in the method of processing plant modifications. The licensee agreed to consider revision of the ALARA design training program to reflect the new and improved modification process.

10.0 Management's Collective Dose Goals

The inspectors reviewed the licensee procedure for establishing annual goals on collective dose, along with the 1990 performance results. The procedure which describes how these goals are formulated and tracked is described in AD-00-745, "ALARA Program," dated 4/4/91, and NSI-2-1.5, "Implementation and Operation of the PP&L ALARA Program," dated 2/22/88. Management involvement was evident in that these goals are approved by the plant manager and senior vice president - nuclear. Collective dose goals are established for the station and for the major departments/sections on an annual basis. The annual collective dose goal for the station in 1990 was 425 person-rem. The 1990 collective dose for SSES for Units 1 and 2 was 440 person-rem. Although the 1990 goal was exceeded by 3.5%, this was the lowest annual collective dose recorded since the first year of operation (1985).

A listing of the various department section goals and actual collective dose total for 1990 are:

1990 Annual Collective Dose Goals (person-rem)			
Department	Goal	Actual	% of Total
Quality Assurance	9	10	2.3
Nuclear Services (ISI)	15	15	3.4
Instrumentation & Control	11	16	3.6
Health Physics/Chemistry	44	52	11.8
Tech Group	3	3	0.7
Maintenance	43	55	12.5
Decontamination	34	37	8.4
Operations	19	26	5.9
Outage Mgmt/IEG	1	13	2.9
Chemistry	4	4	0.9
Nuclear Plant Eng (NPE)	2	2	0.5
Construction	239	205	46.6
Other	1	2	0.5
	425	440	

The method of establishing, monitoring, achieving, and reporting collective dose goals appeared adequate.

11.0 ALARA Program/Organization

The licensee's ALARA program is described in Nuclear Department Instruction NDI-6.4.2, ALARA Policy and Program and AD-00-745, ALARA Program. NDI-6.4.2 is a corporate procedure that describes ALARA responsibilities, ALARA interfaces, the implementation of collective dose goals, and ALARA job reviews. This procedure established the management commitment to ALARA. The procedure is well laid out and appears to cover most facets of an operational ALARA program. An attachment to this procedure included a copy of a specific policy statement that defined an apparent strong management commitment to ALARA. The inspector noted that the detail and comprehensiveness of NDI-6.4.2 was very good.

AD-00-745, ALARA Program, is a plant procedure that describes ALARA responsibilities for site organizations; the ALARA Committee Charter; interfaces; and the ALARA review and evaluation process, including: pre-job review, during job review and post job review criteria, dose reduction methods and process and engineering controls for consideration.

The plant ALARA organization utilizes two structures, one for non-outage and one for outage conditions. The non-outage ALARA organization consists of a health physics foreman-ALARA, an HP planner/scheduler, and two HP specialists. During outages, the ALARA organization expands to include three additional specialists and an assistant HP foreman for backshift ALARA and external dosimetry support. These positions are staffed generally from within the licensee's organization. As noted previously, one to two individuals from the corporate radiation protection group are utilized as ALARA specialists. The other positions are filled by upgraded Level II HP technicians or by contractors. During recent outages the licensee has reduced its reliance on contractors in order to develop and retain experience within its own staff.

The licensee indicated that the maintenance department reorganized into job area functions approximately two years ago. In response to the maintenance reorganization, the ALARA outage group was reorganized. This resulted in the assignment of ALARA specialists to the following areas of coordination: drywell, valves, balance of plant, and inservice inspection/snubbers. Since the maintenance, construction, engineering and other work groups are focused in this manner, consistent lines of communications and established interfaces appear to enhance ALARA performance.

The ALARA committee is composed of plant group supervisors from various plant departments. Notably, the chairman of the ALARA Committee is the Maintenance Supervisor. The ALARA committee is responsible for: reviewing planned activities and modification tasks that are estimated to exceed 10 person-rem; identifying engineering, training, or licensing support which may be necessary for exposure reduction activities; designating groups responsible for performing tasks to present plans to the committee; and reviewing and recommending resolution of employee identified ALARA concerns.

The inspectors also noted that the licensee benefits from a consistent highly experienced work force. Many of the maintenance, instrumentation and controls, and construction personnel have worked at Susquehanna Steam Electric Station (SSES) since plant startup. The licensee utilizes its own maintenance "travel crew". These included machinists, welders and other support personnel who have had previous experience at SSES. Contractor personnel also included high proportions of returnees with previous SSES experience. Interviews with licensee personnel also indicated that worker attitudes toward exposure minimization have improved over the last four to five years. Licensee personnel did acknowledge that improvements are warranted with respect to minimizing personnel contaminations and improving contamination control performance.

Through discussions and interviews with corporate, HP, maintenance, construction, chemistry and engineering management and technical personnel, the inspectors were able to evaluate the work environment at SSES. There appears to be a supportive environment which facilitates and promotes individual responsibility and individual development of solutions to plant problems. This includes numerous inventions, site manufactured equipment, and improvements in practices. This was evidenced by the development of reactor vessel nozzle shielding by a contract decontamination technician, the snubber support tool developed by maintenance, the feedwater nozzle hydrolazing tooling and cleanup methods used by the inservice inspection personnel, and the scaffolding and insulation coordination methodology developed by construction.

12.0 Management Involvement

The functional ALARA organization at the corporate office consists of two health physicists and a health physics (HP) specialist. This group performs an annual ALARA assessment of the plant ALARA program, ALARA reviews for designs initiated at the corporate department level, tracking and data management, coordination of the person-rem goal setting process and evaluation of source term reduction programs. The licensee does utilize long term planning for dose reduction improvement projects. Most of this planning is coordinated with other departments. Implementation of new technology and robotics is coordinated with corporate maintenance engineering. Improvements to the steam plant and condensate system water quality performance is coordinated with corporate chemistry. The corporate office also provides operational support for the plant ALARA program. Corporate personnel indicated that their activities focused on building trust and communications between the plant and corporate organizations.

The corporate radiation protection effort is augmented by a corporate radiological engineering function. This effort is supported by a licensee employee who functions as a radiological engineering consultant. This function provides quantitative radiological engineering and analytical support to the Nuclear Department and is responsible for the design bases for SSES. This support includes ALARA program direction and support, source term, shielding and compartment dose analyses and provision of the bases for technical training in radiological calculation and evaluation. An area that is currently receiving attention is a technical specifications change to allow greater leakage tolerance for main steam isolation valves (MSIV). This would permit reduced outage time. Another area of support includes the gathering of data, techniques, and calculational methods for source term reduction.

One to two individuals from the corporate radiation protection staff are given rotational assignments to the plant to serve as ALARA specialists during refueling outages. These personnel are trained on plant procedures and processes in the area of ALARA. Although additional management oversight may be required for some of these individuals, depending on experience, this is viewed positively. This type of assignment builds relationships and facilitates communications between these groups. Rotational assignments have also been utilized at the intermediate to senior management level. Reportedly, rotations have included the following: corporate positions, radiation protection groups supervisor, environmental group supervisor, and maintenance supervisor.

One area that appears to merit consideration for improvement is management support for a corporate wide incentive program, into which ALARA suggestions could be input. The current incentive program comprise a worker suggestion to supervisor program and a bonus system that rewards plant employees for plant achievement of designated goals. The plant achievement award was made in terms of a percentage of salary for plant wide achievement of management goals for plant performance. These goals included regulatory, operational, safety, and radiological performance. These were measured by industry recognized indicators of performance. The worker suggestion system requires the individual to submit his/her recommendation to his/her supervisor. The supervisor would evaluate the recommendation and then decide whether to push or reject the idea. Licensee personnel indicated that upper management basically was opposed to incentive systems and that there was no mechanism to present an idea outside of the normal chain of command.

13.0 ALARA Initiatives/Practices

13.1 Source Term Reduction

The licensee is engaged in several significant source term reduction projects. Although it was noted that several of these projects appear to be motivated for reasons other than ALARA, ALARA would benefit from their implementation.

Water chemistry has a great effect on the production of activation products which contribute to station source term. Fuel handling and fuel history influences the addition of fission products to the station systems and thereby contributes to station source term. At SSES there have been only three fuel rod leakers during ten fuel cycles. This indicates excellent fuel integrity and minimal contribution to station source term. In an effort to minimize shock to the fuel rods, SSES has implemented a fuel ramping procedure during reactor shutdown and startup. This involves gradual control rod movement rather than a scram or sudden rod withdrawal and adds an extra day to the refueling outage; a good initiative.

The licensee has changed out 48 control rod drive blades during this outage approximately one year before end of life. The primary motivation for this change appears to be minimization of radwaste disposal costs. The old control blades contained cobalt bearing stellite rollers that contributed to the source term in the reactor coolant system (RCS). Since the replacement blades do not contain stellite, ALARA will benefit from this change out.

The licensee is currently involved in a program to improve feed water chemistry performance. This include modifications to the condensate demineralizers to eliminate spent resin residues, improved operational utilization of the ultrasonic resin cleaning system, and installation of erosion resistant replacement piping. Most of this effort in the steam and condensate portion of the plant is focused on reducing the amount of iron in the condensate water. The licensee indicated that unlike most boiling water reactors, which have approximately 90% of its source term due to ^{60}Co, SSES's source term was composed of approximately 75% ^{60}Co and 25% ^{59}Fe and ^{54}Mn. The licensee is also experimenting with different anion to cation resin ratios as well as different types of resin for improved performance. The licensee also indicated that the bid specification was being developed for the development of a lay up program for temporarily inactive liquid radwaste systems in order to minimize corrosion.

The licensee has performed some initial evaluations of zinc injection and hydrogen water chemistry methodologies for source term reduction. These evaluations indicated that both methodologies result in higher shutdown radiation levels and hydrogen water chemistry results in higher operating radiation levels. This appears to be consistent with the limited amount of industry experience to date. The licensee indicated that the source term was already in the range anticipated with the use of zinc injection and would not appreciably benefit from this methodology. The licensee stated that they had adopted a wait and see approach until the industry has had more experience with these methods of source term reduction.

While the licensee's resources have been engaged with cobalt reduction efforts in the reactor core and will be heavily engaged with the snubber reduction program, there has been little management support given to cobalt reduction in reactor plant systems and. components. No evidence was presented by the licensee to indicate that the EPRI method had been utilized to evaluate and systematically reduce the cobalt content of plant systems and components. The challenges associated with the aforementioned efforts is acknowledged; however, attention is merited for cobalt reduction in reactor plant systems and components.

13.2 Shielding

According to SSES data, nearly 60% of all outage radiation exposure occurs inside the drywell. The station's approach to shielding this area was reviewed. During the current unit 2 fourth refueling outage, 73 out of 95 shielding packages were dedicated to the drywell. Approximately 32,000 pounds of lead blankets were hung on chains as shadow shields or wrapped directly on the drywell radiation sources. The target for the drywell shielding was to reduce the whole body dose rate fields below 100 mR/hr for all work areas. The licensee has estimated 6 person-rem for installation and removal of drywell shielding for this outage. Due to the drywell shielding program, there has been a net reduction of 25% in drywell radiation exposures since the shielding efforts began. SSES is building an experience base of standard drywell shield packages. Permanent lugs have been installed at many locations to simplify shield installation. A conveyor belt was used this outage to transport lead blankets through and into the drywell. To date, most of the shielding efforts are for temporary shielding. Overall the station appears to exhibit a strong shielding program.

13.3 Snubber Reduction

The licensee has appropriated funds and committed to implement a snubber reduction program. This will involve a reduction of approximately 60% of the station's snubbers. Over half of the snubber reductions will come from the drywell which was estimated by the licensee to reduce personnel exposures by 40 person-rem per outage. While this will involve a commitment of exposure and resources to complete, ALARA will benefit from a significant reduction of maintenance and inservice inspection work in the drywell over the life of the plants.

13.4 Decontamination Techniques

Hydrolazing has been used extensively to perform feedwater nozzle decontamination, cleaning of cavity drain lines, floor drains and scram discharge lines. The WEPA system has been used for reactor cavity decontamination. Steam cleaning has been utilized to clean concrete after resin spills, reactor water cleanup (RWCU) system heat exchanger end bell and for reactor cavity decontamination. The licensee also indicated that grit/bead blasting was used for turbine rotor and blade decontamination. Chemical decontamination had been evaluated and found not to be cost justified.

The licensee is planning a renovation to the decontamination shop. Currently, decontamination of tools and equipment is performed by hand scrubbing with water, water spray, vibrator finisher, Maytag dishwasher, freon and electropolishing. The freon unit will be decommissioned to reduce the generation of mixed waste.

13.5 Robotics and automated Equipment

The licensee began experimenting and evaluating automated equipment in 1987. The licensee has utilized the Little Andros robot for unplugging waste sludge from the phase separator flow eductor, surveying the RWCU phase separator tanks and recovery from overflow from these tanks. The super scavenger robot has been used for unit two resin regenerative surge tank cleaning and unit one equipment pool decontamination. A Mini Rover ROV was used to support the condensate storage tank cleaning and hydrolazing of the feedwater nozzles in the reactor vessel.

The licensee also utilizes an eight stud reactor pressure vessel tensioner/detensioner carousel. An improved local power range monitor detector removal tool has been acquired. Automated valve packing removal tooling has received a mixed review. This tool is not suitable for all types of valve packings. An automated vessel seam weld inspection rig was used to perform inservice inspections on reactor vessel beltline seam welds. The licensee indicated that a manipulator arm was being evaluated for radioactive waste shipping activities. This device would be utilized to install and remove lines and to attach and detach lift rigs to radioactive waste liners. Generally, the licensee was actively pursuing the use of remotely operating equipment for high dose job applications.

13.6 Operational Practices

Video equipment has been used to monitor activities on the refueling floor and in the reactor cavity, main steam isolation valve work, RWCU work, residual heat removal valve work, on the N8 nozzle work, and for suppression pool access control. During non-outage conditions, video equipment is used to monitor the RWCU pump oil level bulb, the resin regenerative tank and resin surge tank levels to minimize the need for an operator to enter these high radiation areas.

Communication equipment and headsets with base station setup have been used to coordinate drywell and refueling floor work. The licensee also indicated that the maintenance department has its own communication gear for refueling and control rod drive (CRD) maintenance activities.

Sump cleaning was accomplished by the use of spargers and added water to slurry sump contents. The contents were pumped to the radioactive waste system. Temporary filters were not used to support fuel pool cleaning activities. Spent fuel pool cleanup was accomplished by the use of underwater vacuums that exhausted to the fuel pool skimmer system. No discrepancies were noted.

13.7 Reactor Water Cleanup Pumps

The inspectors evaluated the licensee's maintenance history with the RWCU system. A history of RWCU pump seal failures that goes back to 1986 is evident. Since 1986, the following provides a summary of RWCU pump seal failures:

YEAR	Unit 1 Pump A	Pump B	Unit 2 Pump A	Pump B
1990 - 8/31/90	3	3	3	1
1989	2	4	5	4
1988	0	4	1	0
1987	3	4	0	3
1986	1	2	1	1
TOTAL	9	17	10	9

While the licensee did improve procedures, provided training of maintenance workers, required the performance of mockup training the day immediately preceding seal replacement, and implemented an improved O-ring design, RWCU pump seal failures continued to occur. The licensee indicated that there were 10-12 modifications made to the original vendor design to "fix" the pumps. This culminated in a decision that was made in 1990 to replace the RWCU pumps with sealess pumps of greater reliability. It was noted by the inspectors that there was industry experience regarding reliability problems with these pumps prior to 1982. While the decision to replace these pumps with a sealess design appears to be a good decision, radiation exposure could have been reduced had they been replaced earlier. The timeliness of this action was not evaluated by the inspectors.

14.0 Self Evaluation/Assessments

The licensee performs three types of assessments that originate from the corporate radiation protection group. Five programmatic assessments are scheduled over a three year period. These generally consist of an evaluation of a particular aspect of the radiation protection program, such as external exposure control, internal dosimetry, health physics surveillance and instrumentation. These usually involve contractor support and include the development of the objectives, conduct of interviews and participation by a member of the corporate radiation protection group. This effort results in a report in which the evaluated site group has input as to the results of the evaluation.

The second type of assessment involved the evaluation of vendor programs for technical and regulatory adequacy. It was unclear whether these assessments were in addition to, in support of, or in lieu of quality assurance vendor audits. The third type of assessment was the walk through assessment. This involved a member of the corporate radiation protection group visiting the SSES to observe a particular job or program activity.

In addition to the licensee's program of self assessments, a Radiation Advisory Group is utilized. This group is composed of several industry notable personnel that meet four times a year. This group will perform independent evaluation of the licensee's programs, licensee performance, and significant changes in industry thought, such as latest studies on health effects of radiation. The results of these evaluations are then reported to the Senior Vice President - Nuclear.

15.0 Planning and Scheduling

Major outage work requirements are determined over one year in advance for two refueling outages at a time. Draft outage plans are issued consecutively with a minimum lead time of seven months previous to the outages. The outage scheduling group issues the draft plans to all station departments including the ALARA group for review and comment. Due to a licensee initiated Organization Effectiveness Review, the maintenance department was reorganized along plant functional lines in 1989 (i.e. valves, NSSS, balance of plant, snubbers and ISI, maintenance services, electrical, and I & C). Each of these functional maintenance groups has its own planner and scheduler. As the outage work is inherited by each maintenance group, each group's planner/scheduler works to detail the planning within the allotted general outage scheduling framework. The ALARA group also has a planner/scheduler who has access to all of the scheduled work packages as they are developed. Lists of work packages are screened for radiologically significance afterwhich the ALARA specialist begins his or her outage planning activities.

The dedicated position of HP planner/scheduler is viewed as a good station initiative. This function allows for early job identification which provides significant lead time for the application of ALARA techniques and resources. There are two computer systems which do not currently interface with each other; the Plant Maintenance Information System (PMIS) and the Radiological Management System (RMS). All of the maintenance planning/scheduling is done from the PMIS whereas all of the ALARA planning/scheduling functions are performed using the RMS. Due in part to this limitation, the station schedule does not provide job progress measurement data for the ALARA dose tracking system. The general outage schedule has basically standardized an outage approach which includes a four day ALARA window before general work commences inside of primary containment (drywell). This time period

allows for the identification of hot spots, flushing of these hot spots, drywell decontamination, installation of shielding and installation of temporary services (e.g. electricity, lighting, instrument air, etc.). This demonstrates management resolve to minimize personnel exposures.

16.0 ALARA Program Implementation

Formal pre-job reviews were required for any job estimated to cost one person-rem or greater. The ALARA pre-job review checklist was well developed and of appropriate scope. The pre-job review consisted of a four page checklist, meeting attendance sheet documenting the pre-job review meeting, and a detailed job person-rem estimate. From these reviews, and resulting dose estimates the level of ALARA priority and resources were determined.

According to the ALARA Program procedure AD-00-745, Rev. 9, for all jobs estimated over one person-rem an "in progress" review is required at the half way point. This ALARA review is to be completed by the work group supervisor. Upon review, very few in progress reviews were completed by the work group supervisor and of those that were, approximately 90% contained no written comments at all. In general, this "in progress" review initiative is not working. For operational ALARA controls, the dose tracking system (RMS) does compare actual person-rem and actual person-hours to the estimates which would effect an investigation as soon as an estimate is exceeded. Currently the operational ALARA reviews do not incorporate a measure of job completion to compare the person-rem and person-hours to. Apparently, the difficulty in interfacing the PMIS and RMS computer systems prohibits the current availability of the outage schedule information for ALARA control purposes. In general, the operational ALARA control measures could be enhanced.

A list of current RWP's was used to select various ALARA job review packages from the unit 2 fourth refueling outage. Six ALARA job packages represented 17 different RWP's. Since the ALARA job packages normally precede the RWP issuance it is the ALARA job packages which are reviewed and approved by appropriate levels of management. The divergence from a single ALARA package to several RWPs can cause the need for a post-job review to be missed. The station procedure requirement for a post-job review during an outage is any job which accumulates five person-rem or greater. ALARA job package no. 90-095 governing limitorque testing was broken into four RWPs of which the highest individual RWP resulted in 4.55 person-rem. This ALARA job package received no post-job review. The cumulative actual job exposure for all four RWPs was approximately seven person-rem which should have received a post-job review. This particular job was well under estimated exposure however there is a potential for not reviewing significant exposure expenditures. When a particular scope of work is designated as an ALARA package and presented to the station ALARA committee as such, the package should continue to be regarded as the same unit throughout the post-job review process.

Dose reports are published twice a day during outages and weekly during routine operations. The information is obtained from RWP sign-in sheet pocket dosimeter data and is updated with TLD data when available. To meet the specific needs of the Electrical and Structural (E & S) Construction group, a dose report program was written for their use by the ALARA group. This custom report was administered and distributed by E & S construction as needed. It was not clear to the inspectors whether appropriate training was provided to the work group supervisors in order to maximize the use of these dose reports.

An ALARA job package no. 90-113 covering RPV disassembly/reassembly, recommended that RPV stud tensioning be reduced from three passes to two passes as a dose reduction lessons learned. This recommendation was carried through in the outage health physics report and the inspector verified its incorporation into current outage practice.

The post-job reviews are captured as lessons learned in the Outage Health Physics Report which is distributed to all station departments. This document also provides comprehensive dose, man-hour, and dose rate data by task and work group categories. A running historical basis provides trend comparisons and evaluations. There is enough detail in the report to provide for future dose estimating and planning needs. In general, the Unit 1 fifth refuel outage report dated January 2, 1991 was a well developed and useful comprehensive ALARA outage report.

17.0 Exit Meeting

The inspectors met with licensee representative at the conclusion of this inspection, on April 19, 1991. The inspectors reviewed the purpose and scope of the radiological controls inspection and discussed the inspection findings. The inspectors also reviewed the purpose and scope of the ALARA review and discussed the findings.