BNL ALARA CENTER

ALARA NOTES

Number 8

Edited by

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MASTER

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ALARA Notes

October 1993

BNL ALARA Center

Number 8

From The Editors

This issue of 'ALARA Notes' is dedicated to **Lessons Learned From The Experience Of Nuclear Plants**. A number of health physicists have provided information about interesting jobs carried out at their nuclear power plants. They often provide data on the doses incurred in doing these jobs, the man-hours utilized, the number of persons involved and other details. However, the most important parts of the information are the lessons learned as they were doing the job - lessons from which other power plants may profit.

This issue of 'Notes' contains all the data gathered to date. The wide circulation of about 1,300 copies of the 'Notes' should multiply the value of this information more, so that plants in general and radiation workers in particular, may profit from it.

In presenting this data, we have tried to avoid the 'tyranny' of numbers and concentrated on the main lessons learned. Numbers can be misleading, because they often do not take into proper account plant design, age, dose rates, and other factors over which the persons doing the job have little control. Moreover, they impose a kind of 'horse race' approach, so that the main point, which is how to improve the manner in which a job is done, is lost.

A large part of the data presented here was provided on-line to the ACE system, by means of personal computers and modems, and we also receive data through the mail on paper. This is all the data of this type gathered over an 18 -month period because only a few nuclear plants took the trouble to provide information, although many are profiting from the information available. However, some plants have been very generous with their information. Among the top is the Niagara Mohawk plant, Nine Mile Point. Internationally, the Scandinavian and Japanese plants have been very generous, as usual, with their information. Such plants have the broad view that 'if it is going to reduce doses to radiation workers anywhere, then it is worth doing.'

With this issue of 'Notes' we hope to stimulate the same response from other plants. All plants will benefit greatly from this modest effort. We don't all have to reinvent the wheel!

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Nine Mile Point 1: BWR-2 MK1

U.S.A.

Replacement of Waste Collector Filter Septa

Description: All waste collector filter (WCF) septa was replaced:

The operation used data and lessons from a previous replacement of a floor drain filter (FDF) in forming the ALARA review. The FDF replacement used 41.75 man hours, 22 man-hours were added to account for the setup and removal of a 3' containment wall. The work area had a dose rate next to the WCF of 50% greater than the FDF. The above data resulted in an ALARA pre-job estimate of 20 mRem/hr, 1.28 man-rem, 64 man-hours. The post-job results were 8 mRem/hr, 0.155 man-rem, and 19.5 man-hours as a result of ALARA good practices.

Comments: Future recommendations for WCF and FDF filter replacements:

- Backflush the filter until there are no appreciable reductions.
- Ensure the filter vessel is filled with water.
- Maintenance personnel should remove filter media from the septum using long-handled tools as it is raised from the filter.
- Wipe down the upper septum tie plate immediately after removal from the filter body to reduce work area dose rates.
- Use an electric impact wrench for unbolting and rebolting flange connections.
- A 3' wall is installed around the work area to guard against filter media spread of contamination.
- Immediately remove spent septa that has been placed in transport barrels from the work area.
- Use heavy plastic suits rather than thin plastic rain suits to maximize personnel protection from contamination.
- Face shields were used rather than full face respirators to optimize worker efficiency.

The highest air sample record during this work was 15% MPC. [Radiological Work Permit #91-0333 NMP1 ALARA review #91-09].

For more information, contact Tim Hogan, ALARA Supervisor, Niagara Mohawk Power Corporation, P.O. Box 32, Lycoming, NY 13093 USA, Phone: (315) 349-2723, or Joseph Sears, Niagara Mohawk Power Corporation, 301 Plainfield Road, Syracuse, NY 13212 USA, Phone: (315) 428-7387, Fax: (315) 428-7225

Loviisa 2: PWR Finland

Welding and Inspection of Pressurizer

Description: In-service inspection had revealed damage on the inner surface of pressurizer inlet/outlet. Welding and inspection had to be done inside the vessel.

Comments: The inside of the pressurizer was washed with high pressure (200 bar) by capacity (30-40 litre/min) washing machine BEFORE the surface dried. The man performing the washing followed the sinking water level, working from a ladder. Full plastic suit, boots, gloves, mask, and over pressure air supply were used. Four men worked, one at a time. The washing decreased the dose rate from about 2 mSv/h to 0.4-0.6 mSv/h. After washing the inner surface of the heaters supporting cylinder was covered by plastic foil to prevent residual contamination from spreading. Thereafter, lead blankets were hung on the top of the foil until a dose rate of 0.2-0.3 mSv/h was reached. Then the men working inside the supporting cylinder were completely isolated from contamination. During the whole job, including all different tasks, no personnel contamination incident appeared.

For additional information, contact Bjorn Walstrom, Imatran Voima OY, Loviisa Nuclear Power Station, SF-07900 Loviisa, Finland, Phone: 358-15-5501.

Hamaoka 2: BWR

Japan

Repair of Steam Dryer

Description: Repair of steam dryer due to crack in one drain channel.

Comments: The dryer was removed from the reactor pressure vessel. A shielding box mounted on a rail was used for workers. Welding was performed through window in the box, which was opened one by one.

Measures Taken to Reduce Dose:

- mock-up training
- automatic welding equipment
- digital area monitors in high dose-rate areas
- shielding

- prevention of spread of surface and airborne contamination

Dose Rates:

- On contact on the dryer: 28 mGy/h
- At 30 cm from dryer surface: 11 mGy/h
- In working compartment (box): 1-1.5 mGy/h

Experience:

1. Training, especially with mock-ups, is very important and effective in difficult works not previously performed.
2. Information about dose rate in the workplace: It is important to help workers recognize the dose rate distribution or high-dose-rate zones in the work place by means of visual aids: radiation maps, local area monitors with indicators setting illuminations on pipings with high-dose rate, and so on.
3. Future strategies will pursue dose and process trend analyses. These are expected to reduce dose further.

For additional information contact: Takuo Hata, Chubu Electric Power Company, No. 1, Toshin-cho Higashi-ku Nagoya 461-91, Japan, Phone: 81-52-951-8211.

V.C. Summer Station: PWR

U.S.A.

Decontamination of Reactor Cavity

Description: Reactor cavity decontamination using immersible coating, Isolock 300.

Comments: The application and removal of coating required a total of 148 hours to complete. Radiological surveys performed after the removal of the coating indicated contamination levels of 10,000 dpm/100 cm² and 50,000 dpm/100 cm² on the walls and floors, respectively. The cavity decontamination was completed with 65 mman-Sv of exposure; a reduction of approximately 38% as compared to the previous outage. The reactor head work was completed with 33.5 mman-Sv of exposure, a 20% reduction as compared to the previous outage. The man-Sv savings on the reactor head work was attributed to an increase in worker efficiency due to a decline in the protective clothing (plastics) and respiratory protection required to perform the work. The total personnel contaminations decreased from 264 to 120 as compared to the previous outage, and the calculated dose equivalent to the skin as a result of these contaminations was down from 312 mSv to 120 mSv.

Recommendations: A post-outage critique identified several recommendations to be considered prior to the next refueling outage. An increase in the work crew to six is suggested for refueling outage, bringing the total to twenty-six individuals, including two foremen. The increase in the work crew should decrease the time required to mask the cavity and remove the coating. Increased communication between the Health Physics Staff and Planning and Scheduling is needed to specify delays for cure-time. The coating cure time is a function of the cavity wall temperature and relative humidity; therefore, it is difficult to schedule a fixed time. A recommended schedule allowance of twenty hours will be used in the future. Access to the polar crane directly affects the evolution of the masking, painting, and stripping. For this reason, a Cav-Span crane system has been developed and will accelerate the masking and stripping evolutions of the job.

For additional information, contact Claude Laney, South Carolina Electric and Gas Company, V.C. Summer Station, P.O. Box 88, MC-402, Jenkinsville, SC, 29065 U.S.A., Phone: (803) 345-4424.

Nine Mile Point 1: BWR-2 MK1 U.S.A.

Replacement of Filter Septums

Description: The reactor water cleanup (RWCU) filter septums were replaced including the following support work: Install and remove tent, install and remove temporary shielding, install scaffold in filter room, radiological protection (RP) coverage, demobilization of tools and equipment from tent, decontamination of filter cubicle, transport of spent septums to rad waste building.

Comments:

Exposure Saving Techniques: The most significant reduction procedure taken were four flushes of the filter vessel. This reduced the dose rate from a range of 4.0 - 28 mSv/hr to 0.8 mSv/hr - 2.0 mSv/hr.

- Temporary shielding reduced the work area dose rates at the septum housing from 30 mSv/hr to 6 mSv/hr (at the sides of the housing) and 2.0 mSv/hr to 0.8 mSv/hr at the vessel flange.
- The use of bubble hoods/suits significantly improved worker efficiency. This kept loose contamination off the worker and kept them cool.
- Responsible, cognizant supervisors were at the job site to ensure quick decisions were made to prevent job delays.

- A lifting eye inserted into the tube sheet of the septum housing broke when raised from the filter vessel. This necessitated lifting eye repair and approximately 0.5 mSv of worker exposure.
- The drain line from the sludge trough was not placed into the filter vessel prior to the removal of the septum tubes from the housing. This resulted in the spread of loose contamination. The decontamination effort expended approximately 2 mSv.
- A "slight dent" on the lower tie-plate resulted in an alignment problem which resulted in 1.0 mSv of worker exposure.
- The cubicle walls and floor were unpainted which resulted in additional decontamination efforts due to leaching.

Additional Recommendation: Only one barrel should be placed in the tent at a time to receive the spent septums. This will aid in reducing the source term in the work area.

For additional information, contact Tim Hogan, ALARA Supervisor, Niagara Mohawk Power Corporation, P.O. Box 32, Lycoming, NY 13993 USA, Phone: (315) 349-2723, or Joseph Sears, Niagara Mohawk Power Corporation, 301 Plainfield Road, Syracuse, NY 13212 USA, Phone: (315) 428-7387, Fax: (315) 428-7225

Hope Creek: BWR

U.S.A.

Remote Control Rod Drive Handling System

Description: The installation of a remote control rod drive (CRD) handling system.

Comments: Average dose per CRD removal and installation using remote control is the following in some U.S. plants:

1. Perry	6.0 mSv
2. Duane Arnold	2.5 mSv
3. Limerick	3.0 mSv
4. Peach Bottom	2.4 mSv
5. Monticello	4.9 mSv
6. Hope Creek	3.4 mSv

The average for plants using manual techniques is 6.5 mSv.

As can be seen on the dose history illustration, Hope Creek's dose per drive is well below the industry standard for manual removal. Recently developed robotics (ITI & PCI Skids) being used by other plants now show Hope Creek as slightly above the average. Maintenance technicians from Hope Creek have been sent to Denver,

Colorado, for extensive mock-up training over the past two years. Even though this training had been performed, additional hands-on training was found to be necessary which, at times, require two or three maintenance technicians to be undervessel during CRD removal/installation. With training completed, the RHM will be able to function as designed with the use of only one maintenance technician working undervessel. This should, in turn, lower the dose received per drive by at least an additional 30%.

For additional information contact: Thomas Wallender, Hope Creek Nuclear Station, P.O. Box 236 M/C H05 Hancocks Bridge, NJ 08038 U.S.A., Phone: (609) 339-3432.

Forsmark 1: BWR

Sweden

Core Grid Support Repair

Description: Repair of core grid upper support.

Comments: A total of 700 screws keeping guide strips for fuel assemblies fixed to the core grid were broken (intergranular stress corrosion cracking - IGSCC). The core grid was placed on a separately made support in the handling pool. All fuel was unloaded, but control rods and neutron detector tubes were left in the reactor. The water cover on the core grid was 2m. The guide strips were changed by tools separately made for this purpose.

For additional information contact: L. Wahlstrom, Forsmark Nuclear Power Plant, S-74200 Osthrammar Sweden, Phone: 46 173 81000.

San Onofre : PWR

U.S.A.

Heat Exchanger Decontamination

Description: Decontamination of let-down side of regenerative heat exchanger (Citrox method).

Comments: Maintenance activities were planned to be performed on six valves located next to the Unit 1 regenerative heat exchanger. The general area readings were 3.0 mSv/h with "hot spots" up to 80 mSv/h. Contact readings on the hx were 40 mSv/h. The letdown side of the hx was chemically decontaminated (using a 3 step citrox procedure) and an overall average exposure reduction factor of 4 was achieved. This resulted in a net savings of 420 man-mSv for the valve work. The decontamination effort expended a total of 14.6 man-mSv. Additional savings were realized but not quantified.

For additional information contact: E. Scott Medling, Southern California Edison, 2244 Walnut Grove Avenue, Rosemead, CA 91770 U.S.A., Phone: (818) 302-2976.

V.C. Summer Station: PWR

U.S.A.

Modification of Reactor Temperature Detector System

Description: Modification of resistance temperature detector (RTD) system, including removal of bypass system piping, manifolds, valves, and associated support to reduce maintenance needs.

Comments: A total of nine radiation work permits (RWP) were written for the RTD project. The project exposure estimate was 124 man-rem which was determined by comparing our scope to the scopes of other plants having previously completed RTD projects. A challenging goal was set by the plant ALARA committee at 112 man-rem, a 10% reduction of the estimate. The total accumulated exposure for the nine RWPs was 103.47 man-rem. Important consideration was given to:

- Work planning - nine work categories (work permits) were established.
- Getting experience from plants having performed the same job.
- Exposure reduction techniques.
- Radwaste.

Dose-Reduction Techniques Used:

- Mock-up training
- Dedicated crews
- Adequate shielding
- Portable shielded storage

For additional information, contact P. Mothena, South Carolina Electric and Gas Company, V.C. Summer Station, P.O. Box 88, MC-750, Jenkinsville, SC 29063, USA, Phone: (803) 345 4642.

Sendai 1: PWR Japan

Turning Vanes Replacement

Description: Replacement of turning vanes.

Comments: We replaced turning vanes volts of reactor coolant pumps (RCPs) for preventative maintenance during annual inspection. We carried out the following measures regarding radiation protection:

- A temporary house was set up at the operating floor of containment to prevent the spread of contamination.
- Temporary ducts with HEPA filters were used to prevent internal exposure.

- Temporary shields with lead plates were used to reduce external exposure. (These are the usual measures for work such as overhaul of valves.)

For additional information, contact Masachika Hoshen, Kyushu Electric Power Company, Inc., Safety Control Section Nuclear Power Operations, 1-82 2 Chome, Watanabe-Dori Chuo-Ku, Fukuoka-Shi 810, Japan, Phone: 81-092-761-3031.

Oskarshamn 1: BWR

Sweden

Decontamination of RWCU Using the Cord Process

Description: System/component decontamination of reactor water cleanup (RWCU) for the purpose of reducing the dose rates in and around the system. The CORD method (Chemical Oxidation-Reduction Decontamination) developed by Siemens-KWU was used.

Comments: The total amount of released radioactivity was 1.2 TBq. An average decontamination factor was calculated to be 4.3 and the dose rates were reduced in average by 77%.

The collective dose for the planned maintenance work, without system decontamination, was calculated to be 400 mman-Sv. That would have been about one-fifth (1/5) of the total collective dose for the outage period. After the decontamination, the maintenance work was carried out with a total collective dose of 85 mman-Sv. The collective dose for the system decontamination was 50 mman-Sv. Apparently, the dose saving was about 250 mman-Sv.

The total cost for the system decontamination was \$155,000. That gives the figure \$620 per mman-Sv. This was the first real system decontamination at Oskarshamn Nuclear Power Plant. We are happy with the results, and it is likely that more system decontaminations will be carried out in the future.

For additional information contact: Christer Sohlstrand, Oskarshamn Nuclear Power Plant, OKG Aktiebolag, S-570 93 Figeholm, Sweden, Phone: 46-491-86000.

Oskarshamn 1: BWR

Sweden

Feedwater Sparger Replacement

Description: Replacement of feed water sparger inside the reactor vessel (close to upper core grid).

Comments: During a normal shutdown in 1974 for inspection, maintenance, service and refueling, cracks were detected in the ring-formed sparger which is situated

inside the reactor vessel just above the core and which distributes the feedwater in the tank. The exchange of the feed water distributor was carried out during 2.5 months. The total outage: ca. 7 months

The old feedwater ring was cut off and new spargers were welded in their place. During the repair period, all fuel was removed from the reactor vessel and the water level was kept approximately 50 cm over the upper edge of the core grid to reduce radiation levels. Nevertheless, the dose rates were so high that it was necessary to manufacture a radiation shield in the form of an especially made lead box 197 x 145 x 74 cm (inside), 10 cm lead shield, total weight 30 ton. It could contain two repair persons simultaneously and was equipped with overpressure ventilation as well as the equipment for the necessary operations. The work was carried out in the continuous three-shift personnel subcontracted from ABB ATOM. One hundred and seven people were engaged during shorter or longer periods in the reactor hall work. Out of these, 55 persons carried out work from the submerged lead box. In the reactor hall one health physicist was on duty per shift. The collective dose for the work was 440 mmanSv, and, out of this, only 50 mmanSv was received during work in the lead box. The remaining collective dose, 390 mmanSv, was received from work at floor level in the reactor hall. The highest registered personal dose was 20 mSv, and the highest registered hand dose was 34 mSv. This was the first work of its kind in Sweden. The mock-up training gave essential experience. Some of the activities have to be done with the arms outside the lead box which gave special shielding problems (ca. 15 mSv/h in that area after shielding) and ventilation problems. As seen from the dose results, the main problem during the operation was to prevent people from unnecessary presence in the reactor hall.

For additional information, contact Bengt Lowendahl, OKG Atiebolag, Oskarshamn Nuclear Power Plant, S-57093, Figeholm, Sweden, Phone: 46 491 86000.

Nine Mile Point 1: BWR-2 MK1

U.S.A.

Work Inside Reactor Vessel

Description: Reactor vessel disassembly/reassembly, cavity decontamination, install/remove recirc line plugs, RIVP work, offload/reload core, install/remove main steam plugs and associated work.

A complete offload of fuel was required to support the replacement of the emergency cooling valves 39-01 and 39-02 in the drywell. Recirc line plugs were required to be installed in loops 11 and 15 to avoid vessel drain down. Plug installation required the removal of start-up

vibration equipment from the reactor annuls. Replacement of fuel spring clips, control blade replacement, re-fuel bridge maintenance, and other miscellaneous work.

Identified Good ALARA Practices:

- Mechanical maintenance video taped the reactor disassembly to use for future training.
- Lead blankets were used in the cavity to shield gauges at the base of the cavity wall. (prior reading was .05 Sv/hr)
- The refueling floor was maintained as a non-hot-particle area with the exception of the cavity area, the equipment storage pit area, and the NE\SW corners. This allowed personnel not involved in work in these areas to be dressed in a single set of protective clothing
- Cavity walls were kept wet with a soaker hose during drain down.
- Reactor water level was maintained just below the reactor vessel flange to maintain dose rates ALARA.
- Items were rinsed with water prior to being placed in the spent fuel pit or the cavity/storage pit when flooded.
- Reactor head studs were sleeved and left in place eliminating the need for the need for decon and potential airborne contamination problems.
- The inner and outer bellows areas were filled with water to reduce general area doses rates and minimize airborne contamination.
- Experienced radiation protection technicians were used to cover Refuel Floor activities.
- Training Center classes on Refuel Floor activities and viewing videotapes from past outages proved to be very beneficial.

Short List of Problems and Recommendations:

- The permanent marking of large equipment lay down areas is recommended.
- After the dryer and separator were removed from the storage pit, the water level was not maintained. This resulted in the drying out of the floor surfaces causing increased airborne contamination levels.

For further information contact Tim Hogan, ALARA supervisor, Niagara Mohawk Power Corporation, P.O. Box 32, Lycoming, NY 13903, USA, Phone: (315) 349-2723 [ALARA review #92-06, RWP # 920274], or Joseph Sears, Niagara Mohawk Power Corporation, 301 Plainfield Road, Syracuse, NY 13212-4599, USA, Phone: (315) 428-7387, Fax: (315) 428-7225.

Loviisa 1: PWR Finland

Vacuum Cleaning of Steam Generators

Description: Vacuum cleaning of all six steam generators on the secondary side to remove about 2 tons of magnetite collected at the bottom.

Comments: The steam generators are of the horizontal type at the Loviisa.

The secondary side water level was kept as high as possible. Hardboard sheets were put on the tube support. On this structure lead was put until a 0.5 mSv/h dose rate was reached. This was slightly higher than the dose rate outside the steam generator.

Better planning (involving health physics staff from the beginning) and more efficient cleaning equipment would have reduced the collective dose.

For additional information, contact Bjorn Wahlstrom, Imatran Voima OY, Loviisa Nuclear Power Plant, SF-07900 Loviisa, Finland, Phone: 358-15-5501.

Mihama 3 : PWR

Japan

Decontamination of Primary Coolant Pumps

Description: Chemical decontamination of primary coolant pumps to facilitate in-service inspection activities. AP-Citrox method used.

Comments: Dose rates from coolant pump internals reduced from 95 mSV/h to 10 mSv/h (surface dose rate).

For additional information, contact Mineyuki Nishikawa, Kansai Electric Power Company, Nuclear Power Operations Department 3-3-22, Nakanoshima, Kita-ku Osaka 530, Japan, Phone: 81 06 441 8821.

Nine Mile Point 1: BWR

U.S.A.

Replacement of Incore Monitors

Description: Replace IRM # 18 and # .15 This work is performed under vessel. The scope involves removal of the incore monitor cutting up the detector into sections, and placing the highly irradiated detector into a shielded pig. Storage of the detector is in a locked room.

Comments: ALARA good practices included long handled tool at the job site, and a shielded pig at site for the removed detector. The shield should be light enough for two people to carry. Work should be started at the beginning of a new shift, preferably when personnel not required for the work are not in the area. The detector is

special nuclear material, and is stored in a clearly marked drum in the locked rad waste storage pit. This ensured positive control over the material and appropriate material accountability.

Experienced work crews should be used for IRM replacements. If possible an IRM/SRM mock-up should be available for training purposes.

The entire removal and replacement of IRM/SRM detectors is possible without the use of respirators if a plastic containment sleeve is used.

For additional information contact: Joseph Sears, Niagara Mohawk Power Corporation, 301 Plainfield Road, Syracuse NY 13212 USA, Phone: (315) 428-7387, Fax: (315) 428-7225

Nine Mile Point 1: BWR-2 MK1

U.S.A.

Desludging and Decontamination of Radwaste Aisles

Description: Desludge, remove interferences, and decontaminate the old Rad Waste 225' Operating Aisle, Fill Aisle, East Aisle, "A" + "B" line. Support activities required for cleanup completion.

Job History: During Unit 1 reactor startup in July 1981, it was necessary to process large amounts of water. Due to overfilling and sump pump back, up this elevation was flooded. Approximately 150 high-waste storage drums were stored there. Many of these drums floated off their carriers and spilled their contents. After several decontamination attempts, it was concluded that a remote robotic device would be needed. TROD was developed by NMPC + Red Zone.

Comments: Projects: Desludging and decontamination of barrels, barrel carriers, interferences, and open areas; removal of barrels barrel carriers, and interferences; returning 225' elevation sump to an operational condition. These goals were accomplished.

Exposure Savings:

- **Robotics:** TROD was used to empty storage drums, move barrel carriers, remove drum lids, modify the carrier system, desludge drums and floor spaces, hydrolaze walls, remove debris, etc. Use of TROD saved an estimated 1.18 ManSV and possibly up to 1.96 ManSV. Manual Decon and recovery would have resulted in significant radiation doses.
- **Shielding:** The filter sludge's chemical composition may have contributed to the early failure of the paint coating the walls. This damage allowed contamination to be absorbed into the underlying concrete. Sheet

lead plates were attached to the west end walls. Only 0.00150 ManSv were expended in this operation. The dose rates in the area were reduced from 0.015 - 0.050 mSv/hr to 0.003 - 0.015 MSv/hr. The savings from this were 0.027 ManSv. Another effective shield use during the manual periods of the operation was maintaining from 1 to 3 feet of water on the floor. This resulted in a 50% reduction in exposure for manual activities.

- **Airborne Radioactive Controls:** A temporary HEPA ventilation system was used to supplement the RW building's own ventilation. This air flow created a favorable condition by drawing contamination away from the work areas.
- **Protective Clothing:** Bubble hoods and plastic suits were used during most work activities.
- **Video Equipment:** Work activities were controlled by a chief RW operator and Chief RP technician in the project control room. Without this video and communication equipment, significantly more dose would have been received.
- **Daily Planning Meeting:** Often these meetings became forums for the work force to vocalize ideas that lead to better work methods and reduce exposure. Work performed 3/16/90-1/31/91 after several ALARA reviews.

For additional information contact: Tim Hogan, ALARA Supervisor, Niagara Mohawk Power Corporation, P.O. Box 32, Lycoming, NY 13093, Phone: (315) 349-272, or Joseph Sears, Niagara Mohawk Power Corporation, 301 Plainfield Road, Syracuse NY, 13212, USA, Phone: (315) 428-7387, Fax: (315) 428-7225

Oskarshamn 1: BWR

Sweden

Installation of Insulation Cartridges

Description: Installation of insulation cartridges made of stainless steel.

Comments: Maximum dose rates 1-3 mSv/h. Temporary shielding and respiratory protection were used.

For additional information, contact Christer Sohlstrand, Oskarshamn Nuclear Power Plant, OKG Aktiebolag, S-570 93 figeholm, Sweden, Phone: 46-491-86000.

Ringhals 3: PWR

Sweden

Shot Peening of the Hot Leg Tubes of a Steam Generator

Description: Shot peening of hot leg tubes

Comments: Internal outage report (in Swedish) Olle Erixon, Shot Peening at Ringhals 3 and 4, 1986-1987, ALARA Considerations. Third European Scientific Seminar on Radiation Protection Optimization, "Advances in Practical Implementation," Madrid, Spain, September 12-14.

For additional information contact: Olle Erixon or Krister Egner, Vattenfall Ringhals NPP, S-43022 Varo-backa Sweden, Phone: 46-340-67150:

San Onofre: PWR

U.S.A.

Shipment of Spent Fuel Assemblies

Description: 139 spent fuel assemblies were to be transported from Unit 1 to Unit 2/3.

Comments: The project expended 150 mSV less than the pre-job estimate. Exposure savings were largely attributed to:

- The use of dedicated workers
- Pre-job training of all personnel involved
- Decontamination of assemblies prior to transfer
- Use of a seven element spent fuel cask for the transfer because of the superior shielding advantage the cask afforded.

For additional information, contact E. Scott Medling, Southern California Edison, 2244 Walnut Grove Avenue, Rosemead, CA 91770 U.S.A., Phone: (818) 302-2976.

Nine Mile Point 1: BWR-2 MK1

U.S.A.

Radiation Protection Surveys and Job Coverage

Description: Radiation protection surveys, inspections and job coverage. Included the following:

- Radiological surveys:
 1. Pre-scheduled updates (daily, weekly, monthly).
 2. Job coverage per supervisory direction and radiation work permit (RWP) requirements.
 3. Change in conditions (CRUD flushing, shielding, etc.).
 4. Airborne radioactivity concentration assessments
 5. Special and hot particle surveys
- Job coverage per supervisory direction and RWP requirements.
- Radiological posting installations and updates.

- Tours, inspections, and verifications.
- Minor equipment maintenance.

Comments: The radiological controls used during the operation included the following:

- Utilization of Xetex alarming dosimeters.
- Utilization of portable radiation monitors, VAMPs.
- Utilization of video surveillance monitoring equipment.
- Utilization of temporary shielding on the reactor water cleanup supply line shadow shielding on the recirc piping, etc.

Post-Job Suggestion: The ALARA group recommends that radiological protection (RP) supervision develop a method of allowing RP technicians to log their exposure and ManHours onto the radiation work permit specific to the work for which the surveys and job coverage were done.

For additional information, contact Tim Hogan, ALARA Supervisor, Niagara Mohawk Power Corporation, P.O. Box 32, Lycoming, NY 13093, USA, Phone: (315) 349-2723; [ALARA review # 89-06; RWP # 890015] or Joseph Sears, Niagara Mohawk Power Corporation, 301 Plainfield Road, Syracuse, NY 13212, USA, Phone: (315) 428-7387, Fax: (315) 428-7225

Nine Mile Point 1: BWR-2 MK1

U.S.A.

Replacement of a Pump in a High Radiation Area

Description: After an extensive troubleshooting period the job resulted in the replacement of pump to motor flex coupling.

This work is done in the drywell in a high radiation area.

Comments: At the start of the pump problem, reasons for the malfunction was unknown. The testing the amperage of the pump to see if correct amperage was being drawn was the first action. The motor was drawing only 1.5 A when the normal amount was 2.4 A. It was found that the pump was not loaded. After properly starting the motor, the pump was not working. Later, after completing a break down and reassembly of an up-line valve, the pump was again started. The sump pump operated normally with no problems. The plant went back on line for two days before shutting down again. The pump was identified again as not working properly. A plan was devised to replace the pump containing many man hours and man-Sv. However, after removing the pump motor, it was discovered the teeth of the flex coupling had all broken off. The coupling was not "catching" between the motor and pump. Maintenance decided to replace only

the flex coupling. After testing the pump worked as designed. A good ALARA practice which reduced the dose to workers was their effective use of low-dose waiting areas. Also the temporary shielding reduced the dose rates as shown above.

Lessons Learned:

Mechanical Maintenance will now lubricate the flex couplings every refuel cycle for #11 and #12 DWEDT sump pump. This should reduce the likelihood of sump pump failure.

For additional information, contact Tim Hogan, ALARA Supervisor, Niagara Mohawk Power Corporation, P.O. Box 32, Lycoming, NY 13093, USA, Phone: (315) 349-2723. [ALARA review # 92-26, RWP # 920224], or Joseph Sears, Niagara Mohawk Power Corporation, 301 Plainfield Road, Syracuse, NY 13212, USA, Phone: (315) 428-7387, Fax: (315) 428-7225

Nine Mile Point 1: BWR-2 MK1

U.S.A.

Insulation Replacement on Recirculation Piping and Valves

Description: Replace insulation on recirc piping and valves, inspect and supervise, install/modify/remove scaffolding, install/modify/remove shielding, and clean up. The pre-job estimates of ManSv and ManHours were 0.18252 and 863, respectively. The post-job actual readings were 0.25589 and 774.25.

The primary reason for the difference between estimated dose and actual dose is that the mirror insulation was poorly numbered and caused confusion and delays when reinsulating in the high dose rate area. This was particularly true of insulation adjacent to other drywell sources.

Comments:

Effective Job Planning: Insulators, construction services, and outage planning were required to verify, to the ALARA Group, that all open items (i.e. WRs, mods, etc.) were closed out prior to reinsulating any piece of equipment or piping.

Corrective Action: A renumbering system started by the insulators and the modifications to individual pieces of insulation (for a custom) fit will greatly reduce dose for any future insulation or in-service inspection (ISI) work on this system.

Key Radiological Controls: Prior to each entry, RP technicians informed the workers of radiological conditions and low dose waiting areas, and instructed them to minimize time adjacent to localized sources of high radiation. The insulators also sprayed a light demin water

mist onto the insulation prior to removal. This eliminated the spread of contamination, reduced airborne radioactivity, and optimized the use of respirators.

Earlier in the outage, shadow shielding had been installed on 13,15 recirc suction and discharge risers and 12,14 recirc suction risers. The shielding reduced the dose fields of the high-radiation area.

Additional Comment: Sandpaper gloves were extremely effective for the safety of personnel when handling mirror insulation and during subsequent decontamination and modifications.

For additional information, contact Tim Hogan, ALARA Supervisor, Niagara Mohawk Power Corporation, P.O. Box 32, Lycoming, NY 13093, USA, Phone: (315) 349-2723, [ALARA review #89-30, RWP #890874], or Joseph Sears, Niagara Mohawk Power Corporation, 301 Plainfield Road, Syracuse, NY USA 13212, Phone: (315) 428-7387, Fax: (315) 428-7225

Nine Mile Point 1: BWR-2 MK1

U.S.A.

Replacement of Insulation on Main Steam Piping

Description: Replace insulation on main steam piping, inspect and supervise, install/modify/remove scaffolding, modify shielding, and clean up.

The estimated ManSv and ManHours were 0.0849 and 400, respectively. The actual collective dose and ManHours were 0.06865 and 425. This insulation work was done in the drywell.

Comments:

Exposure Estimates: The actual exposure for this job were 19% lower than estimated due to:

1. Shielding the recirc risers
2. Use of experienced personnel familiar with the drywell reinsulation tasks
3. Numbering the individual pieces of insulation as they were removed for easy identification when they were replaced. (This procedure resulted from a lesson learned, told in a previous NMPC ACE file.)

These dose saving techniques are reflected in the actual exposure saved during the reinsulation work being 0.01625 Person-Sv.

Access Controls:

1. Prior to each entry RP informed workers of area radiological conditions and low dose rate waiting areas.

2. Prior to each entry the insulators and scaffolding crews informed RP of specific work areas and tasks.
3. Communication between RP and job supervision was very good, enabling the work to be done in a timely and efficient manner.

The work crews made good use of identified low dose areas when delays occurred.

For additional information, contact Tim Hogan, ALARA Supervisor, Niagara Mohawk Power Corporation, P.O. Box 32, Lycoming, NY 139093, USA, Phone: (315) 349-2723 [ALARA review # 89-39; RWP # 890944] or Joseph Sears, Niagara Mohawk Power Corporation, 301 Plainfield Road, Syracuse, NY USA 13212, Phone: (315) 428-7387, Fax: (315) 428-7225

Nine Mile Point 1: BWR-2 MK1

U.S.A.

Removing Scaffolding from Drywell

Description: Remove scaffolding in drywell, transport out of drywell, decontaminate, and transport to clean area.

Comments: The ALARA group required the work contractor leave as much of the primary piping shadow shielding as possible in place for this work. This shielding was installed earlier in the outage.

ALARA Lessons Learned: Discussions with work contractor management revealed that when the work was initiated the intent was to prepare the drywell for end of outage activities including reactor restart. Removal of the scaffolding at this time may not have been wise. There were two primary reasons for this thinking. The scaffolding removal interfered with work that was continuing in the drywell. Also some of the scaffolding removed on the RWP had to be reinstalled for future work. It was concluded from this that a "Scaffolding Coordinator" should be created. This would prevent interferences with other work occurring in the drywell, and optimize scaffold takedown and setup inside the high-radiation area. Prior to the removal of highly contaminated scaffold, it is recommended that HEPA vacuuming be performed first to optimize efficiency and minimize respirator use.

For additional information, contact Tim Hogan, ALARA Supervisor, Phone: (315) 349-2723, or Joseph Sears, Niagara Mohawk Power Corporation., 301 Plainfield Rd. Syracuse, NY 13212, Phone: (315) 428-7387, Fax: (315) 428-7225

Nine Mile Point 1: BWR-2 MK1

U.S.A.

Replacement of Reactor Recirculation Pump Cooler

Description: The reactor recirculation pump cooler (heat exchanger) was replaced. The exposure estimate was 0.19 ManSv, and estimated man hours were 831. The post-job report contained an actual exposure of 0.0764 ManSv and 369.5 man hours. The exposure was reduced as a result of good planning and ALARA good practices which optimized the work process.

RP Group Pre-Job Tasks: Accurately assessing the need for respiratory equipment and cutting the back from the plastic suits increases the workers' efficiency. Close monitoring and maintaining contamination levels ALARA during the job reduces protective clothing requirements.

Comments:

Exposure Savings:

- Temporary shielding installed on the recirc risers adjacent to the recirc pump reduced the work area dose rates from 2.50 - 3.00 mSv/hr to 0.25 - 0.35 mSv/hr. The shielding also resulted in an estimated 90 Man-mSv savings and required only 4.60 Man-mSv to install.
- The water level of the recirc pump bowl was maintained at its maximum level. The dose rates at the bowl work area were reduced from 1.50 - 2.00 mSv/hr to 0.40 - 1.0 mSv/hr. The estimated dose savings from this was 0.015 Man-Sv.
- The motor cooler and stand were removed as a two-step procedure. The stand was removed first which left the cooler shielded from the workers.
- A new "hydrotorque" wrench was used to remove stud nuts which reduced time in the work area.
- Video cameras were used by maintenance supervision and quality control to supervise work in progress from low- dose- rate areas.

Problems and Recommendations:

- The manually operated chain fall used to lift the pump internals was not as efficient. Extra time was need for winch operation. Also, workers reported large fatigue from its use. The solution would be the use of an electric winch system.
- Final measurements of the new cooler are made just prior to installation. These measurements should be made before entrance into the high- radiation area.

- Care should be taken to prevent to ensure pump over-flow does not occur. The use of a stand pipe and extra drain valve is recommended.
- Gortex suits could be used to increase worker comfort.

For additional information, contact Tim Hogan, ALARA Supervisor, Niagara Mohawk Power Corporation, P.O. Box 32, Lycoming, NY, 13093, USA, Phone: (315) 349-272 or Joe Sears, Niagara Mohawk Power Corporation, 301 Plainfield Road, Syracuse, NY USA 13212, Phone: (315) 428-7387, Fax: (315) 428-7225

Nine Mile Point 1: BWR-2 MK1

U.S.A.

Replacement of a Flange Gasket

Description: Install/remove temporary shielding, remove/install limit torque operator to perform MOVAT & LLRT testing, rad protection coverage, operation's mark-ups and flushing bonnet to body flange gasket replacement.

The estimated Person-Sv was .0432 and the estimated ManHours for the job were 204. Optimizing use of ALARA good practices the ManSv was reduced to .01455, also the maintenance personnel discovered that repair of the internal seating surface was not needed. This resulted in a reduction of time in the work area ManHours.

Comments: The reduction in man-hours accounts for 9 mSv of the 34.77 mSv saved during the valve repair. The additional savings can be attributed to ALARA good practices:

- **Temporary Shielding:** 900 lbs. of lead blankets were placed on adjacent system #33 piping. This resulted in the work area dose rate falling from 1.00-1.50 mSv to 0.15-0.40 mSv.
- **Contamination Control:** A Plexiglas shield was placed in the valve body for the purpose of shielding beta radiation. This had the added effect of preventing debris from falling into the valve. This resulted in a reduction of cleanup time in the high-dose area.
- **Reduction of Job Interferences:** Prior to the start of the job, technicians removed unnecessary material from the work area. This optimized the time spent for access and egress in the work area.
- **Remote Work Techniques:** The instrumentation and control (I&C) techs were able to perform local leak rate test (LLRT) of the valve at a remote low-dose-rate area; saving approximately 1 mSv.
- **Nuclear Plant Operator (NPO) Suits:** The Mechanics wore air-fed suits while in the area. The suits relieved worker heat and stress, which resulted in an increase in

worker efficiency. **NOTE:** ALL breathing zone air samples taken in the work area were less than 100% maximum permissible concentration (MPC). HEPA ventilation was provided.

Post-job Recommendations:

The mechanics recommended that a lifting beam be installed directly over the valve to facilitate and easier method of removing and replacing the valve's internal components. The result of such an installation would be to reduce the number of mechanics to 2 rather than the 3 used for the job.

For additional information, contact Tim Hogan, ALARA Supervisor, Niagara Mohawk Power Corporation, P.O. Box 32, Lycoming, NY 13093, USA, Phone: (315) 349-2723 [NMP ALARA review #91-07] or Joseph Sears, Niagara Mohawk Power Corporation, 301 Plainfield Road, Syracuse, NY 13212 USA, Phone: (315) 428-7387, Fax: (315) 428-7225

Nine Mile Point 1: BWR-2 MK1

U.S.A.

Repair of Main Steam Sensing Line Supports

Description: Repair of system 01 main steam sensing line supports. WRs (58 total) Support tasks include scaffolding construction, mods, removal, QC and ISI inspections, and engineering evaluations and verifications.

Job Planning: This work was performed in the BWR drywell at NMP 1 on the major elevations. The estimated ManSv for the job was 0.07787, and post job results were 0.06537 ManSv of collective dose. [Reference: NMP1 ALARA review #89-37 and RWP #900991]

Comments: Interdepartmental communication and cooperation during this job was excellent and carried out in a timely manner.

Post-Job Recommendations:

- Comprehensive engineering input and direction in the planning phase improves work scope control. This process was optimized by technical liaisons who organized individual work orders into a comprehensive package
- Systematic and effective work area decon prior to work commencement curtails respirator usage.
- Supervisory pre-work walkdown of system components identifies specific work locations, anticipates tool and material requirements, and scaffolding requirements. These proved to be very beneficial on this job and should be done for similar large job scope planning activities.

1. RP liaison interface during the planning and problem resolution phases of this job complimented communication capabilities and effective teamwork. This was necessary to complete this job with ALARA exposure.

For additional information contact Tim Hogan, ALARA Supervisor, Niagara Mohawk Power corporation, P.O. Box 32, Lycoming, NY 13093, USA, Phone: (315) 349-2723, or Joseph Sears, Niagara Mohawk Power Corporation, 301 Plainfield Rd. Syracuse NY, 13212, USA, Phone: (315) 428-7387, Fax: (315) 428-7225

Ringhals 2: PWR

Sweden

Replacement Of Steam Generators

Description: Complete replacement of the three steam generators.

Comments: Internal reports (in Swedish) - Olle Erixon and Lars Hillbom. Steam Generator Replacement at Ringhals 2, 1989 Health Physics Experience Westinghouse REM Seminar, Oct 30-Nov 1 1989, Pittsburgh, PA, USA.

For additional information contact: Krister Egner, Manager, Environment and Safety, Swedish State Power board, Ringhalsverket Nuclear Power Plant, S-43022 Varo-backa, Sweden, Phone: 46 340-67150

Ringhals 1: BWR

Sweden

Replacement of Primary Pipes Inside Containment

Description: Replacement of above 100m of primary pipes inside the reactor containment and about 150m outside the containment due to intergranular stress corrosion cracking (IGSCC).

Comments: Internal outage report (in Swedish).

For additional information contact: Krister Egner, Manager, Environment and Safety, Swedish State Power board, Ringhalsverket Nuclear Power Plant, S-43022 Varo-backa, Sweden, Phone: 46 340-67150

Ringhals 4: PWR

Sweden

Shot Peening of the Cold Leg Tube of Steam Generator

Description: Shot peening of steam generator cold leg tubes (hot leg operation was performed in 1986).

Comments: Will be provided by the contact.

For additional information contact: Krister Egner, Manager, Environment and Safety, Swedish State Power board, Ringhalsverket Nuclear Power Plant, S-43022 Varo-backa, Sweden, Phone: 46 340-67150

Ringhals 2: PWR

Sweden

Up-Flow Conversion

Description: Up-flow conversion. Extensive fuel damage due to baffle jetting. Uranium was lost into the primary system causing high contamination levels.

Comments: Extensive fuel damages due to baffle jetting and up-flow conversion.

Ringhals 2 has experienced baffle jetting since 1977. Baffle peening of 17 corners was performed in 1981 with good results. Jetting from the unpeened corners has increased gradually and solid zircaloy rods have therefore been installed instead of fuel rods in the corners where water jets could be expected. In the 1987 and 1988 outages severe damages in the dummy rods were discovered but also extensive damages in fuel rods. It has been calculated that 120 grams of Uranium was lost into the RCS 1987. The damaged fuel rods resulted 1988 in up to 500 Bq/kg of alpha activity (mostly Cm-242, Pu-238, Pu-239, Am-241, and Cm-244) in the reactor coolant system (RCS).

It was anticipated before the shut-down of 1988 that the high levels of fission products in the RCS would result in higher dose rates and problems with hot spots and "fleas." The dose rates in the station were only marginally higher than 1986 and no problems with fleas were experienced. Through an effective contamination control during the whole outage it was also possible to keep the station clean and avoid internal contamination.

During the outage 1988 it was decided that the only option for continued operation was to perform an up-flow conversion. This work was done in nine days by Westinghouse with a total exposure of 60 mmanSv.

For additional information, contact Krister Egner, Manager, Environment and Safety, Swedish State Power board, Ringhalsverket Nuclear Power Plant, S-43022 Varo-backa, Sweden, Phone: 46 340-67150

Ringhals 3: PWR**Sweden****Additional Experience from Shot Peening**

Description: Shot peening of steam generator cold leg tubes (hot leg was performed in 1986).

Comments: O. Erixon, Shot peening at Ringhals 3 and 4 1986-1987. ALARA Considerations Third European Scientific Seminar on Radiation Protection Optimization "Advances in Practical Implementation," Madrid, Spain, September 12-14, 1988.

For additional information, contact Krister Egner, Manager, Environment and Safety, Swedish State Power board, Ringhalsverket Nuclear Power Plant, S-43022 Varo-backa, Sweden, Phone: 46 340-67150

Nine Mile Point 2: BWR-5 MK2**U.S.A.****Replacement of Reactor Coolant System Valve Internals**

Description: The scope of this work was to replace the reactor coolant system (RCS) MOV18B valve internals, repair any valve body damage wear, and associated support work.

- Lessons learned on RCS MOV18B were incorporated into the repair of RCS MOV18A. (A later NMPC ALARA Center entry.)
- Repair of this valve was added scope to the outage, therefore the pre-job planning of work was by necessity of short duration.
- The duration of certain evolutions on the job were underestimated because there was no history of work on these valves, and the vendor was not on site when the ALARA review estimates were made.
- This is a recirculation system isolation valve repair.

Comments:

- Dose rates inside the valve body were higher than expected. They varied from 1.3 R/hr to 5 R/hr.
- Lapping the seat rings was not anticipated in pre-job planning and was the highest dose intensive work on the valve.
- Mechanical difficulties consumed more time than expected.
- Improvements can be made in the use of ALARA engineering controls. This includes decon of the valve body and lead shielding applications. Lead shielding could have been used more aggressively in all phases of this

job. Shielding should be placed on the bonnet as soon as insulation is removed. This will save dose for all of the following evolutions, up to actually lifting the bonnet: valve manipulation; removal of the motor actuator, yoke, and stem, coupling; cutting the vent line; removal of bonnet nuts and studs; and rigging the bonnet. The shielding needs to be removed to lift the bonnet. As soon as the bonnet has cleared the valve body flange surface by a couple feet, and RP has surveyed the internals, a metal plate with a slot cut for the valve could be placed over the valve body flange surface. Blankets can then be laid on the metal plate to provide shielding for the rest of the bonnet removal.

- Contractor valve technicians were brought in to provide technical assistance. Pipefitters performed most of the physical work. Generally, two pipefitters were working on the valve while two technicians provided oversight. The vendor technicians could have performed all the work themselves.

Recommendations:

- Obtain a detailed task list and accurate pre-job estimate including contingencies for unanticipated problems. For example, the result from lapping seat ring can indicate the necessity of a seat replacement.
- Institute a study of decon methods to determine applicability of valve internals decontamination.
- Use lead shielding aggressively for all phases of valve repair.

For additional information, contact Kevin Rowe, Nine Mile Point Nuclear Station, ALARA K Building, Box 32, Lycoming, NY 13093, USA, Phone: (315) 349-7555 [ALARA Rev. #90-250], or Joseph Sears, Niagara Mohawk Power Corporation, 301 Plainfield Road, Syracuse, NY 13212 USA, Phone: (315) 428-7387, Fax: (315) 428-7225

Nine Mile Point 2: BWR-5 MK2**U.S.A.****Decontamination of the Drywell**

Description: Prior to commencing RFO-1 at NMP2, plans were made to perform an initial decon of the drywell upon shutdown. Intentions were to decon all areas of the drywell necessary to reduce contamination levels below that requiring respiratory protection. This practice is continued for subsequent outages. A post-job meeting was held to identify and discuss problems, concerns and good practices employed during the course of this job. All departments involved with the performance of this job were represented at the meeting.

Comments: On 9/5/90 Unit 2 was shut down. Initial drywell survey results were completed on 9/6/90. Based on these survey results, a Decon Action Plan was written and two pre-job planning meetings were held with the decon crew.

Good ALARA Practices:

- Development of a pre-job action plan and pre-job briefs were useful in ensuring all personnel involved were aware of their responsibilities and requirements prior to commencing decon.
- WCS*MOV101 (hot valve) was wrapped in plastic to avoid the spread of contamination. This action was prudent because no work was scheduled on the valve.

Identified Problems:

- Two attempts were made to decon the 240' elevation of the drywell. Contamination levels were not significantly reduced on either attempt. Survey results indicate that contamination was being spread around not being removed.
- Interferences impeded directing water into floor drains.
- Movement around the 240' elevation is very difficult. Most of the time workers must crawl on hands and knees to move through the area. Several workers complained of sore and blistered knees upon completion of the 240' decon.

Recommendations:

- Investigate other methods of decontamination for future 240' decons. These should include: wet vacuum reusable mops, and various decon solutions.
- Obtain knee pads and make them available to all workers entering the 240' elevation.

Conclusion: Future large-scale decon efforts on the 240' elevation should not be performed unless a more effective decon method is found.

1992 Update: Previous recommendations have been included and found to be successful during RFO-2. Work for RFO-3 is being planned.

For additional information, contact Kevin Rowe, Nine Mile Point Nuclear Station, ALARA K Building, Box 32, Lycoming, NY 13093, USA, Phone: (315) 349-7555 [ALARA Rev. #90-229], or Joseph Sears, Niagara Mohawk Power Corporation, 301 Plainfield Road, Syracuse, NY 13212 USA, Phone: (315) 428-7387, Fax: (315) 428-7225

Nine Mile Point 2: BWR-5 MK2

U.S.A.

Valve Repair in Reactor Water Cleanup System

Description: During the fall of 1988, the non-primary isolation air-operated valves in the water cleanup system (WCS) system failed. During testing, the valves did not close completely causing the loss of instrument air. At that time, a decision was made to completely rebuild the valves during the first refuel outage. The job consisted of repairs to 62 valves in the reactor water cleanup system.

Good Practices:

- Setup of the disassembly and decon in the Contaminated Storage Room with HEPA ventilation.
- Set up of the reassembly area outside hall, without respirators.
- Routing of personnel through lower dose rate areas.

Problems:

- Spare parts were a major problem. The same repair was not needed for each valve therefore many different parts were required.
- The hot machine shop setup for such work could have been optimized with limited time.
- RP could not provide coverage at times because the drywell work was a higher priority than the WCS valve work. It should be noted that, at the same time there were a number of unplanned high priority outage projects that were going on during the outage.

Recommendations: Future work on valves of this type should employ the following:

- Establishment of a separate, low-dose area for disassembly and rebuild.
- Ensure spare parts are properly staged.
- Ensure tools are properly staged and tested.
- Ensure work schedule accounts for proper man loading to optimize labor and dose.

For additional information contact: Kevin Rowe, Nine Mile Point Nuclear Station, ALARA K Building, Box 32, Lycoming, NY 13093, USA, Phone: (315) 349-7555 [ALARA Rev. #90-216], or Joseph Sears, Niagara Mohawk Power Corporation, 301 Plainfield Road, Syracuse, NY 13212 USA, Phone: (315) 428-7387, Fax: (315) 428-7225

Nine Mile Point 2: BWR-5 MK2

U.S.A.

Repair of Tube Bellows Flange

Description: Perform primary containment integrity repair or Engineering resolution of "B" TIP tube bellows flange. Perform subsequent test of "B" TIP tube bellows flange.

This test was accomplished by breaking open the TIP tube in the drywell and installing a temporary test rig onto the flange. Pressure was applied through the test rig back to the TIP tube bellows flange.

Comments:

Problem: Currently (1990) we had no method of shielding the area of TIP tubing that extends out of the back of a TIP shielding pig. When a TIP is withdrawn into its pig, approximately 5' of highly radioactive, activated cable projects out of the back of the pig. During the recent forced outage, general area dose rates of up to 1 R/hr were noted during entries into the inner TIP room. Contact dose rates of up to 3.8 R/hr were noted on the TIP tube projecting out of the back of the pig.

Solution: A shielding request will allow for the installation of a tube and knuckle scaffold frame around the area behind a pig or pigs. Lead blankets can then be hung on the support frame to decrease dose rates in the inner TIP room.

Identified Good ALARA Practices:

- The I&C department displayed good ALARA practices by ensuring all work possible in the inner TIP room was completed prior to withdrawing the "B" TIP into the inner TIP room and marking it up. The other four TIPs were left inserted in the core and marked up to prevent withdrawing. This kept dose rates to a minimum.
- In order to maintain their exposure ALARA, the I&C department also staged their leak rate test rig outside the drywell in a low dose area.

For additional information contact: Kevin Rowe, Nine Mile Point Nuclear Station, ALARA K Building, Box 32, Lycoming, NY 13093, USA, Phone: (315) 349-7555 [ALARA Rev. #90-218], or Joseph Sears, Niagara Mohawk Power Corporation, 301 Plainfield Road, Syracuse, NY 13212 USA, Phone: (315) 428-7387, Fax: (315) 428-7225

Nine Mile Point 2: BWR-5 MK2

U.S.A.

RWCS Pump Reassembly

Description: Disassemble/reassemble WCS-P1A (Reactor Water Clean-up System Pump 1A) pump including seal replacement, bushing replacement transporting, inspection, decontamination, and other associated work.

The scope of the job was revised several times from simple repairs of the pump to finally a complete pump rebuild. Revision 5 to the RWP was issued 12/5/89 to replace the bushing in the outboard pump head. Determining the root cause of the pump problem in advance vs. repair by trial and error could have optimized Man-Hours and ManRem.

Comments:

- The correct root cause of the problem with WCA-P1A initially was not determined. This resulted in significantly added work scope and severely hindered proper pre-job planning and reviews.
- Respiratory protection was required extensively during this project which impeded vision, slowed production, and caused heat stress and discomfort. The use of proper engineering controls (strategic use and location of HEPA- filtered internal pump parts, component decon) could significantly reduce or eliminate the requirement for respiratory protection devices.
- When the pump bell housing was being reassembled, it would not seal properly. An investigation revealed that portions of the old gasket were still adhered to the housing flange surfaces. The housing was dismantled, cleaned, a new gasket installed, and reassembled. A procedural step to verify cleanliness of seating surface prior to reassembly should prevent this from reoccurring. This would eliminate rework time, reduce exposure, and the generation of unnecessary Radwaste (damaged new gasket and protective clothing).
- The room temperature and heat stress continued to be a problem for the first part of this job.
- Timekeeping for beta radiation exposure involving hands-on work for pump internals. This resulted in additional ManRem.
- The post-job questionnaires indicate a concern about the lack of shift turnover information for craft personnel. A considerable amount of time was used to determine what had been done on the previous shift. The effective use of a logbook should optimize time and provide a valuable history and "Lessons Learned" reference file for future work.

Recommendations:

- Review work scope prior to formulating the work plan.
- The use of respiratory protection should only be required when engineering controls are not available or insufficient.
- Ensure procedural step is implemented to verify cleanliness of seating surfaces prior to reassembly of components.
- In 1992 cooling water mod. eliminated frequent repairs.

For additional information, contact Kevin Rowe, Nine Mile Point Nuclear Station, ALARA K Building, Box 32, Lycoming, NY 13093, USA, Phone: (315) 349-7555 [ALARA Rev. #89-210], or Joseph Sears, Niagara Mohawk Power Corporation, 301 Plainfield Road, Syracuse, NY 13212 USA, Phone: (315) 428-7387, Fax: (315) 428-7225

Chromium Coatings to Reduce Activity Pickup

About four years ago at the Doel-2 Belgian PWR, small 309L and 316L stainless steel and CF8M specimens that were first electropolished, then electroplated with a thin film of chromium, and finally preoxidized, were fixed to the manway seal plate. After one operating cycle, dose rate and activity pickup measurements showed a factor of seven reduction compared with electropolished specimens that served as a standard. These encouraging results led Northeast Utilities to use chromium coating on two of the manway seal plates in the replacement steam generators that were installed in the Millstone-2 PWR in October 1992. This process was recently used to treat reactor heat removal (RHR) system piping that was replaced at Pacific Gas and Electric's Diablo Canyon-2 in February 1993. There, a section of this piping was chromium plated but not preoxidized. The performance of these components will be monitored during subsequent plant outages. Additional small coupons of 304L stainless steel and Alloy 600 are being coated with chromium using different deposition parameters and will be installed in Doel-2 during the upcoming outage. These new experiments should provide more insight into the factors responsible for the ability of chromium coatings to resist activity pickup.

Taken from "Chromium Coatings to Reduce Activity Pickup," Radiation Control News, No. 17, May 1993 (EPRI, 3412 Hillview Avenue, Palo Alto, CA 94303).

PWR Primary Chemistry Update

The main primary chemistry issue continues to be the optimum pH for radiation control, minimum fuel

cladding corrosion, and primary water stress corrosion cracking (PWSCC) of nickel-based alloys. Recent results from new plants commencing operation show that using a pH of 7.4 with a maximum lithium of 2.2 ppm reduces field buildup by 20-30%, compared to the pH 6.9 chemistry used in the recent past. French workers reported at a recent conference that the benefit of pH=7.2, tested at a few EDF plants, was not as great. Studies of the potential adverse side effects of lithium concentrations above 2.2 ppm are continuing in several countries. None of the individual fuel examinations after use of 3.5 ppm show a statistically significant effect on Zircaloy oxidation but taken together, preliminary assessments suggest an enhancement of 5-15%, which could be important when cladding oxide thickness is a limiting factor. A recent Japanese study of the effect of lithium on PWSCC confirmed earlier Westinghouse results that 3.5 ppm lithium reduced the time for cracking to initiate; however, 2.2 ppm lithium appeared superior to lower lithium concentrations, as was also indicated but not in a statistically significant way in earlier work. All these studies used reverse U-bend specimens, which are not ideal for evaluating a second-order effect such as chemistry in tests that are dominated by stress and metallurgical effects. These recent results support the modified pH chemistry strategy, using 2.2 ppm lithium and pH=7.4 for as much of the cycle as possible. This is consistent with the PWR Primary Water Chemistry Guidelines - Revision 2, which will remain in effect for the immediate future. In the longer term, zinc injection is a potentially attractive method for inhibiting PWSCC. As with hydrogen water chemistry in BWRs, zinc increased the time to initiate stress corrosion cracking in laboratory tests. These results justify further study, as the effect could be important for minimizing stress corrosion cracking in vessel head penetrations and steam generator tubing. By analogy with BWRs, zinc would be expected to reduce radiation buildup also. Unlike BWRs however, there is no plant experience of the effect of zinc on Zircaloy corrosion under PWR conditions; although no adverse effect is anticipated, fuel issues must be addressed using test reactors and a fuel surveillance program in the first plant demonstration.

Taken from "PWR Primary Chemistry Update," Radiation Control News, No. 17, May 1993 (EPRI, 3412 Hillview Avenue, Palo Alto, CA 94303).

Radiation Exposures in 1992

Overall radiation exposures in 1992 were similar to 1991; total person-remS were up slightly, but so was total power generated. In fact, 1992 was the all-time record breaker for power generated by nuclear power plants. The ratio of person-remS per MW-year was effectively

the same as 1991 (see Figure). PWRs continued a downward trend in person-rem, but BWRs increased. In 1991 however, there was a significant drop in person-rem for both PWRs and BWRs. It may be that more outages occurred in 1992 than in 1991, which would account for the 1992 increase for BWRs. The three year rolling averages, however, continue to trend downward.

Exposure And Power Generation At U.S. Power Plants

Taken from, "Radiation Exposures in 1992," Chris Wood, Radiation Control News, No. 17, May 1993 (EPRI, 3412 Hillview Avenue, Palo Alto, CA 94303).

Robotic Vehicle

REMOTEC, Inc. Offers the MISR II, a new robotic vehicle for remote operation and specifically designed for confined spaces such as ducting and piping. The small tracked vehicle is environmentally sealed and can be readily decontaminated. Equipped with a telescoping arm, the vehicle can be configured with various end effectors, including a gripper, brushing equipment, vacuuming attachments, and spray lances.

For more, see the *Nuclear Plant Journal*, May-June 1993, p. 34.

[EDITORS' NOTE: Certain devices that appear to be particularly useful are sometimes mentioned for reader's information in ALARA Notes. However, this does not imply an endorsement of these products.]

Radiation Shielding

Southern Metal Works, Inc., (SMW) introduces PRIDE (Poly-Coated-Protection Interlocking Deconable Economical) Shielding for radiation protection. Encapsulating various shielding materials in polymer plastics, the shielding provides a full line of standard and custom designed products, including panel walls, bricks, pipe coverings, and containers. Since the shielding media is sealed

from the outside environment, encapsulation minimizes or eliminates traditional problems.

For more, *Nuclear Plant Journal*, May-June 1993, p. 36.

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Managing CRDM Nozzle Cracking

The cracking in nozzles of control rod drive mechanisms (CRDM) in the reactor vessel closure heads has recently been observed. Pure water stress corrosion cracking (PWSCC) in Inconel 600 material has previously been observed in some steam generators. However, cracking in CRDM nozzles is a recent phenomenon, and repairs can be expensive and time consuming. A phased programmatic approach to inspections, retardation of the cracking mechanism, and repairs will minimize down time. CRDM nozzles cracking was first reported in a French power plant in 1991, when a pressure hydro test of the reactor vessel indicated a leak. The European nuclear community evaluated this problem as an "operational" issue, and is implementing inspections during scheduled outages and repairs. The U.S. nuclear community considers that CRDM nozzles cracking would be a "non-safety related" issue. The engineering evaluations by government and industry have concluded that a "leak before break" event would happen if cracks went through-wall. U.S. Utilities must ask, "What actions should we implement to monitor for CRDM nozzle cracking, and what are the risk of not inspecting versus inspecting?" Eventually, inspections of the CRDM nozzles will probably be required by the U.S. Nuclear Regulatory Commission (NRC). A plan must be implemented which considers not only inspection, but also repair and mitigation. Ideally, the vendor which is chosen by the utility to perform this work should be able to provide solutions for all possible situations which may arise from the inspection and be ready to implement a complement program.

When To Inspect

The cracking susceptibility for each plant appears to be a function of Effective Full Power Hours (EFPH), material properties, and vessel head operating temperatures. Each plant can evaluate its specific data and make an educated analysis of expected results. Actual results of inspection in Europe have shown that there are exceptions which do not follow the calculated susceptibility; therefore, these calculations cannot conclusively predict failures. The decision to inspect should be based on operational safety and reliability. Early inspections may

detect smaller cracks that can be repaired. This could prevent the development of major through-wall cracks which could cause the plant to be off-line for longer periods of time. Long shutdowns might be prevented with a program of routine inspection and mitigation. Delaying action until a leak occurs could greatly increase the magnitude of corrective action. Early detection and mitigation of PWSCC appears to be the most sensible approach to avoid the through-wall cracks which could shut down the plant for an extended period. Inspection and repair processes have been successfully used and qualified in European plants. These processes can be adopted for use in the U.S.

Taken from "Managing CRDM Nozzle Cracking," M.G. Tierney, R.N. Brown, and R.L. Willia, Nuclear Plant Journal, p. 82, May-June 1993. For details, contact Roy N. Brown, ABB Combustion Engineering Nuclear Services, 120 Riverfront Parkway, Chattanooga, Tennessee 37402; telephone (615) 752-2304, Fax: (615) 752-2249

Performance Monitoring Tool

THERMAC, a personal-computer-based performance monitoring tool offered by S. Levy, Inc. (SLI), performs accurate analyses of all components of a nuclear power plant, which include building a plant model, reading plant measurements, conducting components performance and predictive cycle calculations, preparing reports, and trending results and measured data.

For more, Nuclear Plant Journal, May-June 1993, p. 34.

[EDITORS' NOTE: Certain devices that appear to be particularly useful are sometimes mentioned for reader's information in ALARA Notes. However, this does not imply an endorsement of these products.]

UK Goes for 20 mSv Limit

New radiation protection standards drawn up by Britain's National Radiological Protection Board (NRPB) recommend a straight annual dose limit for workers of 20 mSv - without exceptions and without averaging and an investigation level of 15mSv per year (to ensure that long term risks are tolerable to those most highly exposed). The new standards constitute the NRPB's formal response to the 1990 recommendations of the International Commission on radiological Protection, which in turn were prompted by reappraisals of the Hiroshima and Nagasaki atomic bomb data suggesting that the risks from radiation were two to three times greater than previously thought. The NRPB endorses the overall framework of ICRP's 1990 recommendations (e.g. in emphasizing optimization, which is the process of keeping doses as low as reasonably achievable beneath the dose limit) but, in

adopting a simple annual figure, is proposing a somewhat more stringent occupational dose limit. The dose limit in the ICRP's 1990 recommendations is 100 mSv over 5 years and not more than 50 mSv in any one year. The NRPB, however, "sees no need, for the UK, to permit up to 50 mSv or averaging over five years," says Geoffrey Webb, Secretary of the Board. He also points to the practical difficulties in enforcing a dose limit averaged over several years. As yet, the NRPB's new proposed standards have the status of recommendations rather than rules, but will clearly have a major impact on the re-drafting of the UK's Ionizing Radiation Regulations (IRR), which will be revised after a new Directive of the European Communities on basic radiation standards has been agreed. It is thought that the new IRR might come into force in 1997, to replace the current Regulations, which were issued in 1985. The 1985 Regulations stipulate a dose limit of 50 mSv per year. In fact only a handful of UK radiation workers currently exceed the 20 mSv level. Five years ago the picture would have been very different, with more than 1000 above the proposed limit. This is largely because the UK industry has acted upon guidelines issued by NRPB in 1987, which anticipated the likely effect that revised radiation risk estimates would have on dose limits. For the public, the NRPB recommends an overall limit of 1mSv per year, again with no averaging over 5 years, "together with a constraint for a single new source of 0.3 mSv in a year. This will be used prospectively, e.g., at the design stage of facilities."

Taken from, "UK Goes for 20 mSv Limit," Nuclear Engineering International, June 1993, p. 10.

U.S. Nuclear Power Plant Performance Improves Again in 1992

The U.S. Nuclear Power industry turned in another good performance in 1992, according to data collected by the industry's Institute of Nuclear Power Operations (INPO). The INPO data measures the performance of commercial nuclear units in seven areas, and US nuclear units on average performed better in six of them.

In 1992 they:

- Had a higher "unit capability factor." Unit capability factor measures the percentage of maximum electricity generation a plant is capable of supplying, limited only by factors within the control of plant management.
- Had fewer unplanned automatic scrams.
- Had a lower "unplanned capability loss factor." This measure is the percentage of maximum energy generation that a plant is unable to supply because of unplanned energy losses such as shutdowns or load reductions.

- Improved thermal efficiency, as the number of British Thermal Units (BTU) required to produce a kWh of electricity dropped to 10,193 from 10,220 in 1991.
- Improved safety performance significantly, as the industrial safety accident rate dropped to 0.77 per 200,000 person-hours worked, from 0.97 the previous year.
- Reduced the volume of low-level solid radioactive waste. The U.S. industry performance, however, dipped slightly

ly in one category--collective radiation exposure, which increased in 1992. Collective radiation exposure for BWRs jumped to a median value of 368 person-rem per unit the year before. For PWRs, the increase was less but the trend was nevertheless up, the INPO data show.

Taken from "INPO Performance Improves Again in 1992," Nuclear Engineering International, June 1993, p. 12..

Collective exposures at U.S. nuclear power plants: INPO data

BWR Plants
Man-rem per unit

PWR Plants
Man-rem per unit

Dose Data From BWR Owner's Group RP/A Committee

<u>Year-to-date Doses in Man-rem for 1993 at U.S. BWRs</u>			
<u>Plant</u>	<u>Units</u>	<u>Site Dose</u>	<u>Avg/Unit</u>
Fermi	1	7	7
Millstone-1	1	8	8
Clinton	1	9	9
Big Rock Point	1	10	10
Susquehanna	2	22	11
Grand Gulf	1	12	12
River Bend	1	13	13
Hope Creek	1	18	18
Vermont Yankee	1	20	20
Duane Arnold	1	25	25
Peach Bottom	2	66	33
Fitzpatrick	1	35	35
Hatch	2	70	35
Pilgrim	1	36	36
Cooper	1	37	37
WNP-2	1	46	46
La Salle	2	98	49
Quad Cities	2	122	61
Limerick	2	153	77
Brunswick	2	200	100
Nine Mile Point	2	204	102
Perry	1	144	144
Browns Ferry*	3	359	180
Oyster Creek	1	310	310
Dresden	2	658	329
Monticello	1	412	412

* Brown's Ferry has 3 units, but only 2 are used for averaging. Average dose per unit: 91 person-rem.

<u>U.S. and Mexican Dose Data for 1992</u>			
<u>Plant</u>	<u>Units</u>	<u>Site Dose</u>	<u>Avg/Unit</u>
Cooper	1	73	73
Millstone-1	1	81	81
Monticello	1	114	114
Limerick	2	330	165
Hatch	2	549	275
Fermi	1	230	230
Peach Bottom	2	502	251
Big Rock Point	1	252	252
Browns Ferry*	3	516	258
Pilgrim	1	265	265
Nine Mile Point	2	616	308
Dresden	2	619	310
Brunswick	2	623	312
Vermont Yankee	1	356	356
Susquehanna	2	724	362
Clinton	1	404	404
Hope Creek	1	437	437
Grand Gulf	1	483	483
Duane Arnold	1	502	502
Laguna Verde (Mexico)	1	544	544
Perry	1	571	571
Quad Cities	2	1157	579
La Salle	2	1167	583
WNP-2	1	612	612
Oyster Creek	1	657	657
Fitzpatrick	1	674	674
River Bend	1	710	710

*Brown's Ferry has 3 units, but only 2 are used for averaging. Average dose per unit: 367 person-rem (excluding Laguna Verde).

This data was provided on March 17, 1993 by Gerry Kindred of the Perry Nuclear Power Plant of the Cleveland Electric Illuminating Company, courtesy of the BWR Owners Group RP/ALARA Committee. Gerry has provided us much useful information in the past, such as a chart showing the dollar worth of a person-rem used by each U.S. plant. This chart is available on our fax-on-demand system by using the phone on your fax machine to call (516) 282-7361 and requesting document 15.

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