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October 12, 1995
Fort St. Vrain
P-95077

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

ATTN: Mr. Michael F. Weber, Chief
Decommissioning and
Regulatory Issues Branch

Docket No. 50-267

SUBJECT: **Fort St. Vrain Final Survey Plan for Site Release, Proposed Revisions for Survey of Piping Systems and Suspect Affected Survey Units**

REFERENCE: PSCo Letter, Fisher to Weber, dated May 25, 1995 (P-95050); "Updated Fort St. Vrain Final Survey Plan for Site Release"

Dear Mr. Weber:

This letter requests NRC approval of three changes to the Fort St. Vrain (FSV) Final Survey Plan, previously provided by the referenced letter. These changes primarily involve piping systems and will resolve concerns identified by Public Service Company of Colorado (PSCo) and its decommissioning contractor, the Westinghouse Team (WT), during radiological characterization surveys and during preparation for final surveys of plant systems and areas. The proposed changes described in this letter fully reflect PSCo's commitment to aggressively decontaminate plant surfaces and reduce residual contamination as low as reasonably achievable (ALARA).

The three proposed changes are detailed in the Attachment to this letter and include the following:

1. Embedded Piping Treatment,
2. Determination of Contamination Levels for Piping System Interior Surfaces, and
3. Exposure Rate Measurement Frequency.

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To simplify your review, the changes and PSCo's justification are summarized as follows:

Proposed Change 1: Embedded Piping Treatment

PSCo proposes that small diameter piping which is embedded in concrete and presents no reasonable exposure pathway to the public be treated as follows:

- Perform aggressive decontamination on contaminated piping internal surfaces to reduce removable contamination to less than the site specific guideline value (SGLV), and to reduce total contamination to levels that have no impact on public health and safety;
- Fill pipes with grout where residual total contamination exceeds the SGLVs after aggressive decontamination; and
- Specifically identify and obtain NRC approval of any instance where residual total contamination cannot be reduced below 100,000 dpm/100 cm^2 using aggressive decontamination techniques.

Justification:

Embedded Piping Overview

As described in the Attachment, the FSV Reactor Building and PCRV contain approximately 30,000 feet of embedded piping in affected systems, most of which is small diameter (i.e., 3 inches and smaller, with 70% being 1 inch). There are approximately 1350 individual pipe sections. This includes affected systems such as drains and purge lines for the Equipment Storage Wells, Fuel Storage Wells, and Hot Service Facility, and tendon tubes and cooling tubes in the PCRV. Embedded piping runs are typically less than 70 feet long and include numerous bends and elbows. Piping that is not embedded in concrete and is contaminated to greater than the SGLVs is being removed and processed as radioactive waste as part of decommissioning. However, removal is not practical for most embedded piping configurations in the PCRV or Reactor Building.

For FSV, the SGLV acceptance criteria established in accordance with the approved Final Survey Plan is 4000 dpm/100 cm^2 for average total contamination, and a maximum of 12,000 dpm/100 cm^2 for individual measurements.

Decontamination Efforts

PSCo and the WT have been developing methods for decontaminating and surveying FSV embedded pipes for over a year, with generally good success. Aggressive grit blasting and abrasive balls have proven most successful for reducing levels of removable and fixed contamination. Removable contamination is typically reduced to less than the Minimum Detectable Activity (MDA), but for some piping total contamination cannot reasonably be reduced to the SGLVs.

Based on FSV experience to date, less than 5% of the survey measurements exceed the SGLVs; however, these elevated measurements are widely distributed. Approximately half of the embedded pipe sections with elbows have at least one measurement location remaining above the SGLVs for total contamination after aggressive decontamination. Where areas of elevated activity are located in short, straight runs of pipe, such as drain lines through concrete floors, they are being decontaminated or removed by core boring. Elevated areas are most often found at elbows or weld joints and are typically less than 20,000 dpm/100 cm^2, after a minimum of four passes of grit blasting or abrasive balls. To achieve the SGLVs, many more decontamination attempts would likely be required since the relative effectiveness of each successive pass is less than the initial passes.

PSCo does not consider that further decontamination efforts for embedded pipes beyond the aggressive methods described herein are reasonable. Further decontamination is not in the interest of ALARA since there is no reasonable exposure pathway to any individual from residual contamination in FSV embedded pipes. PSCo has no current plans to renovate or dismantle the Reactor Building or PCRV and is in the process of repowering the Fort St. Vrain facility with natural gas-fired combustion turbines and heat recovery boilers, which are expected to last at least 30 years. As detailed in the Attachment, PSCo has determined that the maximum individual dose contribution from residual contamination in embedded piping, during a hypothetical occupancy scenario or a hypothetical dismantlement scenario, is 2.4 mREM per year. We have also evaluated the costs associated with further decontamination or removal and disposal of the embedded piping. These additional costs range from $3,070,000 if six additional passes of grit blasting are sufficient to reduce contamination levels below the SGLV, to $33,900,000 if the PCRV and Reactor Building concrete would have to be removed and radioactive piping segregated and disposed of as radioactive waste. These additional costs are not warranted, especially since aggressive decontamination will reduce removable contamination to much less than the SGLVs and any remaining contamination is highly fixed.

Proposed Treatment of Embedded Pipe

Based on the evaluation provided in the Attachment and summarized above, PSCo proposes the following treatment for contaminated small bore embedded piping:

- Decontaminate to attempt to reduce contamination levels to less than the SGLVs and survey embedded piping using the same protocol and procedures used for surveying non-embedded piping. Decontamination will reduce removable contamination levels to much less than the SGLV.

  Decontamination will typically involve grit blasting, abrasive balls, hydro-laser, abrasive brushes, etc. Survey techniques will typically include use of small GM detectors, gas flow proportional detectors, or TLDs. TLDs were used during initial developmental efforts for the FSV project but their extensive use during final piping system surveys may be subject to project schedule limitations; TLDs generally require two to three months to determine contamination levels of pipe surfaces.

- Small diameter embedded piping that does not meet the SGLVs will be verified to have been aggressively decontaminated as described above, and will then be filled with grout.

  Aggressive decontamination reduces removable contamination to much less than the SGLV and reduces fixed contamination ALARA. Based on characterization efforts to date, PSCo/WT estimate that less than 5% of piping system measurements will exceed the SGLVs, and that the majority of these elevated measurements will be less than 20,000 dpm/100 cm^2. The maximum elevated measurement is expected to be less than 50,000 dpm/100 cm^2. Grouting pipes that exceed the SGLVs after aggressive decontamination minimizes future leaching or release of residual fixed contamination. Also, grouted pipes are not likely to be re-used or re-cycled in the future.

- If, after aggressive decontamination, any piping section individual measurement exceeds 100,000 dpm/100 cm^2, PSCo/WT will obtain NRC approval of the resolution on a case by case basis.

  Although PSCo/WT fully expect most elevated measurements to be less than 20,000 dpm/100 cm^2 as identified above, dose impacts were conservatively calculated for an average contamination level of 100,000 dpm/100 cm^2. These calculations showed that the maximum dose consequences from this postulated elevated level of residual contamination are 2.4 mREM per year, which is less

than the 10 mREM per year criteria provided by the NRC for FSV soil and water pathways, as identified in the FSV Decommissioning Plan, Section 4.2, and in the FSV Final Survey Plan.

PSCo considers that this treatment of affected embedded piping represents a reasonable approach to reducing residual contamination levels ALARA.

Proposed Change 2: Determination of Interior Piping System Surface Contamination Levels

Contamination levels of interior piping system surfaces cannot be determined using the same techniques or instruments used for walls and floors. For example, piping interior surfaces cannot be gridded. The instrumentation used for piping surveys requires specialized methods to position and move the detector in the pipe. In addition, the detectors used are typically small, delicate, and require relatively long count times. For all piping system interior surfaces, whether embedded or not, PSCo proposes that contamination levels be determined as follows:

- Demonstrate compliance with the average total activity SGLV, at the 95% confidence interval, by averaging all survey data collected from a piping system survey unit (a minimum of 30 measurements), as opposed to averaging the data over one square meter as specified in Section 5.2.1 of the Final Survey Plan; and

- Compare individual measurements (e.g., 3500 dpm/100 cm^2) to the elevated area guideline value (e.g., 12,000 dpm/100 cm^2), without demonstrating that the extent of the elevated area is limited to 100 cm^2 as specified in Section 5.2.1 of the Final Survey Plan.

Justification

Since no known technology existed, the WT has been developing special instrumentation to survey interior piping surfaces; however, the positioning of the measurement devices is not as easily controlled as for flat accessible surfaces. The instrumentation that would most likely be used includes a string of small GM detectors that are pulled through a pipe, with measurements taken at various locations. Measurement data for the detectors in use is corrected to a 100 cm^2 area (e.g., 10 cm^2 detector data is multiplied by 10).

Averaging all survey data collected from a piping system survey unit is reasonable since operating fluids in the systems would have generally distributed contamination within the

system and PSCo/WT will take biased measurements from those locations most likely to have elevated measurements. Also, PSCo/WT plans to take a large number of measurements for piping survey units suspected of containing elevated activity; in the six survey packages currently being designed for PCRV embedded piping, over 1000 measurements are planned. Averaging this large number of biased measurements should conservatively result in a high average measured value, for comparison to the average SGLV.

WT's special instrumentation is the best currently available but is not capable of demonstrating that the extent of an elevated measurement is limited to an area of 100 cm^2, as specified in the Final Survey Plan. PSCo considers that the survey protocol described above is a reasonable method for determining the radiological condition of interior piping surfaces, considering that significant resources have been expended developing survey instrumentation and considering that interior pipe surfaces are not an accessible exposure pathway, especially for those pipes filled with grout as discussed above. The WT is developing Technical Basis Documents for piping survey instrumentation, which will be provided for your information by November 15, 1995.

Proposed Change 3: Exposure Rate Measurement Frequency

PSCo proposes that the exposure rate measurement frequencies in affected survey units be revised from one measurement per 1 x 1 meter grid intersection to one measurement per four square meters, in accordance with the guidance in Draft NUREG/CR 5849. This revision applies to building surfaces and structures in suspect affected survey units.

Justification

Draft NUREG/CR 5849, Section 4.2.3, states that exposure rate measurements at one meter from floor and lower wall surfaces should be performed at a frequency of one systematic measurement per every four square meters. PSCo requests approval of this change to the FSV Final Survey Plan, consistent with Draft NUREG/CR 5849 guidance.

Conclusion

PSCo considers that the three changes to the FSV Final Survey Plan described above, and detailed further in the Attachment to this letter, represent an aggressive and reasonable method for demonstrating that the radiological condition of the FSV site will pose no threat to public health and safety, and that radiological contamination levels have been reduced as low as reasonably achievable (ALARA).

With regard to the embedded piping treatment, considerable time and effort has been spent developing ways to decontaminate and survey embedded piping. The WT has developed unique tooling and techniques to accomplish this task since currently available technology was not adequate for the size and configuration of FSV embedded piping, and for the low levels of contamination being measured. PSCo and the WT have implemented procedures and methodologies that represent a substantial effort to reduce residual contamination; it is only after these extensive efforts that we are requesting relief from the Final Survey Plan requirements.

In order to support final survey implementation activities, PSCo requests NRC approval of the above proposed changes to the Final Survey Plan by December 31, 1995. If you have any questions regarding this information, please contact Mr. M. H. Holmes at (303) 620-1701.

Sincerely,

Mary J. Fisher

Mary J. Fisher
Decommissioning Program Director

MJF/SWC

Attachment

cc: w/ attachment

Regional Administrator, Region IV

Mr. Robert M. Quillin, Director
Radiation Control Division
Colorado Department of Public Health and Environment

ATTACHMENT TO P-95077

FINAL SURVEY PLAN FOR SITE RELEASE
PROPOSED REVISIONS FOR SURVEY OF PIPING SYSTEMS AND SUSPECT AFFECTED SURVEY UNITS

This Attachment details three proposed changes to the FSV Final Survey Plan:

Proposed Change 1: Embedded Piping Treatment

The first section describes PSCo's proposed treatment methodology for decontaminating, surveying, and releasing for unrestricted use, piping which is embedded within the concrete of the Fort St. Vrain (FSV) Reactor Building or Prestressed Concrete Reactor Vessel (PCRV). The following is included:

1.1 Identification of systems, sizes, lengths and configurations of embedded piping at FSV;

1.2 Decontamination methods developed for embedded piping, including advantages and disadvantages of various alternatives, and typical performance of grit blasting and abrasive balls;

1.3 Survey techniques;

1.4 Hypothetical doses resulting from leaving embedded piping in place;

1.5 Costs involved in additional decontamination and concrete removal; and

1.6 PSCo's proposed treatment of embedded piping.

Proposed Change 2: Determination of Interior Piping System Surface Contamination Levels

The second section describes PSCo's proposed protocol for determining contamination levels of the interior surfaces of piping systems.

Proposed Change 3: Exposure Rate Measurement Frequency

The third section describes a proposed change to the exposure rate measurement frequency requirements.

Proposed Change 1: FSV Embedded Piping

1.1 Piping System Description

Fort St. Vrain includes approximately 185,000 feet of affected piping, as follows:

80,000 feet has been removed for disposal or processing,
75,000 feet is non-embedded piping which is expected to have contamination levels less than the site specific guideline values (SGLV), and will be left in place with no significant decontamination required, and
30,000 feet is embedded in concrete.

Of the approximately 30,000 feet of embedded piping,

26,000 feet are embedded in the PCRV, and
4000 feet are embedded in Reactor Building concrete structures outside the PCRV.

The embedded piping includes about 1350 individual pipe sections. Approximately 22,000 feet of affected embedded piping is one inch diameter piping with elbows.

Reactor Building Systems

The FSV Reactor Building includes various piping systems with embedded pipes that may be contaminated and are therefore considered affected systems. Affected systems include systems such as liquid and gaseous waste (Systems 62 and 63, respectively), building drains (72), helium purge, vents and drains to the Equipment Storage Wells and Fuel Storage Wells (13 and 14, respectively), PCRV cooling (46), decontamination (61), ventilation (73), and PCRV concrete (11).

These systems include approximately 4000 feet of one inch to three inch diameter embedded piping outside the PCRV, consisting of approximately 250 individual sections, as follows:

200 straight pipe sections (approximately 700 feet),
50 pipe sections with bends and elbows (approximately 3300 feet).

Of the individual pipe sections, over 90% of the straight sections decontaminated and surveyed to date have met the SGLV and it is likely that most of the remaining straight pipes can successfully be decontaminated. Of the sections with elbows, almost half of the pipes decontaminated and surveyed to date have met the SGLV; however, the

remaining pipes include elevated areas of tightly adherent contamination, often near elbows and welds, that have typically not been completely removed by aggressive decontamination efforts such as grit blasting or abrasive balls.

PCRV Piping

Piping embedded in the Prestressed Concrete Reactor Vessel (PCRV) includes cooling tubes (one inch), tendon tubes (four inches in diameter), and penetrations (one to twelve inches in diameter). All of these lines will likely be considered affected, although most of this piping is not expected to be significantly contaminated. A complete characterization of PCRV piping is not possible at this time due to ongoing decommissioning activities and elevated background levels. Piping with the greatest potential for contamination includes piping exposed to primary coolant during plant operations. This includes several PCRV cooling tubes that are known to have developed leaks during plant operations. Piping less likely to be contaminated includes pipes that have been cut as part of decommissioning and may have been exposed to cutting slurry and/or shield water. PSCo expects that all of the larger diameter piping, i.e., greater than three inch, will be successfully decontaminated to less than the SGLVs.

PSCo estimates that the total affected embedded piping and tendon tubes in the PCRV includes a total of approximately 26,000 feet, consisting of approximately 1100 pipe sections. Of these 1100 sections, approximately 1000 sections will have been cut and exposed to cutting slurry or were exposed to primary coolant and most likely will require decontamination. These lines average over 20 feet in length, and most are expected to have one or more elbows.

1.2 Decontamination Alternatives

Grit blasting and abrasive balls have been the primary methods of decontaminating piping systems at FSV to date. Other methods considered include wire brushing, chemical cleaning, and high pressure water cleaning. Chemical cleaning was discounted because of the potential for creating mixed waste, the difficulty handling spills, and its questionable ability to achieve SGLVs. High pressure water has not been used to any great extent because of the potential for spills and difficulty with insertion into small one inch lines with elbows.

Grit blasting actually removes some of the interior pipe metal surfaces and is most effective for removable activity and for much of the fixed contamination. Special tooling has been developed to grit blast small, one inch piping; even with this tooling, it is difficult to grit blast small pipes with numerous bends and elbows. Abrasive balls were

investigated for small piping where the WT was not sure that grit blasting equipment could be developed. Abrasive balls are small foam spheres coated with abrasive particles that are compressed into the piping and forced through with pressurized air; they are typically used for cleaning condenser tubes and have been successful with several FSV pipes.

PSCo's experience with grit blasting shows that most contamination is removed after the first pass. As an example, the following contamination reductions were achieved during a test grit blasting of a core support floor column tube that was initially contaminated to an average level of 23,000 dpm/100 cm^2:

Initial	23,000 dpm/100 cm^2
1st Pass	5,900
2nd Pass	4,100
3rd Pass	3,200

After three passes, the column tube met the SGLV of 4,000 dpm/100 cm^2.

On a test of abrasive balls in three core support floor column tubes, one pass of 120 abrasive balls reduced the average contamination level from 19,500 dpm/100 cm^2 to 16,500 dpm/100 cm^2, which is a 15% reduction.

The attached figures show typical configurations and contamination profiles in Equipment Storage Well (ESW) piping after decontamination. During plant operations, these pipes were used to purge, vent, and drain ESWs. Only limited survey data is available prior to decontamination, but the maximum contamination level observed was 233,000 dpm/100 cm^2. Post decontamination surveys were performed for this piping using both TLDs and small GM detectors, although only TLD data is shown in the figures; the results in the figures represent higher than normal survey densities that were performed to evaluate decon methods and survey techniques. The following examples are provided:

ESW-1 This 2" line was decontaminated with 4 passes of grit blasting, starting at the open drain line and ending in the ESW. The average measurement was 300 dpm/100 cm^2 and no individual measurement exceeded the elevated area SGLV.

ESW-9 This 2" line was also decontaminated with 4 passes of grit blasting in the same manner as the ESW-1 pipe. The average measurement was 900 dpm/100 cm^2 and no individual measurement exceeded the elevated area SGLV of 12,000 dpm/100 cm^2. A sketch showing the configuration of this pipe is included.

ESW-5 This 1" line was decontaminated with 4 passes of abrasive balls. This example shows the highest post-decontamination measurements in ESW and Fuel Storage Well (FSW) piping. Both the average measurement of 8200 dpm/100 cm^2 and the most elevated measurement of 44,000 dpm/100 cm^2 exceeded the SGLVs. The abrasive balls were injected into the open vent line and were recovered at the ESW, where the highest contamination levels were measured. A sketch showing the configuration of this pipe is also included.

Most survey results after decontamination are below the average SGLV of 4000 dpm/100 cm^2, and the highest individual measurement after four passes of abrasive balls is 44,000 dpm/100 cm^2. All of this piping is considered representative of piping in the Reactor Building concrete. Also, based on decontamination and survey efforts that have just begun in the PCRV, contamination levels in the PCRV piping are expected to be less than those encountered in the Reactor Building concrete. Based on the above survey data, PSCo/WT consider that less than 5% of embedded piping measurements will exceed the SGLVs after aggressive decontamination, and the maximum elevated measurement is expected to be 50,000 dpm/100 cm^2.

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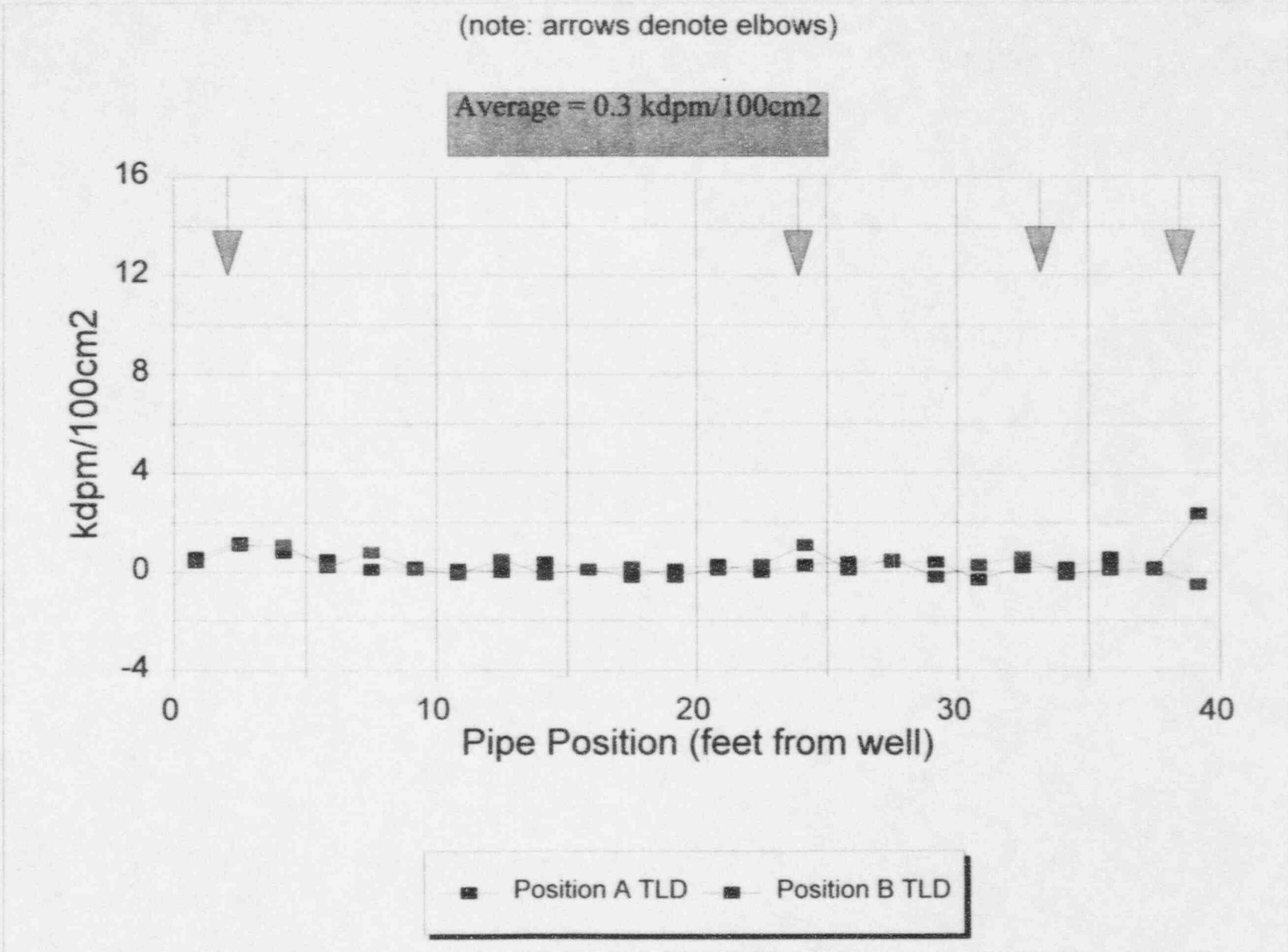
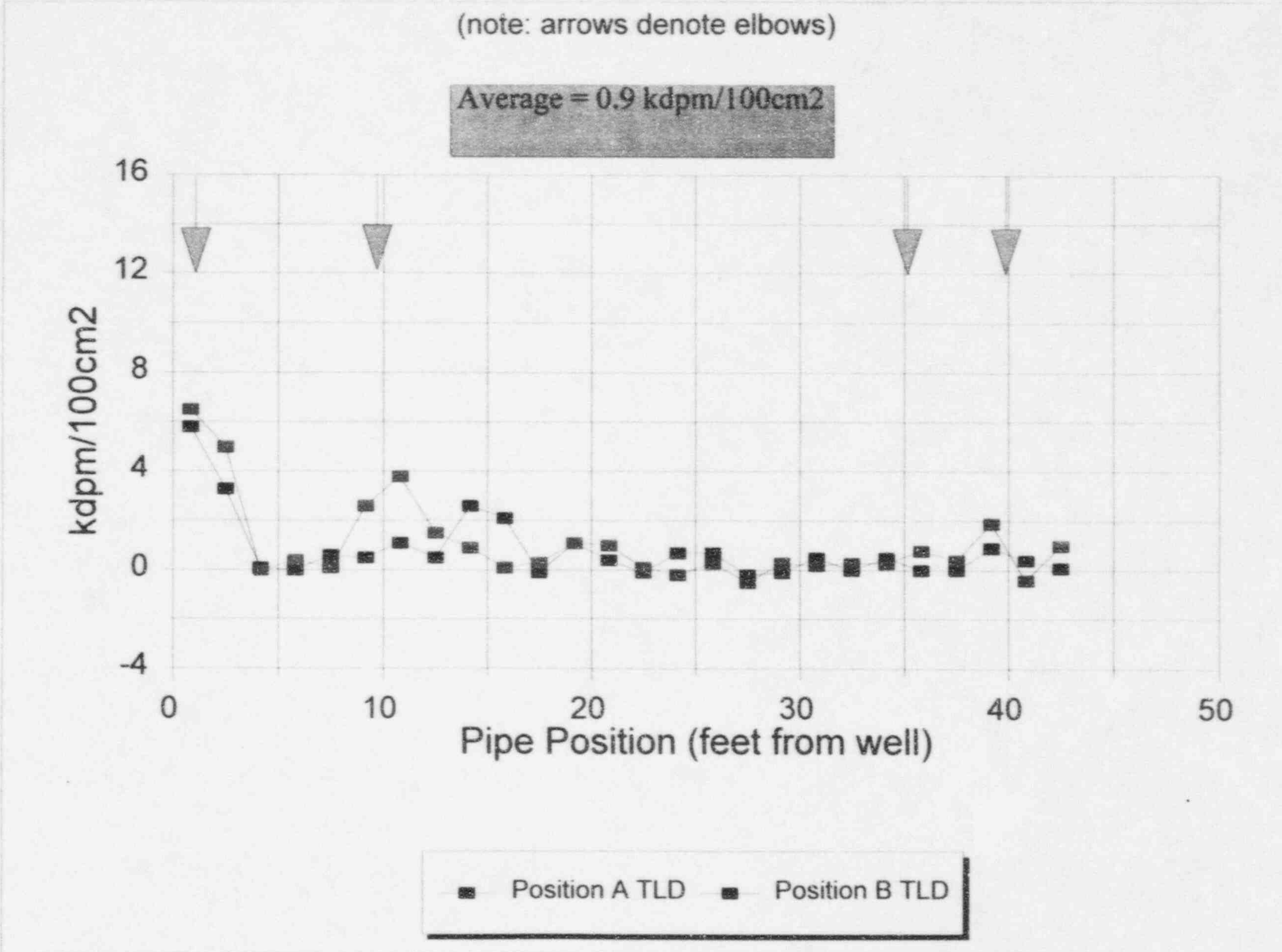
TLD SURVEY RESULTS FOR ESW-1 2" PIPE
POST DECON - 4 GRIT BLASTS



TLD SURVEY RESULTS FOR ESW-9 2" PIPE POST DECON - 4 GRIT BLASTS



TYPICAL EMBEDDED PIPE CONFIGURATION FOR ESW 2" DRAIN LINES

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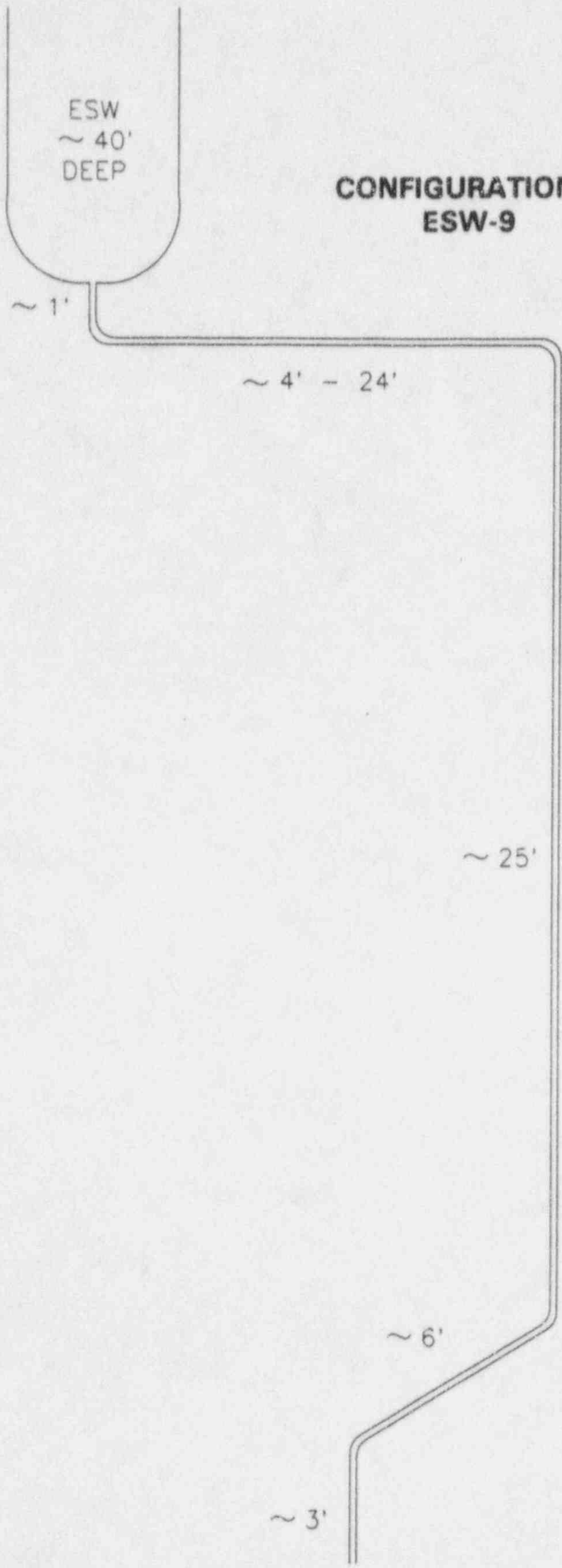
CONFIGURATION FOR ESW-9



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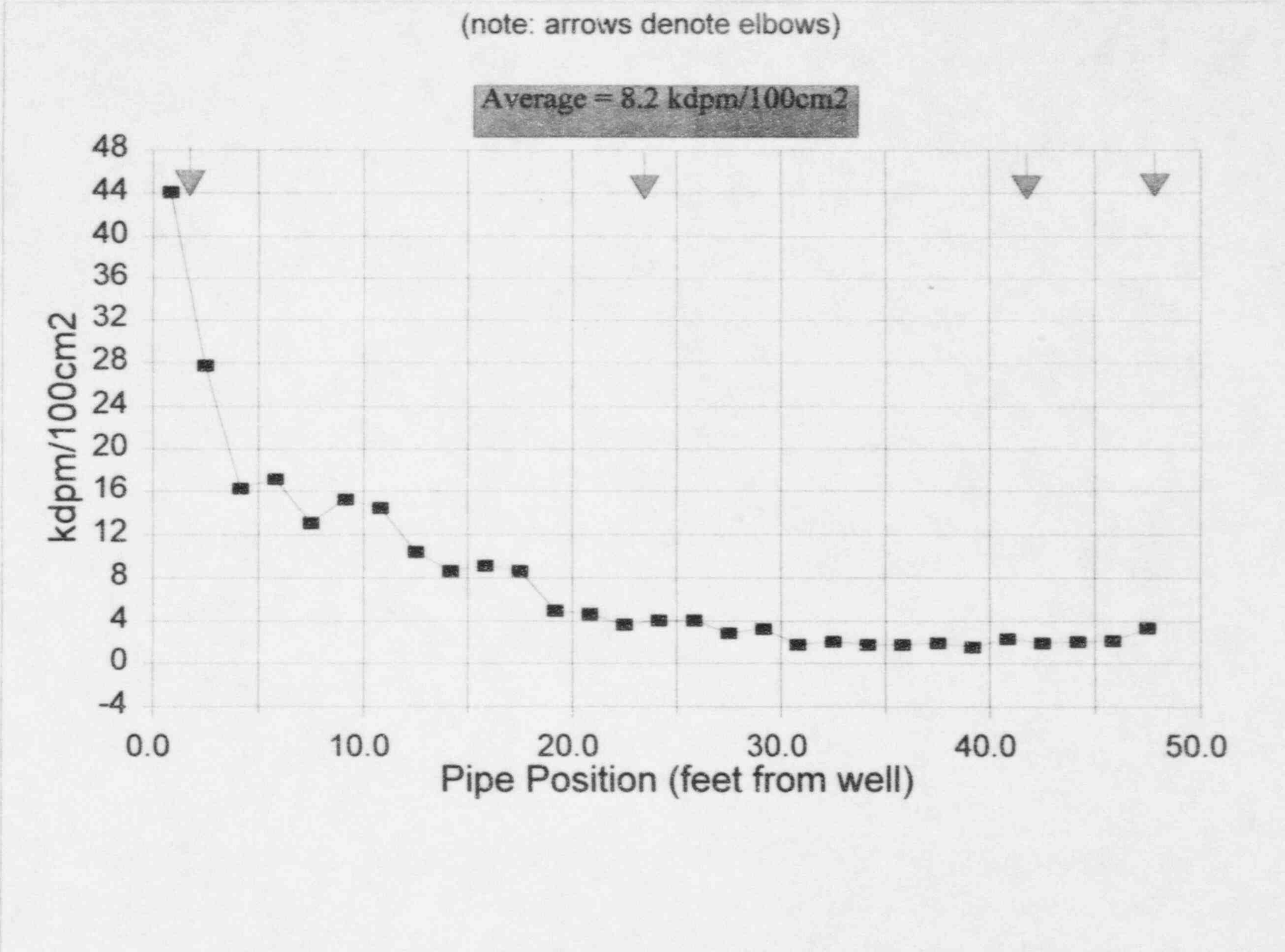
TLD SURVEY RESULTS FOR ESW-5 1" PIPE POST DECON - 4 BALL BLASTS



FORT ST. VRAIN DECOMMISSIONING FINAL SURVEY MAP

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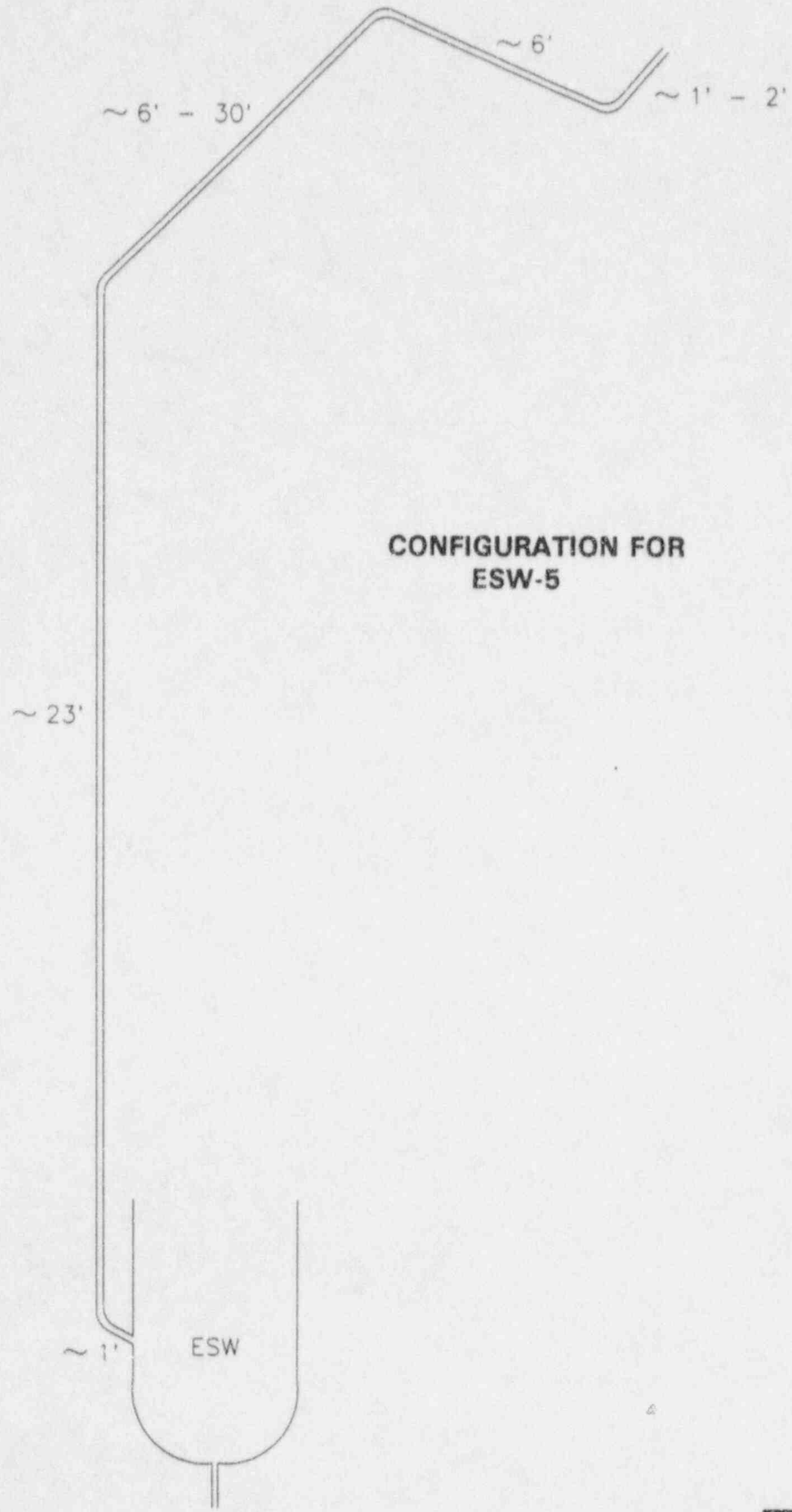
TYPICAL EMBEDDED PIPE CONFIGURATION FOR ESW 1" VENT LINES



CONFIGURATION FOR
ESW-5

FILE: MISC\ESW_1 (CH)

1.3 Survey Techniques

Surveying interior surfaces of all piping, whether embedded or not, presents a challenge. Small diameter piping and piping with bends require special detectors, and the WT/SEG has done considerable research and development in this area.

The WT is developing specialized instrumentation such as small GM detectors in segmented carrier assemblies that can be drawn through pipes by a cable, and small gas flow proportional probes that can be inserted into the accessible ends of piping. These detectors provide reliable fixed measurements but have limited sensitivity when used to scan. In addition, TLDs have been inserted into various locations in piping runs for fixed measurements, although TLDs require two to three months to obtain measurement results. For the final survey, all three detection systems will likely be used. Although still in the developmental stage, the small GM systems are expected to provide reliable, timely results; currently the small GM systems are delicate and easily damaged, and are time consuming to setup and use. TLDs are much less labor-intensive than GM detectors or gas flow proportional probes, and may be used where the schedule allows two to three months to obtain results.

In accordance with Section 4.3.3 of the Final Survey Plan, PSCo/WT plans to take a minimum of 30 biased measurements per piping system survey unit, and to perform a scan survey of 25% of the accessible surface at each measurement location. In excess of Final Survey Plan requirements, the current survey design effort has developed six survey packages for embedded piping in the PCRV, with over 1000 measurements planned. This effort is planned to ensure that piping surface contamination levels are reduced ALARA.

The WT is preparing Technical Basis Documents for instrumentation used to survey interior piping surfaces. These documents will describe the equipment, detector sizes, efficiencies, sensitivities, and other performance characteristics, and will be provided for information to the NRC by November 15, 1995.

1.4 Resultant Doses

PSCo has no plans to use the Reactor Building or PCRV in the future. The FSV facility is being repowered with natural gas-fired combustion turbines and heat recovery boilers, which are expected to last at least 30 years. It is possible to postulate an occupancy scenario wherein an office or shop could be built in the Reactor Building in a near-term timeframe; however, it is not likely that dismantlement would take place for at least 30 years in the future.

Although PSCo has no plans to take any action with the FSV Reactor Building and PCRV, our current task is to decontaminate the facility and release the site for unrestricted use. Therefore, dose calculations were performed to determine the dose resulting from two hypothetical scenarios of future use of the Reactor Building and PCRV. These dose contributions are based on the assumption that contamination levels in embedded piping are 100,000 dpm/100 cm^2, which is conservative and significantly above the 50,000 dpm/100 cm^2 maximum expected measurement identified above, based on WT's experience with decontamination of Equipment Storage Well and Fuel Storage Well piping.

As described later in this Attachment, PSCo proposes to fill all piping with residual fixed contamination above the SGLVs with grout. Thus, any contamination released during future occupancy or dismantlement scenarios would be extremely minor, even if the grout-filled piping were cut in half. Also, grouted piping is not expected to release significant amounts of contamination to groundwater during hypothetical future burial scenarios. Therefore, the occupancy or dismantlement scenarios evaluated here do not include dose contributions from inhalation or ingestion pathways and PSCo does not consider that internal exposures would be credible.

1. The occupancy scenario evaluates the situation where a shop or office would be established immediately adjacent to a concrete surface which includes five embedded pipes that terminate directly at the surface. This is reasonable for any plant area where a shop or office could be located. This evaluation includes the following assumptions:

    - An individual is located in this area for 2080 hours per year.
    - The distance from the exposed ends of the pipes is 1 meter.
    - Average contamination level in the pipes is 100,000 dpm/100 cm^2.
    - No credit is taken for the shielding effect of grout.
    - The predominant radionuclides are cobalt-60 and cesium-137, consistent with FSV decommissioning experience.

    Based on these assumptions and using Microshield to determine dose rates, the individual dose was determined to be 2.0 mREM per year.

2. The dismantlement scenario evaluates the dose that an individual would receive from debris removed from the Reactor Building and PCRV. Although PSCo has no plans for dismantlement, hypothetical dismantlement scenarios vary from toppling the PCRV and burying it onsite with its shielding nearly intact, to cutting the building and PCRV into sections and removing them to a landfill. Explosive techniques would not likely be used in the near term because of the proximity to the repowered turbine and support equipment that is expected to be used for at least 30 years. Therefore, the most likely dismantlement methods for at least the

next 30 year timeframe would leave some amount of high density concrete around the embedded piping, which would provide shielding.

The dismantlement scenario assumes that embedded pipes are buried in a location where an individual could gain access and build a house. Workers involved in the dismantlement process would receive only a short term exposure and their exposure is considered bounded by the residence scenario. This evaluation includes the following assumptions:

- The combined shielding effects of the concrete around the pipes and the fill dirt covering the pipes are assumed to reduce exposure rates by a factor of ten. This reduction occurs with approximately 2 to 3 feet of fill dirt or sand, and is a reasonable assumption considering that dismantlement debris including embedded pipes would most likely be randomly deposited in a burial location, and would have to be covered by at least 3 feet of fill dirt to make a suitable construction site. Excavation for a building foundation would be of short duration and the dirt removed would most likely be replaced with concrete (with greater shielding value) and additional dirt.
- Seven pipes of various sizes are assumed to be piled together approximately 1 meter from the individual.
- Average contamination level in the pipes is 100,000 dpm/100 cm^2.
- The resident of the house spends 50% of the time, on an annual basis, 1 meter from the pipes.
- The predominant radionuclides are cobalt-60 and cesium-137, consistent with FSV decommissioning experience.
- No credit is taken for the shielding effect of grout.

Based on these assumptions and using Microshield to determine dose rates along the side of the buried pipes, the individual dose was determined to be 2.4 mREM per year.

It is noted that an additional conservatism in this calculation is that it does not take into account the decay that would occur before dismantlement activities would take place, the disposal location would be prepared and opened for residential construction, and a house could be built; in this unlikely event, this process could easily involve at least 5 years, during which time the radioactive decay of cobalt-60, the predominant contributor to dose, would reduce its contribution by approximately one-half; furthermore, this process would most likely not occur for at least 30 years, as previously identified, by which time total exposure rates would have significantly decreased.

These calculations are conservatively based on residual contamination levels of 100,000 dpm/100 cm^2. Based on FSV experience to date, PSCo/WT expect that after aggressive decontamination, less than 5% of all piping system measurements will exceed the SGLVs, that most of the elevated measurements will not exceed 20,000 dpm/100 cm^2, and that the maximum elevated measurement will be less than 50,000 dpm/100 cm^2.

The greater of these two scenarios results in an individual dose of 2.4 mREM per year, which is considerably less than the 10 mREM annual dose identified in Section 4.2 of the FSV Decommissioning Plan acceptance criteria for public dose contributions from soil and water pathways.

1.5 Costs of Additional Decontamination

If all embedded piping is required to meet the current SGLVs, it will require additional decontamination beyond the aggressive decontamination described above, or removal. There are various possible approaches to meeting the SGLVs and the costs vary widely. PSCo/WT have attempted to bound the range of costs, depending on the success of various decontamination approaches. In the least cost scenario, additional decontamination using an average of six additional grit blast passes is assumed to be sufficient to reduce contamination in all elevated areas to less than the SGLVs. In the most expensive case, decontamination efforts would prove so difficult that it becomes necessary to remove the piping and its surrounding concrete, segregate the piping from the concrete, and dispose of the piping as radioactive waste.

The costs associated with this wide range of approaches are estimated as follows:

Further Decontamination

It is assumed that further decontamination to achieve the SGLVs would require six additional passes of aggressive grit blasting, beyond the initial four passes. This is based on decontamination experience with piping connected to the Equipment Storage Wells (ESW) and Fuel Storage Wells (FSW), where fixed contamination above the SGLVs remained after eight grit blast passes in at least one case. Some lines may require more than six additional passes, but this is assumed to be a representative average for estimating purposes.

Reactor Building Piping

A typical embedded piping system outside the PCRV is the piping associated with the ESWs and FSWs. Most of the individual pipe sections likely to require additional decontamination include bends and elbows and are approximately 70 feet long. The cost of six additional passes of aggressive grit blasting on a single 70' pipe section with

elbows is estimated to be $10,000. The cost of six additional passes of aggressive grit blasting on a single 10' straight pipe section is estimated to be $3000.

As indicated above, less than 5% of the survey measurements are expected to exceed the SGLVs; however, these elevated measurements are widely distributed. Using the ESW and FSW piping system experience discussed in "Piping System Description," Section 1.1 above, it is assumed that 10% of the 200 straight sections and half of the 50 pipe sections with elbows require additional decontamination. This is a total of about 45 individual pipe sections. For the embedded piping outside the PCRV, additional decontamination is estimated to cost $310,000.

PCRV Piping

Piping embedded in the PCRV ranges from a straight pipe section passing straight through the 9 foot thick, high density concrete wall, to circuitously routed piping to the core support floor column cooling tubes that could extend over 80 feet. For estimating purposes, a 20 foot pipe section with bends and elbows is considered. The cost of six additional passes of aggressive grit blasting on a single 20 foot pipe section with bends and elbows is estimated to be $6,500. Assuming that approximately 85% of the 1000 most likely contaminated piping sections has elbows and that half of that requires further decontamination, the cost of these activities for embedded PCRV piping is estimated to be $2,760,000.

Total costs of additional decontamination for piping in the Reactor Building and PCRV are estimated to be $3,070,000, not including costs for any associated schedule delay. It must be emphasized that even this additional decontamination may not be sufficient to reduce contamination levels to less than the SGLVs.

Concrete Removal

If decontamination efforts are not successful in reducing contamination levels below the SGLV, the piping would likely have to be removed. In the worst case the piping would not be accessible for core boring, and removal would involve removal of much of the surrounding concrete also. This is assumed to involve rubblizing the concrete, segregating the radioactive waste from the non-radioactive waste, and disposing of the radioactive waste.

For piping embedded in Reactor Building concrete, removal is estimated to include concrete around the drain piping associated with the Hot Service Facility, Equipment Storage Wells, Fuel Storage Wells, and all drains on Level 1. This effort is estimated to cost at least $14,500,000, including a 99 day schedule delay.

For piping embedded within the PCRV, if decontamination efforts were not effective and removal were the only option, the entire PCRV would have to be dismantled and disposed of as radioactive waste. This process, including a 198 day schedule delay, is estimated to cost at least $27,300,000.

Total costs to remove all embedded piping in the Reactor Building and PCRV, assuming both Reactor Building and PCRV concrete removal projects could be completed within the 198 day schedule delay, are estimated at $33,900,000.

1.6 Proposed Treatment of Embedded Piping

PSCo proposes the following treatment for small diameter (i.e., three inches and smaller) contaminated embedded piping:

- Decontaminate to attempt to reduce contamination levels to less than the SGLVs and survey embedded piping using the same protocol and procedures used for surveying non-embedded piping. Decontamination will reduce removable contamination levels to much less than the SGLV.

- Small diameter embedded piping that does not meet the SGLVs will be verified to have been aggressively decontaminated, and will then be filled with grout.

- If, after aggressive decontamination, any piping section individual measurement exceeds 100,000 dpm/100 cm^2, PSCo/WT will obtain NRC approval of the resolution on a case by case basis.

In conclusion, PSCo considers that this treatment of affected embedded piping represents a reasonable approach to reducing residual contamination levels ALARA. Aggressive efforts will be made to reduce contamination on interior piping system surfaces. Piping will be surveyed as described in the Final Survey Plan. Where aggressive decontamination efforts are not sufficient to achieve the SGLVs, the embedded pipe will be filled with grout to minimize hypothetical future accessibility to the public. The dose consequences from residual contamination in excess of the SGLVs, including postulated elevated areas of 100,000 dpm/100 cm^2, have been determined to be less than the 10 mREM per year criteria provided by the NRC for the soil and water pathways, as identified in the FSV Decommissioning Plan.

Proposed Change 2: Determination of Interior Piping System Surface Contamination Levels

Piping system interior surfaces cannot be gridded like walls and floors, and the extent of contamination cannot be determined as accurately as for walls and floors. The Final Survey Plan requirements for demonstrating compliance with the release limits were developed for more readily accessible surfaces. Section 5.2.1 and Table 3.1 of the Final Survey Plan require that average total surface activity measurements not exceed the SGLV *when averaged over an area not to exceed 1 square meter*, and that elevated areas be confined to a surface area *not to exceed 100 cm²*. These requirements cannot reasonably be met for the inaccessible interior surfaces of piping systems.

For all piping system interior surfaces, whether embedded or not, PSCo proposes that contamination levels be determined as follows:

- Demonstrate compliance with the average SGLV, at the 95% confidence interval, by averaging survey data collected from all interior surfaces of a piping system survey unit (a minimum of 30 measurements), as opposed to averaging the data over one square meter as specified in Section 5.2.1 and Table 3.1 of the Final Survey Plan, and

- Compare individual measurements (e.g., 3500 dpm/100 cm^2) to the elevated area guideline value (e.g., 12,000 dpm/100 cm^2), without demonstrating that the extent of the elevated area is limited to 100 cm^2 as specified in Section 5.2.1 and Table 3.1 of the Final Survey Plan.

Justification

Since no known technology existed, the WT has been developing special instrumentation to survey piping interior surfaces; however, the positioning of the measurement devices is not as easily controlled as for flat accessible surfaces. The instrumentation that would most likely be used includes a string of small GM detectors that are pulled through a pipe, with measurements taken at various locations. Measurement data for the detectors in use is corrected to a 100 cm^2 area (e.g., 10 cm^2 detector data is multiplied by 10). WT's special instrumentation is the best currently available but cannot readily demonstrate that the extent of an elevated measurement is limited to an area of 100 cm^2, as specified in the Final Survey Plan.

Averaging all survey data collected from a piping system survey unit provides a reasonable indication of its radiological condition. Section 4.3.3 of the Final Survey Plan requires at least 30 biased measurements from each piping system survey unit, and PSCo/WT's plans are much more aggressive. Embedded pipe survey packages are in

the preliminary design stage, and current plans include six embedded pipe survey packages for the PCRV, with over 1000 measurements. Pipe systems contained fluids during their operation which would have distributed contamination; measuring biased locations examines those areas most likely to have elevated measurements, such as low points, elbows and welds. Averaging these biased, most likely elevated measurements is therefore a conservative indication of the radiological condition of the piping system survey unit.

Evaluating individual measurements against the elevated SGLV, without determining the extent of the elevated area is reasonable considering that these are biased measurements. Since the entire piping interior surface is not an accessible pathway to the public, the extent of an elevated area is not as significant as it is for walls, floors, and other exposed building surfaces. Also, since all individual biased measurements are averaged and compared to the SGLV for average total contamination, as discussed above, the number of elevated areas will of necessity be limited if the SGLV for average total contamination is to be met.

PSCo considers that the survey protocol described above, using survey instrumentation developed especially for this project, is a reasonable method for determining the radiological condition of interior piping surfaces, considering current technology and considering that these surfaces are not an accessible exposure pathway, especially for those pipes filled with grout as discussed above. The WT is developing Technical Basis Documents for piping survey instrumentation, which will be provided for your information by November 15, 1995.

Proposed Change 3: Exposure Rate Measurement Frequency

FSV Final Survey Plan Section 4.3.2 states that suspect affected survey units will be divided into 1 x 1 meter grids and Section 4.3.3 requires measurements in these survey units to be taken at each grid intersection.

PSCo proposes that the exposure rate measurement frequencies in affected areas be revised from one measurement per 1 x 1 meter grid intersection to one measurement per four square meters, in accordance with the guidance in Draft NUREG/CR 5849. This revision applies to building surfaces and structures in suspect affected survey units.

Justification

Draft NUREG/CR 5849, Section 4.2.3, states that exposure rate measurements at one meter from floor and lower wall surfaces should be performed at a frequency of one systematic measurement per every four square meters. The proposed change to the FSV Final Survey Plan is consistent with Draft NUREG/CR 5849 guidance.

Conclusion

PSCo considers that the changes to the FSV Final Survey Plan described above represent an aggressive and reasonable method for demonstrating that the radiological condition of the FSV site will pose no threat to public health and safety and that radiological contamination levels have been reduced as low as reasonably achievable (ALARA).

With regard to the embedded piping treatment, considerable time and effort have been spent developing ways to decontaminate and survey embedded piping. The WT has developed unique tooling and techniques to accomplish this task since currently available technology was not adequate for the size and configuration of FSV embedded piping, and for the low levels of contamination being measured. PSCo and the WT have implemented procedures and methodologies that represent a substantial effort to reduce residual contamination; it is only after these extensive efforts that we are requesting relief from the Final Survey Plan requirements.