CONSUMERS POWER COMPANY

PALISADES PLANT

STEAM GENERATOR REPAIR REPORT

Docket 50-255
License DPR-20

At the request of the Commission and pursuant to the Atomic Energy Act of 1954 and the Energy Reorganization Act of 1974, as amended, and the Commission's Rules and Regulations thereunder, Consumers Power Company submits the "Palisades Plant Steam Generator Repair Report," Revision 3, July 1979, which describes the potential repair program based on complete replacement of the existing steam generators if major repairs become necessary.

CONSUMERS POWER COMPANY

By R C Youngdahl (Signed)
R C Youngdahl, Executive Vice President

Sworn and subscribed to before me this 3rd day of August 1979.

Dorothy H Bartkus (Signed)
Dorothy H Bartkus, Notary Public
Jackson County, Michigan
My commission expires March 26, 1983.

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| REMOVE | | INSERT | |
|---|---|---|---|
| vi | Rev 2 | vi | Rev 3 |
| vii | Rev 2 | vii | Rev 3 |
| viii | Rev 1 | viii | Rev 3 |
| x | Rev 2 | x | Rev 3 |
| Figure 3-3-2 | Rev 0 | Figure 3-3-2 | Rev 3 |
| Table 4-3-2 (Sheet 1 to 2) | Rev 0 | Table 4-3-2 (Sheet 1 to 2) | Rev 3 |
| | | Appendix C C-1-1 | Rev 3 |
| | | Table C-1-1 (Sheet 1 to 12) | |
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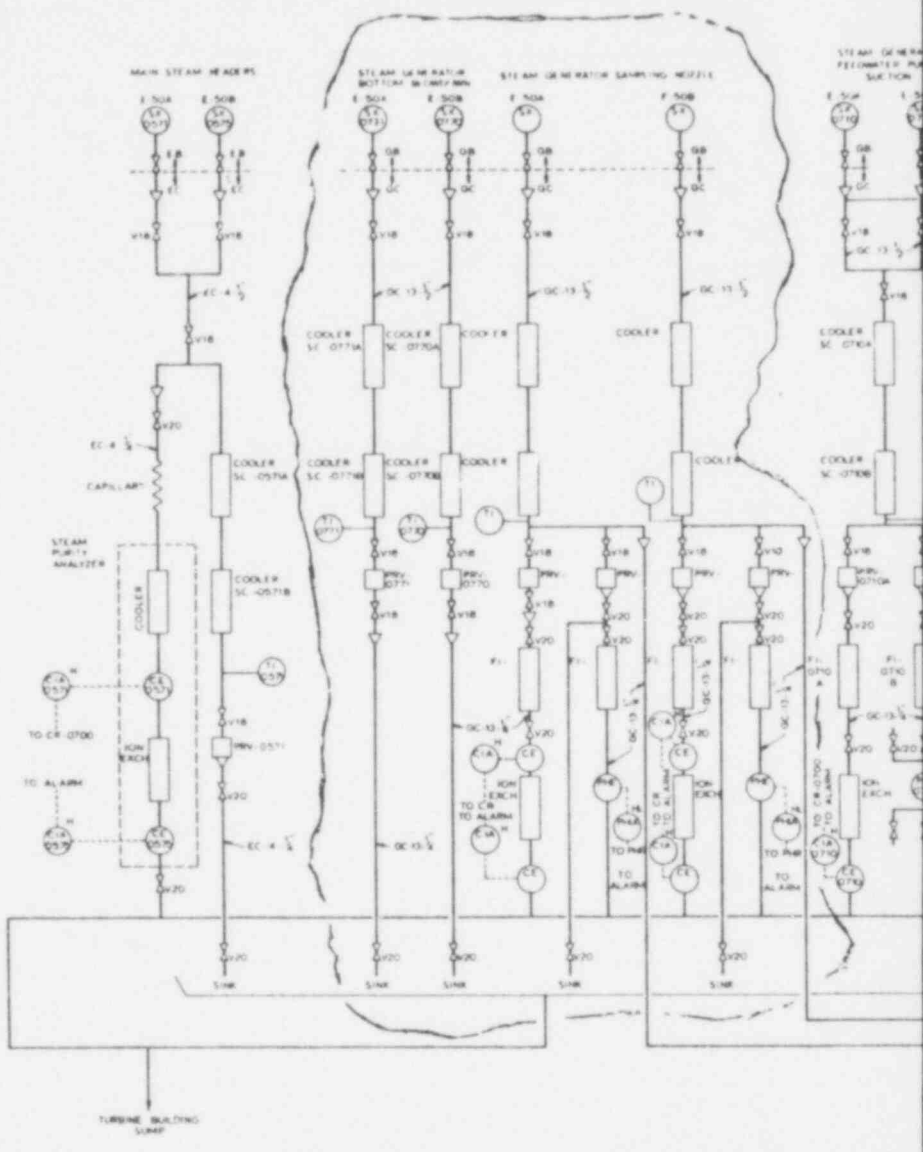
MAIN STEAM HEADERS
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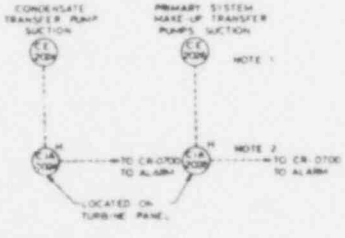
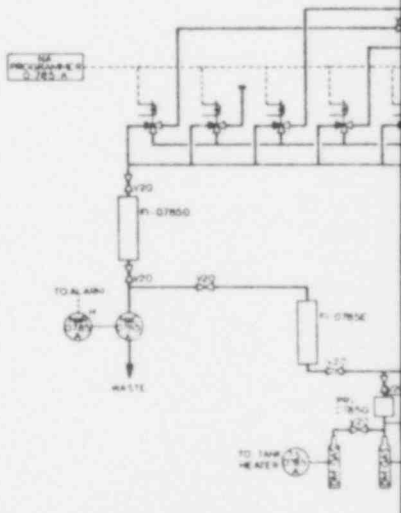
STEAM PURITY ANALYZER
COOLER
CAPILLARY
ION EXCH
TO ALARM
TURBINE BUILDING SUMP


CONDENSATE TRANSFER PUMP SUCTION
PRIMARY SYSTEM MAKE-UP TRANSFER PUMPS SUCTION
NOTE 1
TO CR-0700 TO ALARM
NOTE 2
LOCATED ON TURBINE PANEL


TO ALARM
WASTE

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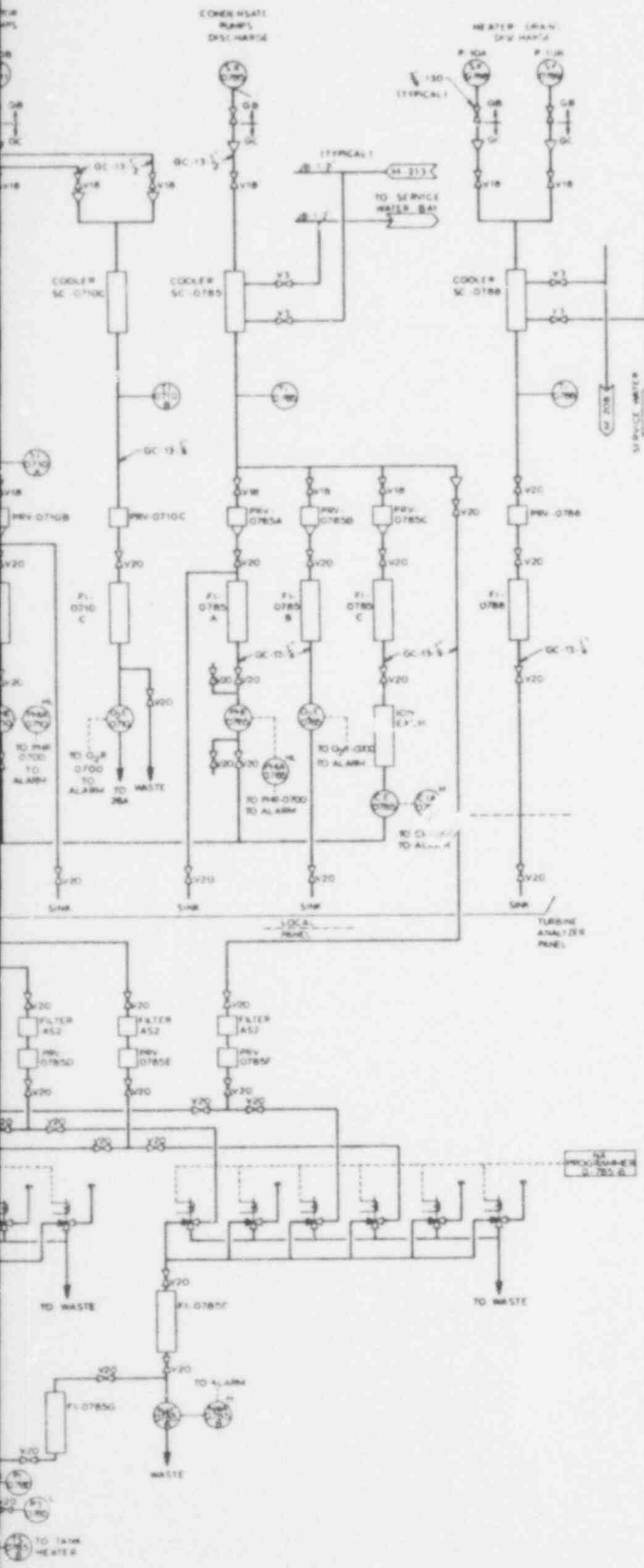


**PALISADES PLANT**
**STEAM GENERATOR REPAIR REPORT**

MODIFIED TURBINE ANALYZER PANEL FOR SAMPLING SYSTEM

Figure 3.3-2

Revision 3
July 1979

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TABLE 4.3.2

(SHEET 1)

MAN-REM ASSESSMENT FOR REPLACEMENT

(The manhour and man-rem estimates have been revised refer to Table C-1-1 to C-1-5.)

| Work Area | Estimated (1) Manhours in Radiation Field | Average Radiation Field (rem/hr) | Area (1) Man-Rem Dose (Man-Rem) Unshielded | Reduction Factor (Shielding and/or Decontamination) | Area Man-Rem Dose (Man-Rem) |
|---|---|---|---|---|---|
| 1. Outside of power plant building but within security fence | 213,300 | $.5x10^{6}$ | 1.06 | 1.0 | 1.06 |
| 2. Checking in and out through security and health pysics, as well as time spent suiting up, cleaning up, and moving to and from work area for personnel working in radioactive areas | 55,300 | .0025 | 138.25 | 1.0 | 138.25 |
| 3. Inside containment near new construction opening | 3,550 | 0.001 | 3.55 | 1.0 | 3.55 |
| 4. Within 6 feet of outside of reactor coolant pipe or bottom of steam generator before removal of steam generators | 5,050 | 0.03 | 151.5 | 1.0 | 151.5 |
| 5. Within 6 feet of outside of reactor coolant pipe after steam generator's removal | 19,100<br>23,400 A1 | 0.01 | 191.0<br>234.0 A1 | 1.0 | 191.0<br>234.0 A1 |
| 6. Within 6 feet of outside of reactor coolant pipe or bottom of steam generators with partial exposure to inside of reactor coolant pipe before steam generator's removal | 750 | 1.0 | 750.0 | 0.05 | 37.5 |
| 7. Within 6 feet of outside of reactor coolant pipe with partial exposure to inside of reactor coolant pipe after steam generator's removal | 4,400 | 1.0 | 4,400 | 0.05 | 220.0 |
| 8. Inside reactor coolant pipe | 4,500<br>200 A1<br>300 A2 | 9.0 | 40,500<br>1,800 A1<br>2,700 A2 | 0.1 | 4070.0<br>180.0 A1<br>270.0 A2 |
| 9. Low radiation area within containment | 41,250<br>4,200 A2 | 0.001<br>.005 A2 | 41.25<br>21.0 A2 | 1.0 | 41.25<br>21.0 A2 |

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TABLE 4.3.2

(SHEET 2)

MAN-REM ASSESSMENT FOR REPLACEMENT

(The manhour and man-rem estimates have been changed refer to Table C-1-1 to C-1-5.)

| Work Area | Estimated [1] Manhours in Radiation Field | Average Radiation Field (rem/hr) | Area [1] Man-Rem Dose (Man-Rem) Unshielded | Reduction Factor (Shielding and/or Decontamination) | Area Man-Rem Dose (Man-Rem) |
|---|---|---|---|---|---|
| 10. Within 6 feet of top half of original steam generators | 1,100 | 0.005 | 5.5 | 1.0 | 5.5 |
| 11. Within 6 feet of top half of new steam generators | 8,050 | 0.001 | 8.05 | 1.0 | 8.05 |
| 12. Operating floor of containment | 15,800 | 0.005 | 79.0 | 0.2 | 15.8 |
| 13. Inside containment, above polar crane | 1,150 | 0.001 | 1.15 | 1.0 | 1.15 |
| 14. Auxiliary building near clean resin tank and cooling water tank | 750 | 0.001 | 0.75 | 1.0 | 0.75 |
| 15. Auxiliary building near blowdown tank | 6,700 | 0.001 | 6.7 | 1.0 | 6.7 |
| 16. Spent fuel pool floor | 2,750 | 0.005 | 13.75 | 1.0 | 13.75 |
| 17. Within 6 feet of the bottom half of new steam generators | 3,700 | 0.010 | 37.0 | 1.0 | 37.0 |
| 18. Within 6 feet of the outside of the reactor vessel | 50 | 1.0 | 50.0 | 1.0 | 50.0 |
| 19. Next to the existing steam generators outside of the containment | 1,000 | 0.02 | 20.0 | 1.0 | 20.0 |
| | | | | Total | 4,993 |
| | | | | A1 | 1,666 |
| | | | | A2 | 1,193 |

Note:

[1] The three man-rem estimates given for work area 8 (inside of reactor coolant pipe) are presented because of three welding techniques under consideration. The ALARA considerations will be the factor determining which technique is eventually used. The total time estimated for cutting, welding, and inspecting inside the reactor coolant pipes is 4,500 manhours. One alternative (A1) is a technique, presently being investigated for feasibility, utilizing manual welding from the outside of the piping. Using this method, only 200 manhours out of a total of 4,500 would be required inside primary coolant piping. The remaining 4,300 manhours would be spent within 6 feet of the reactor coolant pipe (work area 5). The second alternative (A2) is an automatic welding technique for the cladding from inside the piping utilizing remote viewing. This method required 300 manhours inside the piping, and the remaining 4,200 manhours would be spent in a low radiation area in the containment (work area 9).

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C-1 Provide the following additional information regarding ALARA considerations (Sections 1.1.5 and 4.3.5):

(1) Duration of exposure associated with anticipated replacement/repair tasks

(2) Repetition rate of the tasks

(3) Numbers of work force exposed during each task

(4) Occupational exposures associated with anticipated replacement/repair activities

RESPONSE:

Tables (C-1-1 through C-1-5) provide the requested additional information. The manhour and corresponding man-rem estimates have changed from the original presented in Table 4.3.2. The changes are based on modifications to the welding techniques, described as Alternative ($A_1$) and Alternative ($A_2$), and further development of work packages.

The new exposure estimates are as follows: 1,547 to 2,803 man-rem ($A_1$), based on manual welding the reactor coolant pipe carbon steel portion and machine welding the cladding (with remote viewing), and 1,537 to 2,663 man-rem ($A_2$) based on machine welding (with remote viewing) both the carbon steel and cladding. The man-rem range reflects two analyses, for 140 and 42 days after shut down for the commencement of primary system pipe cutting. These estimates do not include a contingency.

It should be noted that Work Area 8, which represents manhours spent inside the reactor coolant pipe, has been expanded to appropriately differentiate radiation field levels before and after local decontamination.

TABLE C-1-1
(Sheet 1)

MANUAL WELDING OF RC PIPE WITH MACHINE CLADDING

| TASK NUMBER | DESCRIPTION | DURATION (HOURS) | AVERAGE NUMBER OF PERSONNEL | *LOCATION | NUMBER OF TIMES TASK PERFORMED | MANHOURS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 1 | Scaffold, cut, and remove construction opening liner plate. | 180 | 6 | 1 | 1 | 1,080 | |
| | | 83 | 6 | 2 | 1 | 498 | |
| 2 | Install new liner plate for construction opening, including fitup, scaffolding welding, etc. | 233 | 6 | 3 | 1 | 1,398 | |
| | | 100 | 6 | 2 | 1 | 600 | |
| 3 | Cover and uncover spent fuel pool (protective cover). | 270 | 7 | 16 | 0 | 1,890 | |
| | | 116 | 7 | 2 | 0 | 812 | |
| | | 240 | 7 | 1 | 0 | 1,680 | |
| 4 | Cut reactor coolant pipe. | 15 | 2 | 4 | 12 | 360 | Inside radiation control envelope |
| | | 15 | 2 | 6 | 12 | 360 | |
| | | 17 | 2 | 2 | 12 | 408 | |
| | | 12 | 2 | 9 | 12 | 288 | |
| 5 | Machine weld preparation on ends of reactor coolant pipes. | 58 | 2 | 7 | 18 | 2,088 | 12 weld preps would be on decontaminated pipe and 6 on pipe attached to reactor. |
| | | 35 | 2 | 2 | 18 | 1,260 | |
| | | 23 | 2 | 9 | 18 | 828 | |
| 6 | Rig, fitup, line up, and tack in place reactor coolant pipe closure spools. | 28 | 5 | 7 | 12 | 1,680 | |
| | | 17 | 5 | 2 | 12 | 1,020 | |
| | | 11 | 5 | 9 | 12 | 660 | |

*Refer to Table C-1-5

TABLE C-1-1
(Sheet 2)

MANUAL WELDING OF RC PIPE WITH MACHINE CLADDING

| TASK NUMBER | DESCRIPTION | DURATION (HOURS) | AVERAGE NUMBER OF PERSONNEL | *LOCATION | NUMBER OF TIMES TASK PERFORMED | MANHOURS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 7 | Weld hot leg reactor coolant pipe (carbon steel). | 131 | 4 | 5 | 4 | 2,096 | Manual welding 8C level |
| | | 2 | 1 | 8C | 4 | 8 | |
| | | 131 | 4 | 9 | 4 | 2,104 | |
| | | 113 | 4 | 2 | 4 | 1,800 | |
| 8 | Clad hot leg reactor coolant pipe (stainless steel) | 2 | 1 | 8C | 4 | 8 | Utilizing machine welding with remote welding |
| | | 50 | 2 | 9 | 4 | 400 | |
| | | 30 | 2 | 2 | 4 | 240 | |
| 9 | Weld cold leg reactor coolant pipe (carbon steel). | 89 | 4 | 5 | 8 | 2,864 | Manual welding |
| | | 2 | 1 | 8C | 8 | 16 | Manual welding |
| | | 91 | 4 | 9 | 8 | 2,896 | |
| | | 77 | 4 | 2 | 8 | 2,448 | |
| 10 | Clad cold leg reactor coolant pipe (stainless steel) | 2 | 1 | 8C | 8 | 16 | Machine welding with remote viewing |
| | | 45 | 2 | 9 | 8 | 720 | |
| | | 28 | 2 | 2 | 8 | 448 | |
| 11 | Stress relieve reactor coolant pipe. | 22 | 4 | 5 | 12 | 1,056 | |
| | | 2 | 1 | 8C | 12 | 24 | |
| | | 22 | 4 | 9 | 12 | 1,056 | |
| | | 20 | 4 | 2 | 12 | 960 | |

*Refer to Table C-1-5

TABLE C-1-1
(Sheet 3)

MANUAL WELDING OF RC PIPE WITH MACHINE CLADDING

| TASK NUMBER | DESCRIPTION | DURATION (HOURS) | AVERAGE NUMBER OF PERSONNEL | *LOCATION | NUMBER OF TIMES TASK PERFORMED | MANHOURS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 12 | X-Ray and NDT reactor coolant pipe. | 1/2 | 1 | 8 | 48 | 24 | Leave pill guide in place 8C when possible in order to reduce exposure. |
| | | 4 | 2 | 5 | 120 | 1,960 | |
| | | 3 | 2 | 2 | 120 | 720 | |
| | | 1 | 2 | 9 | 120 | 240 | |
| 13 | Install cleanliness plugs in reactor coolant pipe prior to cutting pipe. | 1/2 | 1 | 8A | 6 | 3 | |
| | | 1 | 2 | 4 | 6 | 12 | |
| 14 | Clean inside of reactor coolant pipe after welding. | 1 | 1 | 8C | 12 | 8 | |
| 15 | Cover steam generator reactor coolant nozzles | 1 | 4 | 8B | 6 | 24 | |
| | | 1 | 4 | 1 | 6 | 24 | |
| | | 1 | 4 | 9 | 6 | 24 | |
| | | 4 | 2 | 7 | 6 | 48 | (Seal weld only) |
| 16 | Cover ends of reactor coolant pipe spools (temporary). | 1 | 4 | 8B | 18 | 72 | |
| | | 2 | 4 | 7 | 18 | 144 | |
| | | 1/2 | 4 | 1 | 18 | 36 | |
| | | 1 | 4 | 2 | 18 | 72 | |
| 17 | Rig reactor coolant pipes to decontamination area. | 3 | 4 | 5 | 6 | 72 | |
| | | 1 | 4 | 2 | 6 | 24 | |

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*Refer to Table C-1-5

TABLE C-1-1
(Sheet 4)

MANUAL WELDING OF RC PIPE WITH MACHINE CLADDING

| TASK NUMBER | DESCRIPTION | DURATION (HOURS) | AVERAGE NUMBER OF PERSONNEL | *LOCATION | NUMBER OF TIMES TASK PERFORMED | MANHOURS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 18 | Measure reactor coolant pipe | 4 | 3 | 5 | 12 | 144 | |
| | closure spools. | 1 | 3 | 2 | 12 | 36 | |
| 19 | Remove insulation from steam | 38 | 4 | 2 | 2 | 304 | |
| | generators. | 32 | 4 | 4 | 2 | 256 | |
| | | 25 | 4 | 9 | 2 | 200 | |
| | | 32 | 4 | 10 | 2 | 256 | |
| 20 | Reinsulate new steam generator. | 180 | 4 | 2 | 2 | 1,440 | |
| | | 120 | 4 | 9 | 2 | 960 | |
| | | 150 | 4 | 11 | 2 | 1,200 | |
| | | 150 | 4 | 17 | 2 | 1,200 | |
| 21 | Remove and replace reactor | 5 | 2 | 2 | 12 | 120 | |
| | coolant pipe insulation. | 3 | 2 | 4 | 12 | 72 | |
| | | 5 | 2 | 5 | 12 | 120 | |
| | | 3 | 2 | 9 | 12 | 72 | |
| 22 | Cut, remove, bevel, erect, weld, | 260 | 3 | 2 | 2 | 1,560 | |
| | stress relieve, and insulate main | 277 | 3 | 9 | 2 | 1,662 | |
| | steam lines at top of steam | 40 | 3 | 10 | 2 | 240 | |
| | generator. | 148 | 3 | 11 | 2 | 888 | |
| | | 148 | 3 | 12 | 2 | 888 | |
| 23 | X-Ray and NDT main steam line. | 40 | 2 | 2 | 2 | 160 | (6 weld) |
| | | 25 | 2 | 9 | 2 | 100 | |
| | | 65 | 2 | 11 | 2 | 260 | |

*Refer to Table C-1-5

TABLE C-1-1
(Sheet 5)

MANUAL WELDING OF RC PIPE WITH MACHINE CLADDING

| TASK NUMBER | DESCRIPTION | DURATION (HOURS) | AVERAGE NUMBER OF PERSONNEL | *LOCATION | NUMBER OF TIMES TASK PERFORMED | MANHOURS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 24 | Cut, bevel, erect, weld, stress reileve, and insulate feedwater line. | 162 | 2 | 2 | 2 | 648 | |
| | | 107 | 2 | 9 | 2 | 428 | |
| | | 25 | 2 | 10 | 2 | 100 | |
| | | 245 | 2 | 11 | 2 | 980 | |
| 25 | X-Ray and NDT feedwater line. | 20 | 2 | 2 | 2 | 80 | (4 welds) |
| | | 45 | 2 | 11 | 2 | 180 | |
| 26 | Remove and replace miscellaneous small pipe near steam generators. | 60 | 4 | 2 | 1 | 240 | |
| | | 50 | 4 | 4 | 1 | 200 | |
| | | 40 | 4 | 9 | 1 | 160 | |
| | | 50 | 4 | 17 | 1 | 200 | |
| 27 | Move component cooling water tank and clean resin tank out of way and reinstall. | 75 | 4 | 2 | 1 | 300 | |
| | | 50 | 4 | 9 | 1 | 200 | |
| | | 125 | 4 | 14 | 1 | 500 | |
| 28 | Install blowdown, tank, pump, and insulation. | 40 | 3 | 2 | 1 | 120 | |
| | | 20 | 3 | 9 | 1 | 60 | |
| | | 67 | 3 | 15 | 1 | 201 | |
| 29 | Install new blowdown piping inside containment. | 122 | 6 | 2 | 1 | 732 | |
| | | 13 | 6 | 4 | 1 | 78 | |
| | | 92 | 6 | 5 | 1 | 552 | |
| | | 177 | 6 | 9 | 1 | 1,062 | |

*Refer to Table C-1-5

TABLE C-1-1
(Sheet 6)

MANUAL WELDING OF RC PIPE WITH MACHINE CLADDING

| TASK NUMBER | DESCRIPTION | DURATION (HOURS) | AVERAGE NUMBER OF PERSONNEL | *LOCATION | NUMBER OF TIMES TASK PERFORMED | MANHOURS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 30 | Install new blowdown piping outside containment. | 193 | 6 | 2 | 1 | 1,158 | |
| | | 128 | 6 | 9 | 1 | 768 | |
| | | 322 | 6 | 15 | 1 | 1,932 | |
| 31 | Remove electrical inside containment so steam generator can be removed. | 37 | 4 | 2 | 1 | 148 | |
| | | 63 | 4 | 4 | 1 | 252 | |
| | | 25 | 4 | 9 | 1 | 150 | |
| 32 | Reinstall electrical inside containment. | 90 | 8 | 2 | 1 | 720 | |
| | | 60 | 8 | 9 | 1 | 480 | |
| | | 75 | 8 | 11 | 1 | 600 | |
| | | 75 | 8 | 17 | 1 | 600 | |
| 33 | Install electrical for new blowdown system. | 92 | 4 | 2 | 1 | 368 | |
| | | 12 | 4 | 9 | 1 | 48 | |
| | | 173 | 4 | 15 | 1 | 692 | |
| | | 32 | 4 | 17 | 1 | 128 | |
| 34 | Install and remove equipment required to monitor position of reactor and steam generators during weldup of reactor coolant pipe. | 30 | 2 | 2 | 1 | 60 | |
| | | - | - | 10 | - | - | |
| | | 130 | 1 | 9 | 1 | 130 | |
| | | 20 | 2 | 17 | 1 | 40 | |
| | | 20 | 2 | 18 | 1 | 40 | |

*Refer to Table C-1-5

TABLE C-1-1
(Sheet 7)

MANUAL WELDING OF RC PIPE WITH MACHINE CLADDING

| TASK NUMBER | DESCRIPTION | DURATION (HOURS) | AVERAGE NUMBER OF PERSONNEL | *LOCATION | NUMBER OF TIMES TASK PERFORMED | MANHOURS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 35 | Mobilize, install cages. Remove dome and buttress facia, relax tendons, remove tendons, chip concrete, cut rebar and tendon sheathing for containment construction opening. | 1,075 | 20 | 1 | 1 | 21,500 | |
| 36 | Replace opening on containment, including the following: Replace tendon sheathing, rebar, concrete and tendons, stress tendons and replace dome and buttress facia, demobilize. | 1,275 | 15 | 1 | 1 | 19,125 | |
| 37 | Construct and remove barge slip. | 829 | 14 | 1 | 1 | 11,606 | |
| 38 | Foundations for rigging equipment, including sheetpiling, earthwork, concrete foundations and removal of foundations (at containment building). | 692 | 12 | 1 | 1 | 8,304 | |
| 39 | Mobile heavy lift rigger. | 100 | 15 | 1 | 1 | 1,500 | |
| 40 | Assemble 4 crawlers. | 150 | 10 | 1 | 1 | 1,500 | |

*Refer to Table C-1-5

TABLE C-1-1
(Sheet 8)

MANUAL WELDING OF RC PIPE WITH MACHINE CLADDING

| TASK NUMBER | DESCRIPTION | DURATION (HOURS) | AVERAGE NUMBER OF PERSONNEL | *LOCATION | NUMBER OF TIMES TASK PERFORMED | MANHOURS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 41 | Assemble jacking frame at barge. | 62 | 12 | 1 | 1 | 744 | |
| 42 | Assemble jacking frame at containment. | 78 | 12 | 1 | 1 | 936 | |
| 43 | Preassemble equipment for inside containment. | 78 | 12 | 1 | 1 | 936 | |
| 44 | Install lifting equipment inside containment. | 112 | 15 | 2 | 1 | 1,680 | |
| | | 158 | 15 | 12 | 1 | 2,370 | |
| | | 105 | 15 | 13 | 1 | 1,575 | |
| 45 | Remove existing steam generators from containment (rigging). | 23 | 15 | 1 | 2 | 690 | |
| | | 26 | 15 | 2 | 2 | 780 | |
| | | 44 | 15 | 4 | 2 | 1,320 | |
| | | 19 | 15 | 19 | 2 | 570 | |
| 46 | Transport and store existing steam generators. | 31 | 10 | 19 | 2 | 620 | |
| 47 | Receive and ballast barge. | 20 | 5 | 1 | 1 | 100 | |
| 48 | Offload, store, load, and transport new steam generators. | 158 | 10 | 1 | 2 | 3,160 | |
| 49 | Rerig as required to install. | 16 | 15 | 1 | 2 | 480 | |

*Refer to Table C-1-5

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TABLE C-1-1
(Sheet 9)

MANUAL WELDING OF RC PIPE WITH MACHINE CLADDING

| TASK NUMBER | DESCRIPTION | DURATION (HOURS) | AVERAGE NUMBER OF PERSONNEL | *LOCATION | NUMBER OF TIMES TASK PERFORMED | MANHOURS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 50 | Install new steam generators. | 19 | 15 | 1 | 2 | 570 | |
| | | 21 | 15 | 2 | 2 | 630 | |
| | | 37 | 15 | 12 | 2 | 1,110 | |
| | | 12 | 15 | 17 | 2 | 360 | |
| 51 | Remove all external rigging equipment from site. | 225 | 15 | 1 | 1 | 3,375 | |
| 52 | Remove all rigging equipment from containment. | 75 | 15 | 2 | 1 | 1,125 | |
| | | 105 | 15 | 12 | 1 | 1,575 | |
| | | 70 | 15 | 13 | 1 | 1,050 | |
| 53 | Remove internal rigging equipment from site. | 63 | 15 | 1 | 1 | 945 | |
| 54 | Miscellaneous rigging | 150 | 5 | 1 | 1 | 750 | |
| 55 | Steam generator storage building. | 406 | 10 | 1 | 1 | 4,060 | |
| 56 | Cut and remove top support of steam generator. | 8 | 5 | 10 | 1 | 40 | |
| | | 5 | 5 | 2 | 1 | 25 | |
| | | 3 | 5 | 9 | 1 | 15 | |
| 57 | Remove shims other steam generator top support. | 6 | 4 | 10 | 1 | 24 | |
| | | 4 | 4 | 2 | 1 | 16 | |
| | | 2 | 4 | 9 | 1 | 8 | |

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TABLE C-1-1
(Sheet 10)

MANUAL WELDING OF RC PIPE WITH MACHINE CLADDING

| TASK NUMBER | DESCRIPTION | DURATION (HOURS) | AVERAGE NUMBER OF PERSONNEL | *LOCATION | NUMBER OF TIMES TASK PERFORMED | MANHOURS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 58 | Remove hydraulic snubbers. | 4 | 5 | 10 | 8 | 160 | |
| | | 3 | 5 | 2 | 8 | 120 | |
| | | 1 | 5 | 9 | 8 | 40 | |
| 59 | Unbolt existing steam generator. | 4 | 3 | 4 | 2 | 24 | |
| | | 3 | 3 | 2 | 2 | 18 | |
| | | 1 | 3 | 9 | 2 | 6 | |
| 60 | Remove shims at steam generator base. | 15 | 3 | 4 | 2 | 90 | |
| | | 9 | 3 | 2 | 2 | 54 | |
| | | 6 | 3 | 9 | 2 | 36 | |
| 61 | Bolt down steam generators. | 10 | 3 | 5 | 2 | 60 | |
| | | 6 | 3 | 2 | 2 | 36 | |
| | | 4 | 3 | 9 | 2 | 24 | |
| 62 | Reshim bottom steam generator (sliding base). | 50 | 3 | 5 | 2 | 300 | |
| | | 30 | 3 | 2 | 2 | 180 | |
| | | 20 | 3 | 9 | 2 | 120 | |
| 63 | Replace top steam generator support. | 120 | 3 | 11 | 2 | 720 | |
| | | 72 | 3 | 2 | 2 | 432 | |
| | | 48 | 3 | 9 | 2 | 288 | |
| 64 | Reshim top steam generator supports. | 40 | 3 | 11 | 2 | 240 | |
| | | 24 | 3 | 2 | 2 | 144 | |
| | | 16 | 3 | 9 | 2 | 96 | |

*Refer to Table C-1-5

TABLE C-1-1
(Sheet 11)

MANUAL WELDING OF RC PIPE WITH MACHINE CLADDING

| TASK NUMBER | DESCRIPTION | DURATION (HOURS) | AVERAGE NUMBER OF PERSONNEL | *LOCATION | NUMBER OF TIMES TASK PERFORMED | MANHOURS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 65 | Reinstall steam generator hydraulic snubbers. | 30 | 4 | 11 | 8 | 960 | |
| | | 18 | 4 | 2 | 8 | 576 | |
| | | 12 | 4 | 9 | 8 | 384 | |
| 66 | Miscellaneous pipe operations (welders tests, material hangling, scaffolding, training, hangers and supports, line testing, cleanup, tents). | | | 1 | | 25,088 | Welders tests, training, material handling and fabrication of tents are in Location 1. Remainder of manhours were allocated on the basis of piping manhours in each location. |
| | | | | 2 | | 7,030 | |
| | | | | 4 | | 952 | |
| | | | | 5 | | 3,699 | |
| | | | | 8 | | 20 | |
| | | | | 9 | | 6,982 | |
| | | | | 10 | | 552 | |
| | | | | 11 | | 1,088 | |
| | | | | 12 | | 413 | |
| | | | | 15 | | 914 | |
| | | | | 17 | | 87 | |
| 67 | Distributables (startup, cleanup, scaffolding, welders tests other than pipe fitters, miscellaneous). | | | 1 | | 11,436 | Welders tests and miscellaneous in Area 1. Remainder of manhours allocated on the basis of direct manhours excluding Area 1. |
| | | | | 2 | | 13,298 | |
| | | | | 3 | | 1,003 | |
| | | | | 4 | | 1,526 | |
| | | | | 5 | | 4,883 | |
| | | | | 6 | | 131 | |
| | | | | 7 | | 1,613 | |
| | | | | 8 | | 51 | |
| | | | | 9 | | 9,766 | |
| | | | | 10 | | 567 | |
| | | | | 11 | | 2,921 | |

*Refer to Table C-1-5

TABLE C-1-1
(Sheet 12)

MANUAL WELDING OF RC PIPE WITH MACHINE CLADDING

| TASK NUMBER | DESCRIPTION | DURATION (HOURS) | AVERAGE NUMBER OF PERSONNEL | *LOCATION | NUMBER OF TIMES TASK PERFORMED | MANHOURS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 67 | (Continued) | | | 12 | | 2,616 | |
| | | | | 13 | | 1,090 | |
| | | | | 14 | | 218 | |
| | | | | 15 | | 1,526 | |
| | | | | 16 | | 785 | |
| | | | | 17 | | 1,090 | |
| | | | | 19 | | 480 | |
| 68 | Nonmanual | | | 1 | | 99,160 | Office personnel and 50% of engineers and supervision's man-hours are in Location #1. Remainder of man-hours by discipline were allocated to the proper location based on direct manhours expended in that location by discipline. |
| | | | | 2 | | 6,511 | |
| | | | | 3 | | 53 | |
| | | | | 4 | | 1,110 | |
| | | | | 5 | | 2,872 | |
| | | | | 6 | | 16 | |
| | | | | 7 | | 85 | |
| | | | | 8 | | 14 | |
| | | | | 9 | | 5,770 | |
| | | | | 10 | | 426 | |
| | | | | 11 | | 1,176 | |
| | | | | 12 | | 895 | |
| | | | | 13 | | 149 | For example: The man-hours for electrical engineers and supts were allocated based on the electrical direct hours expended on each task at each location. |
| | | | | 14 | | 11 | |
| | | | | 15 | | 1,143 | |
| | | | | 16 | | 141 | |
| | | | | 17 | | 401 | |
| | | | | 19 | | 67 | |

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*Refer to Table C-1-5

TABLE C-1-2
(Sheet 1)

SUMMARY OF MANHOURS FOR ALL TASKS BY LOCATION

MANUAL WELDING OF REACTOR COOLANT C.S. PIPE WITH
MACHINE CLADDING AND REMOTE VIEWING

| TASK NO. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 498 | 1,080 | | | | | | | | | | | | | | | | |
| 2 | | 600 | 1,398 | | | | | | | | | | | | | | | | |
| 3 | 1,680 | 812 | | | | | | | | | | | | | | 1,890 | | | |
| 4 | | 468 | | 360 | | 360 | | | 288 | | | | | | | | | | |
| 5 | | 1,260 | | | | | 2,088 | | 828 | | | | | | | | | | |
| 6 | | 1,020 | | | | | 1,680 | | 660 | | | | | | | | | | |
| 7 | | 1,800 | | | 2,096 | | | 8 | 2,104 | | | | | | | | | | |
| 8 | | 240 | | | | | | 8 | 400 | | | | | | | | | | |
| 9 | | 2,448 | | | 2,864 | | | 16 | 2,896 | | | | | | | | | | |
| 10 | | 448 | | | | | | 16 | 720 | | | | | | | | | | |
| 11 | | 960 | | | 1,056 | | | 24 | 1,056 | | | | | | | | | | |
| 12 | | 720 | | | 960 | | | 24 | 240 | | | | | | | | | | |
| 13 | | | | 12 | | | | 3 | | | | | | | | | | | |
| 14 | | | | | | | | 8 | | | | | | | | | | | |
| 15 | 24 | | | | | | 48 | 24 | 24 | | | | | | | | | | |
| 16 | 36 | 72 | | | | | 144 | 72 | | | | | | | | | | | |
| 17 | | 24 | | | 72 | | | | | | | | | | | | | | |
| 18 | | 36 | | | 144 | | | | | | | | | | | | | | |
| 19 | | 304 | | 256 | | | | | 200 | 256 | | | | | | | | | |
| 20 | | 1,440 | | | | | | | 960 | | 1,200 | | | | | | 1,200 | | |
| 21 | | 120 | | 72 | 120 | | | | 72 | | | | | | | | | | |
| 22 | | 1,560 | | | | | | | 1,662 | 240 | 888 | 888 | | | | | | | |
| 23 | | 160 | | | | | | | 100 | | 260 | | | | | | | | |
| 24 | | 648 | | | | | | | 428 | 100 | 980 | | | | | | | | |
| 25 | | 80 | | | | | | | | | 180 | | | | | | | | |
| 26 | | 240 | | 200 | | | | | 160 | | | | | | | | 200 | | |
| 27 | | 300 | | | | | | | 200 | | | | | 500 | | | | | |

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TABLE C-1-2
(Sheet 2)

SUMMARY OF MANHOURS FOR ALL TASKS BY LOCATION

MANUAL WELDING OF REACTOR COOLANT C.S. PIPE WITH
MACHINE CLADDING AND REMOTE VIEWING

| TASK NO. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28 | | 120 | | | | | | | 60 | | | | | | 204 | | | | |
| 29 | | 732 | | 78 | 552 | | | | 1,062 | | | | | | | | | | |
| 30 | | 1,158 | | | | | | | 768 | | | | | | 1,932 | | | | |
| 31 | | 148 | | 252 | | | | | 150 | | | | | | | | | | |
| 32 | | 720 | | | | | | | 480 | | 680 | | | | | | 600 | | |
| 33 | | 368 | | | | | | | 48 | | | | | | 692 | | 128 | | |
| 34 | | 60 | | | | | | | 130 | | | | | | | | 40 | 40 | |
| 35 | 21,500 | | | | | | | | | | | | | | | | | | |
| 36 | 19,125 | | | | | | | | | | | | | | | | | | |
| 37 | 11,606 | | | | | | | | | | | | | | | | | | |
| 38 | 8,304 | | | | | | | | | | | | | | | | | | |
| 39 | 1,500 | | | | | | | | | | | | | | | | | | |
| 40 | 1,506 | | | | | | | | | | | | | | | | | | |
| 41 | 744 | | | | | | | | | | | | | | | | | | |
| 42 | 936 | | | | | | | | | | | | | | | | | | |
| 43 | 936 | | | | | | | | | | | | | | | | | | |
| 44 | | 1,680 | | | | | | | | | | | | | | | | | |
| 45 | 690 | 780 | | 1,320 | | | | | | | | 2,370 | 1,575 | | | | | | |
| 46 | | | | | | | | | | | | | | | | | | | 570 |
| 47 | 100 | | | | | | | | | | | | | | | | | | 620 |
| 48 | 3,160 | | | | | | | | | | | | | | | | | | |
| 49 | 480 | | | | | | | | | | | | | | | | | | |
| 50 | 570 | 630 | | | | | | | | | | 1,110 | | | | | 360 | | |
| 51 | 3,375 | | | | | | | | | | | | | | | | | | |
| 52 | | 1,125 | | | | | | | | | | 1,575 | 1,050 | | | | | | |
| 53 | 945 | | | | | | | | | | | | | | | | | | |

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TABLE C-1-2
(Sheet 3)

SUMMARY OF MANHOURS FOR ALL TASKS BY LOCATION

MANUAL WELDING OF REACTOR COOLANT C.S. PIPE WITH
MACHINE CLADDING AND REMOTE VIEWING

| TASK NO. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 54 | 250 | | | | | | | | | | | | | | | | | | |
| 55 | 4,060 | | | | | | | | | | | | | | | | | | |
| 56 | | 25 | | | | | | | 15 | 40 | | | | | | | | | |
| 57 | | | | | | | | | 8 | 24 | | | | | | 16 | | | |
| 58 | | 120 | | | | | | | 40 | 160 | | | | | | | | | |
| 59 | | 18 | | 24 | | | | | 6 | | | | | | | | | | |
| 60 | | 54 | | 9 | | | | | 36 | | | | | | | | | | |
| 61 | | 76 | | | 60 | | | | 24 | | | | | | | | | | |
| 62 | | 180 | | | 300 | | | | 120 | | | | | | | | | | |
| 63 | | 432 | | | | | | | 288 | | 720 | | | | | | | | |
| 64 | | 144 | | | | | | | 96 | | 240 | | | | | | | | |
| 65 | | | | | | | | | 384 | | 960 | | | | | | | | |
| 66 | 25,088 | 7,03 | | 1 2 | 1,699 | | | 20 | 6,982 | 552 | 1,088 | 413 | | | 914 | | 87 | | |
| Total Directs | 107,061 | 32,134 | 2,478 | 3,640 | 11,923 | 360 | 3,960 | 223 | 23,662 | 1,372 | 7,116 | 6,356 | 2,625 | 500 | 3,739 | 1,906 | 2,615 | 40 | 1,190 |
| 67 | 11,436 | 13,298 | 1,003 | 1,526 | 4,883 | 131 | 1,613 | 51 | 9,766 | 567 | 2,921 | 2,616 | 1,090 | 218 | 1,526 | 785 | 1,090 | - | 480 |
| 68 | 99,160 | 6,511 | 53 | 1,110 | 2,872 | 16 | 85 | 14 | 5,770 | 426 | 1,176 | 895 | 149 | 11 | 1,143 | 141 | 401 | - | 67 |
| Total | 217,657 | 52,143 | 3,534 | 6,276 | 19,678 | 507 | 5,658 | 288 | 39,198 | 2,365 | 11,213 | 9,867 | 3,864 | 729 | 6,408 | 2,832 | 4,106 | 40 | 1,737 |

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TABLE C-1-3
(Sheet 1)

MACHINE WELDING OF R.C. PIPE WITH REMOTE VIEWING

| TASK NUMBER | DESCRIPTION | DURATION (HOURS) | AVERAGE NUMBER OF PERSONNEL | *LOCATION | NUMBER OF TIMES TASK PERFORMED | MANHOURS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 1 | Scaffold, cut, and remove construction opening liner plate. | 180 | 6 | 3 | 3 | 1,080 | |
| | | 83 | 6 | 2 | 1 | 498 | |
| 2 | Install new liner plate for construction opening, including fitup, scaffolding, welding, etc. | 233 | 6 | 3 | 1 | 1,398 | |
| | | 100 | 6 | 2 | 1 | 600 | |
| 3 | Cover and uncover spent fuel pool (protective cover). | 270 | 7 | 16 | 0 | 1,890 | |
| | | 116 | 7 | 2 | 0 | 812 | |
| | | 240 | 7 | 1 | 0 | 1,680 | |
| 4 | Cut reactor coolant pipe. | 15 | 2 | 4 | 12 | 360 | Inside radiation control envelope |
| | | 15 | 2 | 6 | 12 | 360 | |
| | | 17 | 2 | 2 | 12 | 408 | |
| | | 12 | 2 | 9 | 12 | 288 | |
| 5 | Machine weld prep on ends of reactor coolant pipes. | 58 | 2 | 7 | 18 | 2,088 | 12 weld preps would be on decontaminated pipe and 6 on pipe attached to reactor. |
| | | 35 | 2 | 2 | 18 | 1,260 | |
| | | 23 | 2 | 9 | 18 | 828 | |
| 6 | Rig, fitup, lineup and tack in place reactor coolant pipe closure spools. | 28 | 5 | 7 | 12 | 1,680 | |
| | | 17 | 5 | 2 | 12 | 1,020 | |
| | | 11 | 5 | 9 | 12 | 660 | |

*Refer to Table C-1-5

TABLE C-1-3
(Sheet 2)

MACHINE WELDING OF R.C. PIPE WITH REMOTE VIEWING

| TASK NUMBER | DESCRIPTION | DURATION (HOURS) | AVERAGE NUMBER OF PERSONNEL | *LOCATION | NUMBER OF TIMES TASK PERFORMED | MANHOURS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 7 | Weld hot leg reactor coolant pipe (carbon steel). | 4 | 2 | 7 | 4 | 32 | Utilizing machine welding with remote viewing. |
| | | 3 | 1 | 8C | 4 | 12 | |
| | | 234 | 1 | 5 | 4 | 935 | |
| | | 146 | 3 | 2 | 4 | 1,753 | |
| | | 273 | 3 | 9 | 4 | 3,276 | |
| 8 | Clad hot leg reactor coolant pipe (stainless steel) | 2 | 1 | 8C | 4 | 8 | Utilizing machine welding with remote viewing. |
| | | 50 | 2 | 9 | 4 | 400 | |
| | | 30 | 2 | 2 | 4 | 240 | |
| 9 | Weld cold leg reactor coolant pipe (carbon steel). | 4 | 2 | 7 | 8 | 64 | |
| | | 2 | 1 | 8 | 8 | 16 | |
| | | 160 | 1 | 5 | 8 | 1,280 | |
| | | 100 | 3 | 2 | 8 | 2,400 | |
| | | 186 | 3 | 9 | 8 | 4,464 | |
| 10 | Clad cold leg reactor coolant pipe (stainless steel). | 2 | 1 | 8C | 8 | 16 | Machine welding with remote viewing. |
| | | 45 | 2 | 9 | 8 | 720 | |
| | | 28 | 2 | 2 | 8 | 448 | |
| 11 | Stress relieve reactor coolant pipe. | 22 | 4 | 5 | 12 | 1,056 | |
| | | 2 | 1 | 8C | 12 | 24 | |
| | | 22 | 4 | 9 | 12 | 1,056 | |
| | | 20 | 4 | 2 | 12 | 960 | |

*Refer to Table C-1-5

TABLE C-1-3
(Sheet 3)

MACHINE WELDING OF R.C. PIPE WITH REMOTE VIEWING

| TASK NUMBER | DESCRIPTION | DURATION (HOURS) | AVERAGE NUMBER OF PERSONNEL | *LOCATION | NUMBER OF TIMES TASK PERFORMED | MANHOURS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 12 | X-Ray and NDT reactor coolant pipe. | 1/2 | 1 | 8C | 48 | 24 | Leave pill guide in place 8C when possible in order to reduce exposure. |
| | | 4 | 2 | 5 | 120 | 1,960 | |
| | | 3 | 2 | 2 | 120 | 720 | |
| | | 1 | 2 | 9 | 120 | 240 | |
| 13 | Install cleanliness plugs in reactor coolant pipe prior to cutting pipe. | 1/2 | 1 | 8A | 6 | 3 | |
| | | 1 | 2 | 4 | 6 | 12 | |
| 14 | Clean inside of reactor coolant pipe after welding. | 1 | 1 | 8C | 12 | 8 | |
| 15 | Cover steam generator reactor coolant nozzles. | 1 | 4 | 8B | 6 | 24 | |
| | | 1 | 4 | 1 | 6 | 24 | |
| | | 1 | 4 | 9 | 6 | 24 | |
| | | 4 | 2 | 7 | 6 | 48 | (Seal weld only) |
| 16 | Cover ends of reactor coolant pipe spools (temporary). | 1 | 4 | 8B | 18 | 72 | |
| | | 1 | 4 | 7 | 18 | 144 | |
| | | 1/2 | 4 | 1 | 18 | 36 | |
| | | 1 | 4 | 2 | 18 | 72 | |
| 17 | Rig reactor coolant pipes to decontamination area. | 3 | 4 | 5 | 6 | 72 | |
| | | 1 | 4 | 2 | 6 | 24 | |

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*Refer to Table C-1-5

TABLE C-1-3
(Sheet 4)

MACHINE WELDING OF R.C. PIPE WITH REMOTE VIEWING

| TASK NUMBER | DESCRIPTION | DURATION (HOURS) | AVERAGE NUMBER OF PERSONNEL | *LOCATION | NUMBER OF TIMES TASK PERFORMED | MANHOURS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 18 | Measure reactor coolant pipe | 4 | 3 | 5 | 12 | 144 | |
| | closure spools. | 1 | 3 | 2 | 12 | 36 | |
| 19 | Remove insulation from steam | 38 | 4 | 2 | 2 | 304 | |
| | generators. | 32 | 4 | 4 | 2 | 256 | |
| | | 25 | 4 | 9 | 2 | 200 | |
| | | 32 | 4 | 10 | 2 | 256 | |
| 20 | Reinsulate new steam generator. | 180 | 4 | 2 | 2 | 1,440 | |
| | | 120 | 4 | 9 | 2 | 960 | |
| | | 150 | 4 | 11 | 2 | 1,200 | |
| | | 150 | 4 | 17 | 2 | 1,200 | |
| 21 | Remove and replace reactor coolant | 5 | 2 | 2 | 12 | 120 | |
| | pipe insulation. | 3 | 2 | 4 | 12 | 72 | |
| | | 5 | 2 | 5 | 12 | 120 | |
| | | 3 | 2 | 9 | 12 | 72 | |
| 22 | Cut, remove, bevel, erect, weld, | 260 | 3 | 2 | 2 | 1,560 | |
| | stress relieve, and insulate main | 277 | 3 | 9 | 2 | 1,662 | |
| | steam lines at top of steam | 40 | 3 | 10 | 2 | 240 | |
| | generator. | 148 | 3 | 11 | 2 | 888 | |
| | | 148 | 3 | 12 | 2 | 888 | |

*Refer to Table C-1-5

TABLE C-1-3
(Sheet 5)

MACHINE WELDING OF R.C. PIPE WITH REMOTE VIEWING

| TASK NUMBER | DESCRIPTION | DURATION (HOURS) | AVERAGE NUMBER OF PERSONNEL | *LOCATION | NUMBER OF TIMES TASK PERFORMED | MANHOURS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 23 | X-Ray and NDT main steam line. | 40 | 2 | 2 | 2 | 160 | (6 welds) |
| | | 25 | 2 | 9 | 2 | 100 | |
| | | 65 | 2 | 11 | 2 | 260 | |
| 24 | Cut, bevel, erect, weld, stress relieve, and insulate feedwater line. | 162 | 2 | 2 | 2 | 648 | |
| | | 107 | 2 | 9 | 2 | 428 | |
| | | 25 | 2 | 10 | 2 | 100 | |
| | | 245 | 2 | 11 | 2 | 980 | |
| 25 | X-Ray and NDT feedwater line. | 20 | 2 | 2 | 2 | 80 | (4 welds) |
| | | 45 | 2 | 11 | 2 | 180 | |
| 26 | Remove and replace miscellaneous small pipe near steam generators. | 60 | 4 | 2 | 1 | 240 | |
| | | 50 | 4 | 4 | 1 | 200 | |
| | | 40 | 4 | 9 | 1 | 160 | |
| | | 50 | 4 | 17 | 1 | 200 | |
| 27 | Move component cooling water tank and clean resin tank out of way and reinstall. | 75 | 4 | 2 | 1 | 300 | |
| | | 50 | 4 | 9 | 1 | 200 | |
| | | 125 | 4 | 14 | 1 | 500 | |

*Refer to Table C-1-5

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TABLE C-1-3
(Sheet 6)

MACHINE WELDING OF R.C. PIPE WITH REMOTE VIEWING

| TASK NUMBER | DESCRIPTION | DURATION (HOURS) | AVERAGE NUMBER OF PERSONNEL | *LOCATION | NUMBER OF TIMES TASK PERFORMED | MANHOURS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 28 | Install blowdown, tank, pump, and insulation. | 40 | 3 | 2 | 1 | 120 | |
| | | 20 | 3 | 9 | 1 | 60 | |
| | | 67 | 3 | 15 | 1 | 201 | |
| 29 | Install new blowdown piping inside containment. | 122 | 6 | 2 | 1 | 732 | |
| | | 13 | 6 | 4 | 1 | 78 | |
| | | 92 | 6 | 5 | 1 | 552 | |
| | | 177 | 6 | 9 | 1 | 1,062 | |
| 30 | Install new blowdown piping outside containment. | 193 | 6 | 2 | 1 | 1,158 | |
| | | 128 | 6 | 9 | 1 | 768 | |
| | | 322 | 6 | 15 | 1 | 1,932 | |
| 31 | Remove electrical inside containment so steam generator can be removed. | 37 | 4 | 2 | 1 | 148 | |
| | | 63 | 4 | 4 | 1 | 252 | |
| | | 25 | 4 | 9 | 1 | 150 | |
| 32 | Reinstall electrical inside containment. | 90 | 8 | 2 | 1 | 720 | |
| | | 60 | 8 | 9 | 1 | 480 | |
| | | 75 | 8 | 11 | 1 | 600 | |
| | | 75 | 8 | 17 | 1 | 600 | |
| 33 | Install electrical for new blowdown system. | 92 | 4 | 2 | 1 | 368 | |
| | | 12 | 4 | 9 | 1 | 48 | |
| | | 173 | 4 | 15 | 1 | 692 | |
| | | 32 | 4 | 17 | 1 | 128 | |

*Refer to Table C-1-5

TABLE C-1-3
(Sheet 7)

MACHINE WELDING OF R.C. PIPE WITH REMOTE VIEWING

| TASK NUMBER | DESCRIPTION | DURATION (HOURS) | AVERAGE NUMBER OF PERSONNEL | *LOCATION | NUMBER OF TIMES TASK PERFORMED | MANHOURS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 34 | Install and remove equipment required to monitor position of reactor and steam generators during weldup of reactor coolant pipe. | 30 | 2 | 2 | 1 | 60 | |
| | | - | - | 10 | - | - | |
| | | 130 | 1 | 9 | 1 | 130 | |
| | | 20 | 2 | 17 | 1 | 40 | |
| | | 20 | 2 | 18 | 1 | 40 | |
| 35 | Mobilize, install cages. Remove dome and buttress facia, relax tendons, remove tendons, chip concrete, cut rebar and tendon sheathing for containment construction opening. | 1,075 | 20 | 1 | 1 | 21,500 | |
| 36 | Replace opening on containment, including the following: Replace tendon sheathing, rebar, concrete and tendons, stress tendons and replace dome and buttress facia, demobilize. | 1,275 | 15 | 1 | 1 | 19,125 | |
| 37 | Construct and remove barge slip. | 829 | 14 | 1 | 1 | 11,606 | |

*Refer to Table C-1-5

TABLE C-1-3
(Sheet 8)

MACHINE WELDING OF R.C. PIPE WITH REMOTE VIEWING

| TASK NUMBER | DESCRIPTION | DURATION (HOURS) | AVERAGE NUMBER OF PERSONNEL | *LOCATION | NUMBER OF TIMES TASK PERFORMED | MANHOURS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 38 | Foundations for rigging equipment, including sheet-piling, earthwork, concrete foundations, and removal of foundations (at containment building). | 692 | 12 | 1 | 1 | 8,304 | |
| 39 | Mobile heavy lift rigger | 100 | 15 | 1 | 1 | 1,500 | |
| 40 | Assemble 4 crawlers. | 150 | 10 | 1 | 1 | 1,500 | |
| 41 | Assemble jacking frame at barge. | 62 | 12 | 1 | 1 | 744 | |
| 42 | Assemble jacking frame at containment. | 78 | 12 | 1 | 1 | 936 | |
| 43 | Preassemble equipment for inside containment. | 78 | 12 | 1 | 1 | 936 | |
| 44 | Install lifting equipment inside containment. | 112 | 15 | 2 | 1 | 1,680 | |
| | | 158 | 15 | 12 | 1 | 2,370 | |
| | | 105 | 15 | 13 | 1 | 1,575 | |

*Refer to Table C-1-5

TABLE C-1-3
(Sheet 9)

MACHINE WELDING OF R.C. PIPE WITH REMOTE VIEWING

| TASK NUMBER | DESCRIPTION | DURATION (HOURS) | AVERAGE NUMBER OF PERSONNEL | *LOCATION | NUMBER OF TIMES TASK PERFORMED | MANHOURS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 45 | Remove existnig steam generators from containment (rigging). | 23 | 15 | 1 | 2 | 690 | |
| | | 26 | 15 | 2 | 2 | 780 | |
| | | 44 | 15 | 4 | 2 | 1,320 | |
| | | 19 | 15 | 19 | 2 | 570 | |
| 46 | Transport and store existing steam generators. | 31 | 10 | 19 | 2 | 620 | |
| 47 | Receive and ballast barge. | 20 | 5 | 1 | 1 | 100 | |
| 48 | Offload, store, load, and transport new steam generators. | 158 | 10 | 1 | 2 | 3,160 | |
| 49 | Rerig as required to install. | 16 | 15 | 1 | 2 | 480 | |
| 50 | Install new steam generators. | 19 | 15 | 1 | 2 | 570 | |
| | | 21 | 15 | 2 | 2 | 630 | |
| | | 37 | 15 | 12 | 2 | 1,110 | |
| | | 12 | 15 | 17 | 2 | 360 | |
| 51 | Remove all external rigging equipment from site. | 225 | 15 | 1 | 1 | 3,375 | |

*Refer to Table C-1-5

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TABLE C-1-3
(Sheet 10)

MACHINE WELDING OF R.C. PIPE WITH REMOTE VIEWING

| TASK NUMBER | DESCRIPTION | DURATION (HOURS) | AVERAGE NUMBER OF PERSONNEL | *LOCATION | NUMBER OF TIMES TASK PERFORMED | MANHOURS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 52 | Remove all rigging equipment from containment. | 75 | 15 | 2 | 1 | 1,125 | |
| | | 105 | 15 | 12 | 1 | 1,575 | |
| | | 70 | 15 | 13 | 1 | 1,050 | |
| 53 | Remove internal rigging equipment from site. | 63 | 15 | 1 | 1 | 945 | |
| 54 | Miscellaneous rigging. | 150 | 5 | 1 | 1 | 750 | |
| 55 | Steam generator storage building. | 406 | 10 | 1 | 1 | 4,060 | |
| 56 | Cut and remove top support of steam generator. | 8 | 5 | 10 | 1 | 40 | |
| | | 5 | 5 | 2 | 1 | 25 | |
| | | 3 | 5 | 9 | 1 | 15 | |
| 57 | Remove shims other steam generator top support. | 6 | 4 | 10 | 1 | 24 | |
| | | 4 | 4 | 2 | 1 | 16 | |
| | | 2 | 4 | 9 | 1 | 8 | |
| 58 | Remove hydraulic snubbers. | 4 | 5 | 10 | 8 | 160 | |
| | | 3 | 5 | 2 | 8 | 120 | |
| | | 1 | 5 | 9 | 8 | 40 | |
| 59 | Unbolt existing steam generator. | 4 | 3 | 4 | 2 | 24 | |
| | | 3 | 3 | 2 | 2 | 18 | |
| | | 1 | 3 | 9 | 2 | 6 | |

*Refer to Table C-1-5

TABLE C-1-3
(Sheet 11)

MACHINE WELDING OF R.C. PIPE WITH REMOTE VIEWING

| TASK NUMBER | DESCRIPTION | DURATION (HOURS) | AVERAGE NUMBER OF PERSONNEL | *LOCATION | NUMBER OF TIMES TASK PERFORMED | MANHOURS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 60 | Remove shims at steam generator base. | 15 | 3 | 4 | 2 | 90 | |
| | | 9 | 3 | 2 | 2 | 54 | |
| | | 6 | 3 | 9 | 2 | 36 | |
| 61 | Bolt down steam generators | 10 | 3 | 5 | 2 | 60 | |
| | | 6 | 3 | 2 | 2 | 36 | |
| | | 4 | 3 | 9 | 2 | 24 | |
| 62 | Reshim bottom steam generator (sliding base). | 50 | 3 | 5 | 2 | 300 | |
| | | 30 | 3 | 2 | 2 | 180 | |
| | | 20 | 3 | 9 | 2 | 120 | |
| 63 | Replace top steam generator support. | 120 | 3 | 11 | 2 | 720 | |
| | | 72 | 3 | 2 | 2 | 432 | |
| | | 48 | 3 | 9 | 2 | 288 | |
| 64 | Reshim top steam generator supports. | 40 | 3 | 11 | 2 | 240 | |
| | | 24 | 3 | 2 | 2 | 144 | |
| | | 16 | 3 | 9 | 2 | 96 | |
| 65 | Reinstall steam generator hydraulic snubbers. | 30 | 4 | 11 | 8 | 960 | |
| | | 18 | 4 | 2 | 8 | 576 | |
| | | 12 | 4 | 9 | 8 | 384 | |

*Refer to Table C-1-5

TABLE C-1-3
(Sheet 12)

MACHINE WELDING OF R.C. PIPE WITH REMOTE VIEWING

| TASK NUMBER | DESCRIPTION | DURATION (HOURS) | AVERAGE NUMBER OF PERSONNEL | *LOCATION | NUMBER OF TIMES TASK PERFORMED | MANHOURS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 66 | Miscellaneous pipe operations (welders tests, material handling, scaffolding, training, hangers and supports, line testing, cleanup, tests). | | | | 1 | 25,058 | Welders tests, training, material handling and fabrication of tents are in Location 1. Remainder of manhours were allocated on the basis of piping manhours in each location. |
| | | | | | 2 | 6,993 | |
| | | | | | 4 | 1,064 | |
| | | | | | 5 | 1,954 | |
| | | | | | 7 | 217 | |
| | | | | | 8 | 26 | |
| | | | | | 9 | 8,358 | |
| | | | | | 10 | 543 | |
| | | | | | 11 | 1,107 | |
| | | | | | 12 | 434 | |
| | | | | | 15 | 933 | |
| | | | | | 17 | 87 | |
| 67 | Distributables (startup, cleanup, scaffolding, welders tests other than pipe fitters, miscellaneous). | | | | 1 | 11,400 | |
| | | | | | 2 | 13,385 | |
| | | | | | 3 | 1,003 | |
| | | | | | 4 | 1,526 | |
| | | | | | 5 | 3,052 | |
| | | | | | 6 | 131 | |
| | | | | | 7 | 1,744 | |
| | | | | | 8 | --- | |

*Refer to Table C-1-5

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TABLE C-1-3
(Sheet 13)

MACHINE WELDING OF R.C. PIPE WITH REMOTE VIEWING

| TASK NUMBER | DESCRIPTION | DURATION (HOURS) | AVERAGE NUMBER OF PERSONNEL | *LOCATION | NUMBER OF TIMES TASK PERFORMED | MANHOURS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 67 | (Continued) | | | | 9 | 11,466 | |
| | | | | | 10 | 567 | |
| | | | | | 11 | 2,921 | |
| | | | | | 12 | 2,616 | |
| | | | | | 13 | 1,090 | |
| | | | | | 14 | 218 | |
| | | | | | 15 | 1,526 | |
| | | | | | 16 | 785 | |
| | | | | | 17 | 1,090 | |
| | | | | | 19 | 480 | |
| 68 | Nonmanual | | | | 1 | 99,160 | Office personnel +50% |
| | | | | | 2 | 6,431 | of engineers and |
| | | | | | 3 | 53 | supervision manhours |
| | | | | | 4 | 1,191 | are in Location 1. |
| | | | | | 5 | 1,648 | Remainder of manhours |
| | | | | | 6 | 16 | by discipline were |
| | | | | | 7 | 238 | allocated to the |
| | | | | | 8 | 61 | proper location based |
| | | | | | 9 | 6,753 | on direct manhours |
| | | | | | 10 | 420 | expended in that |
| | | | | | 11 | 1,191 | location by discipline. |
| | | | | | 12 | 911 | |

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*Refer to Table C-1-5

TABLE C-1-3
(Sheet 14)

MACHINE WELDING OF R.C. PIPE WITH REMOTE VIEWING

| TASK NUMBER | DESCRIPTION | DURATION (HOURS) | AVERAGE NUMBER OF PERSONNEL | *LOCATION | NUMBER OF TIMES TASK PERFORMED | MANHOURS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 68 | (Continued) | | | | 13 | 149 | For example: The manhours for electrical engineers and supts were allocated based on the electrical direct hours expended on each task at each location. |
| | | | | | 14 | 11 | |
| | | | | | 15 | 1,158 | |
| | | | | | 16 | 141 | |
| | | | | | 17 | 401 | |
| | | | | | 18 | --- | |
| | | | | | 19 | 67 | |

*Refer to Table C-1-5

TABLE C-1-4
(Sheet 1)

SUMMARY OF MANHOURS FOR ALL TASKS BY LOCATION

WELDING OF REACTOR COOLANT PIPE BY
MACHINE WITH REMOTE VIEWING

| TASK NO. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 498 | 1,080 | | | | | | | | | | | | | | | | |
| 2 | | 600 | 1,398 | | | | | | | | | | | | | | | | |
| 3 | 1,680 | 812 | | | | | | | | | | | | | | 1,890 | | | |
| 4 | | 408 | | 360 | | 360 | | | 288 | | | | | | | | | | |
| 5 | | 1,260 | | | | | 2,088 | | 828 | | | | | | | | | | |
| 6 | | 1,020 | | | | | 1,680 | | 660 | | | | | | | | | | |
| 7 | | 1,753 | | | 935 | | 32 | 12 | 3,276 | | | | | | | | | | |
| 8 | | 240 | | | | | | 8 | 400 | | | | | | | | | | |
| 9 | | 2,400 | | | 1,280 | | 64 | 16 | 4,464 | | | | | | | | | | |
| 10 | | 448 | | | | | | 16 | 720 | | | | | | | | | | |
| 11 | | 960 | | | 1,056 | | | 24 | 1,056 | | | | | | | | | | |
| 12 | | 720 | | | 960 | | | 24 | 240 | | | | | | | | | | |
| 13 | | | | 12 | | | | 3 | | | | | | | | | | | |
| 14 | | | | | | | | 8 | | | | | | | | | | | |
| 15 | 24 | | | | | | 48 | 24 | 24 | | | | | | | | | | |
| 16 | 36 | 72 | | | | | 144 | 72 | | | | | | | | | | | |
| 17 | | 24 | | | 72 | | | | | | | | | | | | | | |
| 18 | | 36 | | | 144 | | | | | | | | | | | | | | |
| 19 | | 304 | | 256 | | | | | 200 | 256 | | | | | | | | | |
| 20 | | 1,440 | | | | | | | 960 | | 1,200 | | | | | | 1,200 | | |
| 21 | | 120 | | 72 | 120 | | | | 72 | | | | | | | | | | |
| 22 | | 1,560 | | | | | | | 1,662 | 240 | 888 | 888 | | | | | | | |
| 23 | | 160 | | | | | | | 100 | | 260 | | | | | | | | |
| 24 | | 648 | | | | | | | 428 | 100 | 980 | | | | | | | | |
| 25 | | 80 | | | | | | | | | 180 | | | | | | | | |

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TABLE C-I-4
(Sheet 2)

SUMMARY OF MANHOURS FOR ALL TASKS BY LOCATION

WELDING OF REACTOR COOLANT PIPE BY
MACHINE WITH REMOTE VIEWING

| TASK NO. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26 | | 240 | | 200 | | | | | 160 | | | | | | | | 200 | | |
| 27 | | 300 | | | | | | | 200 | | | | | 500 | | | | | |
| 28 | | 120 | | | | | | | 60 | | | | | | 201 | | | | |
| 29 | | 732 | | 78 | 552 | | | | 1,062 | | | | | | | | | | |
| 30 | | 1,158 | | | | | | | 768 | | | | | | 1,932 | | | | |
| 31 | | 148 | | 252 | | | | | 150 | | | | | | | | | | |
| 32 | | 720 | | | | | | | 480 | | 600 | | | | | | 600 | | |
| 33 | | 368 | | | | | | | 48 | | | | | | 692 | | 128 | | |
| 34 | | 60 | | | | | | | 130 | | | | | | | | 40 | 40 | |
| 35 | 21,500 | | | | | | | | | | | | | | | | | | |
| 36 | 19,125 | | | | | | | | | | | | | | | | | | |
| 37 | 11,606 | | | | | | | | | | | | | | | | | | |
| 38 | 8,304 | | | | | | | | | | | | | | | | | | |
| 39 | 1,500 | | | | | | | | | | | | | | | | | | |
| 40 | 1,500 | | | | | | | | | | | | | | | | | | |
| 41 | 744 | | | | | | | | | | | | | | | | | | |
| 42 | 936 | | | | | | | | | | | | | | | | | | |
| 43 | 936 | | | | | | | | | | | | | | | | | | |
| 44 | | 1,680 | | | | | | | | | | | | | | | | | |
| 45 | 690 | 780 | | 1,320 | | | | | | | | 2,370 | 1,575 | | | | | | 570 |
| 46 | | | | | | | | | | | | | | | | | | | 620 |
| 47 | 100 | | | | | | | | | | | | | | | | | | |
| 48 | 3,160 | | | | | | | | | | | | | | | | | | |
| 49 | 480 | | | | | | | | | | | | | | | | | | |
| 50 | 570 | 630 | | | | | | | | | | 1,110 | | | | | 360 | | |
| 51 | 3,375 | | | | | | | | | | | | | | | | | | |
| 52 | | 1,125 | | | | | | | | | | 1,575 | 1,050 | | | | | | |
| 53 | 945 | | | | | | | | | | | | | | | | | | |

TABLE C-1-4
(Sheet 3)

SUMMARY OF MANHOURS FOR ALL TASKS BY LOCATION

WELDING OF REACTOR COOLANT PIPE BY
MACHINE WITH REMOTE VIEWING

| TASK NO. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 54 | 750 | | | | | | | | | | | | | | | | | | |
| 55 | 4,060 | | | | | | | | | | | | | | | | | | |
| 56 | | 25 | | | | | | | 15 | 40 | | | | | | | | | |
| 57 | | | | | | | | | 8 | 24 | | | | | | 16 | | | |
| 58 | | 120 | | | | | | | 40 | 160 | | | | | | | | | |
| 59 | | 18 | | 24 | | | | | 6 | | | | | | | | | | |
| 60 | | 54 | | 90 | | | | | 36 | | | | | | | | | | |
| 61 | | 36 | | | 60 | | | | 24 | | | | | | | | | | |
| 62 | | 180 | | | 300 | | | | 120 | | | | | | | | | | |
| 63 | | 432 | | | | | | | 288 | | 720 | | | | | | | | |
| 64 | | 144 | | | | | | | 96 | | 240 | | | | | | | | |
| 65 | | 576 | | | | | | | 384 | | 960 | | | | | | | | |
| Subtotal | 82,021 | 25,209 | 2,478 | 2,664 | 5,479 | 360 | 4,056 | 207 | 19,453 | 820 | 6,028 | 5,943 | 2,625 | 500 | 2,825 | 1,906 | 2,528 | 40 | 1,190 |
| 66 | 25,058 | 6,993 | - | 1,064 | 1,954 | - | 217 | 20 | 8,358 | 543 | 1,107 | 434 | | | 933 | | 87 | | |
| Total Directs | 107,079 | 32,202 | 2,478 | 3,728 | 7,433 | 360 | 4,273 | 227 | 27,811 | 1,363 | 7,135 | 6,377 | 2,625 | 500 | 3,758 | 1,906 | 2,615 | 40 | 1,190 |
| 67 | 11,400 | 13,385 | 1,003 | 1,526 | 3,052 | 131 | 1,744 | - | 11,466 | 567 | 2,921 | 2,616 | 1,090 | 218 | 1,526 | 785 | 1,090 | - | 480 |
| 68 | 99,160 | 6,431 | 53 | 1,191 | 1,648 | 16 | 238 | 61 | 6,753 | 420 | 1,191 | 911 | 149 | 11 | 1,158 | 141 | 401 | - | 67 |
| Total | 217,639 | 52,018 | 3,534 | 6,445 | 12,133 | 507 | 6,255 | 288 | 46,030 | 2,350 | 11,247 | 9,904 | 3,864 | 729 | 6,422 | 2,832 | 4,106 | 40 | 1,737 |

PALISADES PLANT SGPR
TABLE C-1-5
(SHEET 1)
MAN-REM ESTIMATE

| Work Area (Location) | (1) Average Radiation Field (rem/hr) | Estimated Manhours in Radiation Field (Manual Welding) $A_1$ | (Machine Welding) $A_2$ | (2) Area Man-Rem Dose (Man-Rem) (Manual Welding) | (Machine Welding) |
|---|---|---|---|---|---|
| 1. Outside of power plant building but within security fence. | $.5 \times 10^{-5}$ | 217659 | 217639 | 1.1 | 1.1 |
| 2. Checking in and out through security and health physics as well as time spent suiting up, cleaning up and moving to and from work areas for personnel working in radioactive areas. | .0025 | 52143 | 52018 | 130.3 | 130 |
| 3. Inside containment near new construction opening. | .001 | 3534 | 3534 | 3.5 | 3.5 |
| 4. Within 6' of outside of reactor coolant pipe or bottom of steam generator prior to removal of steam generators. | .030 - .050 | 6276 | 6445 | 188.3 - 313.8 | 193.3 - 322.3 |
| 5. Within 6' outside of reactor coolant pipe after steam generator's removal. | .010 - .030 | 19678 | 12133 | 196.8 - 590.3 | 121.3 - 364.0 |
| 6. Within 6' of outside of reactor coolant pipe or bottom of steam generators with partial exposure to inside of reactor coolant pipe prior to steam generator's removal. | .050 - 0.100 | 507 | 507 | 25.4 - 50.7 | 25.4 - 50.7 |
| 7. Within 6' of outside of reactor coolant pipe with partial exposure to inside of reactor coolant pipe after steam generator's removal. | .050 - .100 | 5658 | 6255 | 283 - 454.8 | 312.8 - 625.5 |

PALISADES PLANT SGRR
TABLE C-1-[illegible]
(SHEET 2)
MAN-REM ESTIMATE

| Work Area (Location) | (1) Average Radiation Field (rem/hr) | Estimated Manhours in Radiation Field (Manual Welding) $A_1$ | (Machine Welding) $A_2$ | (2) Area Man-Rem Dose (Man-Rem) (Manual Welding) | (Machine Welding) |
|---|---|---|---|---|---|
| 8. a) Inside of reactor coolant pipe before decontamination. | 9.0 - 12.0 | 4.3 | 4.2 | 38.7 - 51.6 | 37.8 - 50.4 |
| b) Outside of pipe w/partial exposure inside before decontamination. | 1.0 - 2.0 | 136 | 134 | 136 - 272.0 | 134 - 268.0 |
| c) Inside of reactor coolant pipe after decontamination. | .035 | 148 | 150 | 5.2 | 5.3 |
| 9. Low radiation area within containment | .005 | 39198 | 46030 | 196 | 230.2 |
| 10. Within 6' of top half of original steam generators (installed in place). | .005 | 2365 | 2350 | 11.8 | 11.8 |
| 11. Within 6' of top half of new steam generators (installed in place). | .001 | 11213 | 11247 | 11.2 | 11.3 |
| 12. Operating floor or containment. | .005 - .010 | 9867 | 9904 | 49.3 - 98.7 | 49.5 - 99.0 |
| 13. Inside containment, at polar crane elevation. | .001 | 3867 | 3864 | 3.9 | 3.9 |
| 14. Auxiliary building near clear resin tank and cooling water tank. | .001 | 729 | 729 | 0.7 | 0.7 |
| 15. Auxiliary building near blowdown tank. | .001 | 6408 | 6442 | 6.4 | 6.4 |
| 16. Spent fuel pool floor. | .005 | 2832 | 2832 | 14.2 | 14.2 |
| 17. Within 6' of the bottom half of new steam generators (in place). | .010 - .030 | 4106 | 4106 | 41.1 - 123.2 | 41.1 - 123.2 |

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PALISADES PLANT SGRR
TABLE C-1-5
(SHEET 3)
MAN-REM ESTIMATE

| Work Area (Location) | (1) Average Radiation Field (rem/hr) | Estimated Manhours In Radiation Field (Manual Welding) $A_1$ | (Machine Welding) $A_2$ | (2) Area Man-Rem Dose (Man-Rem) (Manual Welding) | (Machine Welding) |
|---|---|---|---|---|---|
| 18. Within 6' of the outside of the reactor vessel. | .100 | 40 | 40 | 4.0 | 4.0 |
| 19. Next to the existing steam generators outside of the containment | .020 - .030 | 1737 | 1737 | 34.7 - 52.1 | 34.7 - 52.1 |
| 20. Installation of shielding and local decontamination. | (3) | (3) | (3) | 165.7 - 300.8 | 164.7 - 285.3 |
| | | | | 1547 - 2807.6 | 1537 - 2662.9 |

NOTE:

(1) Reduction factors attributed to shielding and/or decontamination have been incorporated into these field estimates and will not be presented here as a separate column.

(2) Further reduction in area man-rem dose could occur as work packages and ALARA studies continue. The estimates are based on conservative assumptions.

(3) The manhour estimates for placement of shielding and local decontamination are tentative due to the continuation of ALARA analysis and work package development. The numbers presented here are an estimate and represent a percentage of the total man-rem.

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C-2 Describe the designated contamination control envelopes and your plan to maintain occupational exposure within these envelopes "ALARA." Include also dose rates, exposure times, and numbers of workers involved in the tasks (Section 4.3.3).

RESPONSE:

The contamination control envelopes will be used for the cutting of reactor coolant piping (Task 4). Although the design of the envelopes has not been finalized, the envelopes will include a high efficiency filtration system. The flow of air within the envelopes will preclude the escape of contaminants through the tent openings used for entering and exiting the area.

Each of the 12 cuts on primary coolant piping will require two workers approximately 15 manhours. It is estimated that 720 man-hours will be spent within the control envelopes, with an average radiation field of 30-50 mr/hr. This results in an estimated 21-36 man-rem of occupational exposure.

As described in the Repair Report, Section 4.3-1, personnel involved in work within areas with a high level of contamination will wear two sets of protective clothing. Respiratory protection will be required in accordance with Palisades health physics procedures. Sheet lead, lead wool blanket, or other shielding will be used where possible in accordance with ALARA guidelines.

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PALISADES PLANT SGRR

C-3 Provide a diagram showing the radiation surveys around the steam generator replacement/repair activities. Include similar radiation surveys for Figures 4.2-4 through 4.2-7. Include a table showing the whole body dose received during the inspection and plugging of the degraded steam generator tubes for 1976, 1977, and 1978.

RESPONSE:

1. Figures 4.3-3, 4.3-4, and 4.3-5, which are included in the Steam Generator Repair Report, show radiation surveys around the steam generators at various times after shutdown. The fields specified are representative of those expected for the replacement repair activities. It should be noted that the fields specified in Figure 4.3-5 are expected to decrease significantly at the time that pipe cutting begins, considered to be 42-140 days post-shutdown for study purposes. The decrease will follow the general radiation field near the steam generator piping shown in Figure 4.3-7. Figures 4.2-4 through 4.2-7 have been modified to include general field information in areas where replacement/repair activities will occur and are now designated as Figures C-3-1 through C-3-4.

2. As requested, Tables C-3-1 and C-3-2 show the whole body dose received for inspection and plugging steam generator tubes during 1976 and 1978, respectively.

TABLE C-3-1
PALISADES PLANT - RADIATION DOSE SUMMARY
STEAM GENERATOR WORK 1976

| | Activity | | 1976 Exposure |
|---|---|---|---|
| 1. | ECT Personnel | | |
| | Inside steam generator (without shielding) | 16.5R | |
| | Outside steam generator | 19.3R | |
| | Total (received over a period of 21 days) | | 35.8R |
| 2. | Insert and remove shielding | | |
| | Inside steam generator | 17.8R | |
| | Outside steam generator | 2.0R | |
| | Total | | 19.8R |
| 3. | Insert templates | | |
| | Inside steam generator | 25.3R | |
| | Outside steam generator | 2.8R | |
| | total | | 28.1R |
| 4. | Brushing and rolling | | |
| | Inside steam generator | 37.6R | |
| | Outside steam generator | 4.3R | |
| | Total | | 41.9R |

PALISADES PLANT SGRR

| Activity | | 1976 Exposure |
|---|---|---|
| 5. Insert plugs | | |
| Inside steam generator | 28.8R | |
| Outside steam generator | 2.9R | |
| Total | | 31.7R |
| 6. Weld plugs | | |
| Inside steam generator | 54.4R | |
| Outside steam generator | 15.3R | |
| Total | | 69.7R |
| 7. QC inspection of above operation | | |
| Inside steam generator | 23.6R | |
| Outside steam generator | 1.6R | |
| Total | | 25.2R |
| 8. Engineers support of above operations | | 10.7R |
| Exposure accumulated inside steam generator | 204.0R | |
| Exposure accumulated outside steam generator | 48.2R | |
| TOTAL ACCUMULATED EXPOSURE | | 262.9R |

NOTE: The exposure designated inside and outside steam generator are only estimates (although the total for each operation is accurate), since inside steam generator data is extracted from high radiation dose summary sheets which also include some outside steam generator work. The net result is that the inside steam generator data reads slightly higher and the outside steam generator data reads slightly lower than actually occurred. Radiation exposure to engineers is not included in this breakdown.

TABLE C-3-2
PALISADES PLANT - RADIATION DOSE SUMMARY
STEAM GENERATOR WORK 1978

| Organization/Activity | *1978 Exposure (Level 9 R/hr 3.5 R/hr) |
|---|---|
| 1. Consumers Power Company Repairmen | |
| a. Manway cover removal/vacuuming | 5.6 |
| b. Dam installation | 45.0 |
| c. Surge line shielding + miscellaneous | 5.5 |
| d. Flooring/RSS hot legs | 8.5 |
| e. Flooring, struts, tracks, bridge | |
| A cold leg | 14.3 |
| B cold leg | 22.5 |

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| Activity | | *1978 Exposure |
|---|---|---|
| f. Tracks, bridge | | |
| | A hot leg | 6.1 |
| | B hot leg | 6.3 |
| g. General maintenance | | 1.9 |
| h. Tube plugging | | |
| | A cold leg | 3.1 |
| | A hot leg | 1.6 |
| | B cold leg | 3.9 |
| | B hot leg | 1.8 |
| i. Equipment removal/leg cleanup | | 6.8 |
| j. Dam removal | | 4.6 |
| k. Manway cover replacement | | 4.9 |
| l. Cont. cleanup | | 2.6 |
| | | 145.0 |
| 2. HP coverage | | 6.0 |
| 3. NDT lab/contractors | | 44.3 |
| 4. CE - Setup | | 2.4 |
| Deplugging | A cold leg | 7.4 |
| | A hot leg | 4.3 |
| Sleeving | | 14.9 |
| | | 29.0 |
| | Total exposure | *224.3 Man-rem |

NOTE: *These exposures are based on dosimeters and TLDs. Source is containment entry logs. These numbers should only be considered close approximations.

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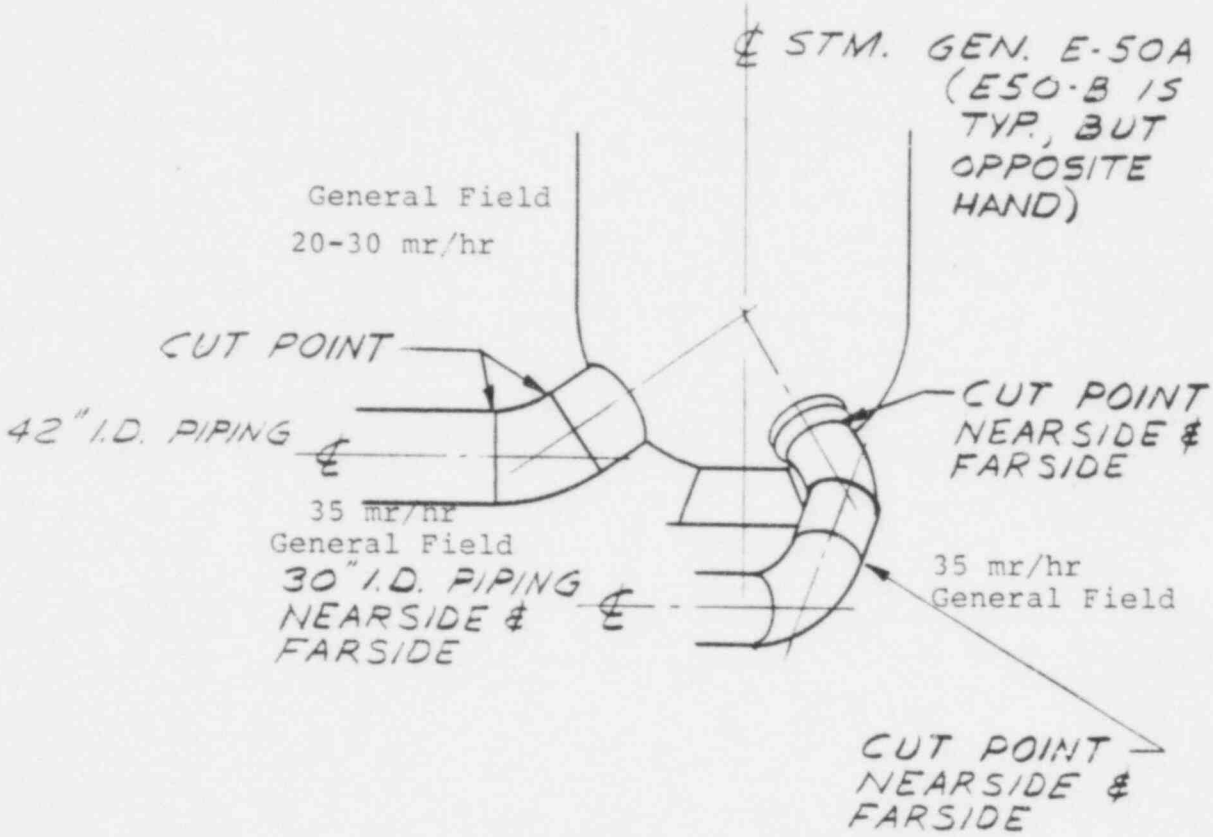


ELEVATION

| PALISADES PLANT<br>STEAM GENERATOR REPAIR REPORT |
|---|
| PRIMARY COOLANT<br>PIPING CUT POINTS<br>Figure C-3-1 |

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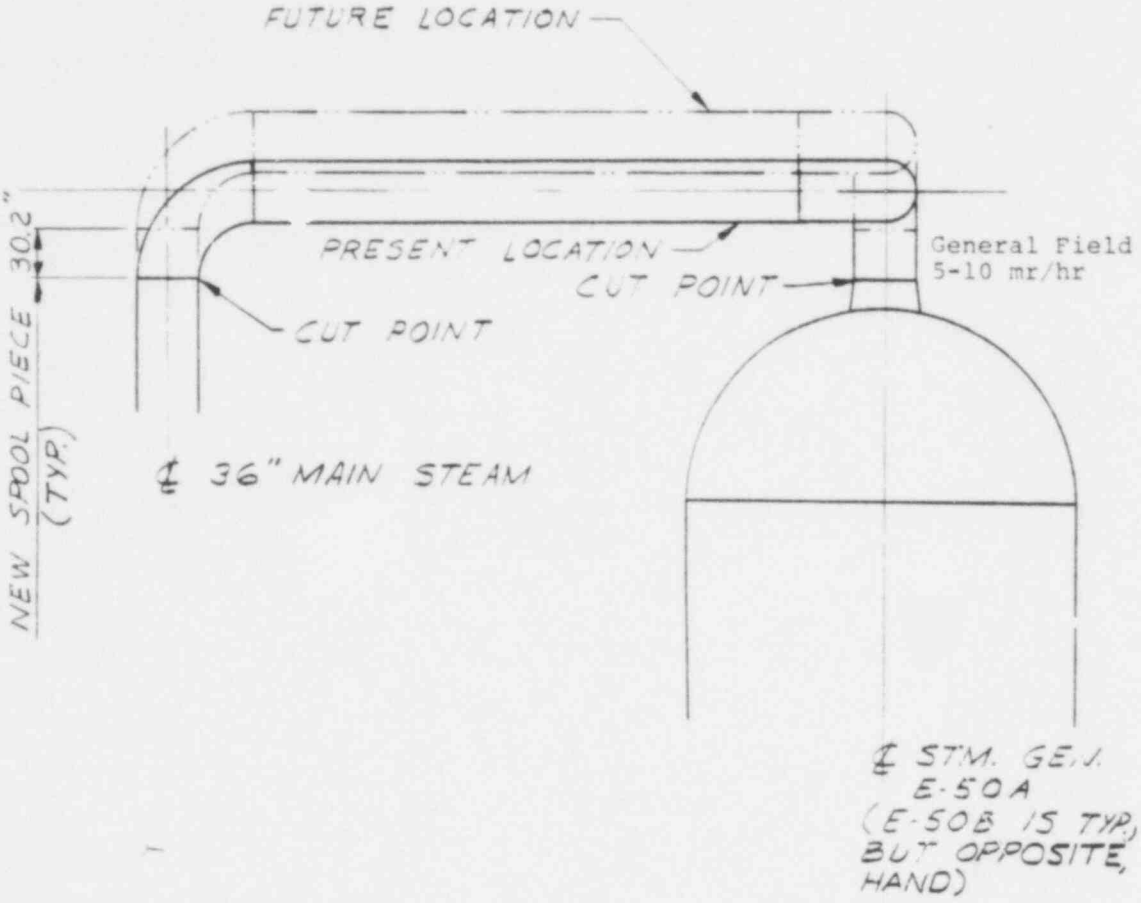


ELEVATION

| PALISADES PLANT<br>STEAM GENERATOR REPAIR REPORT |
|---|
| MAIN STEAM PIPING<br>CUT POINTS<br><br>Figure C-3-2 |

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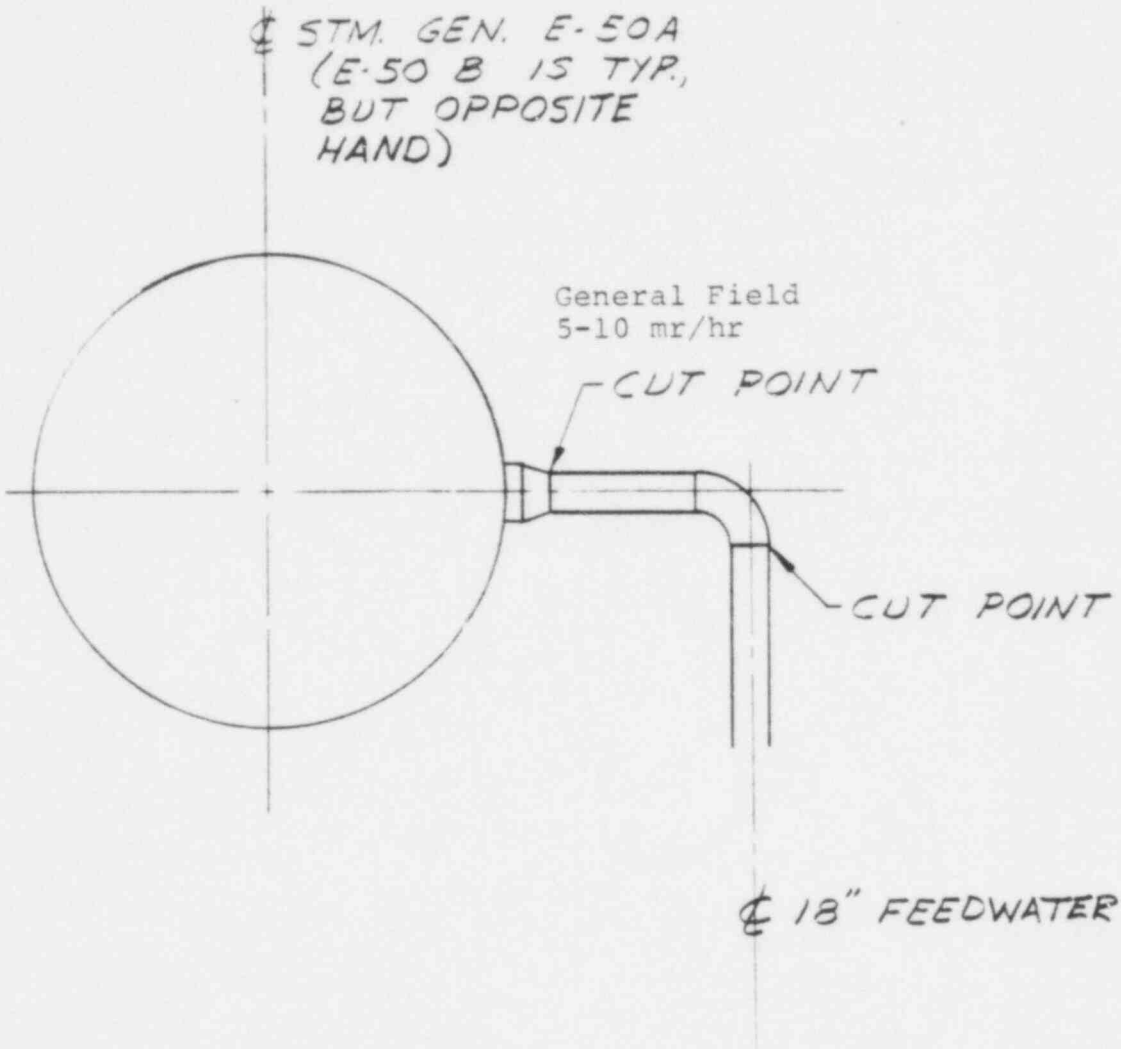


PLAN

PALISADES PLANT
STEAM GENERATOR REPAIR REPORT

FEEDWATER PIPING
CUT POINTS
Figure C-3-3

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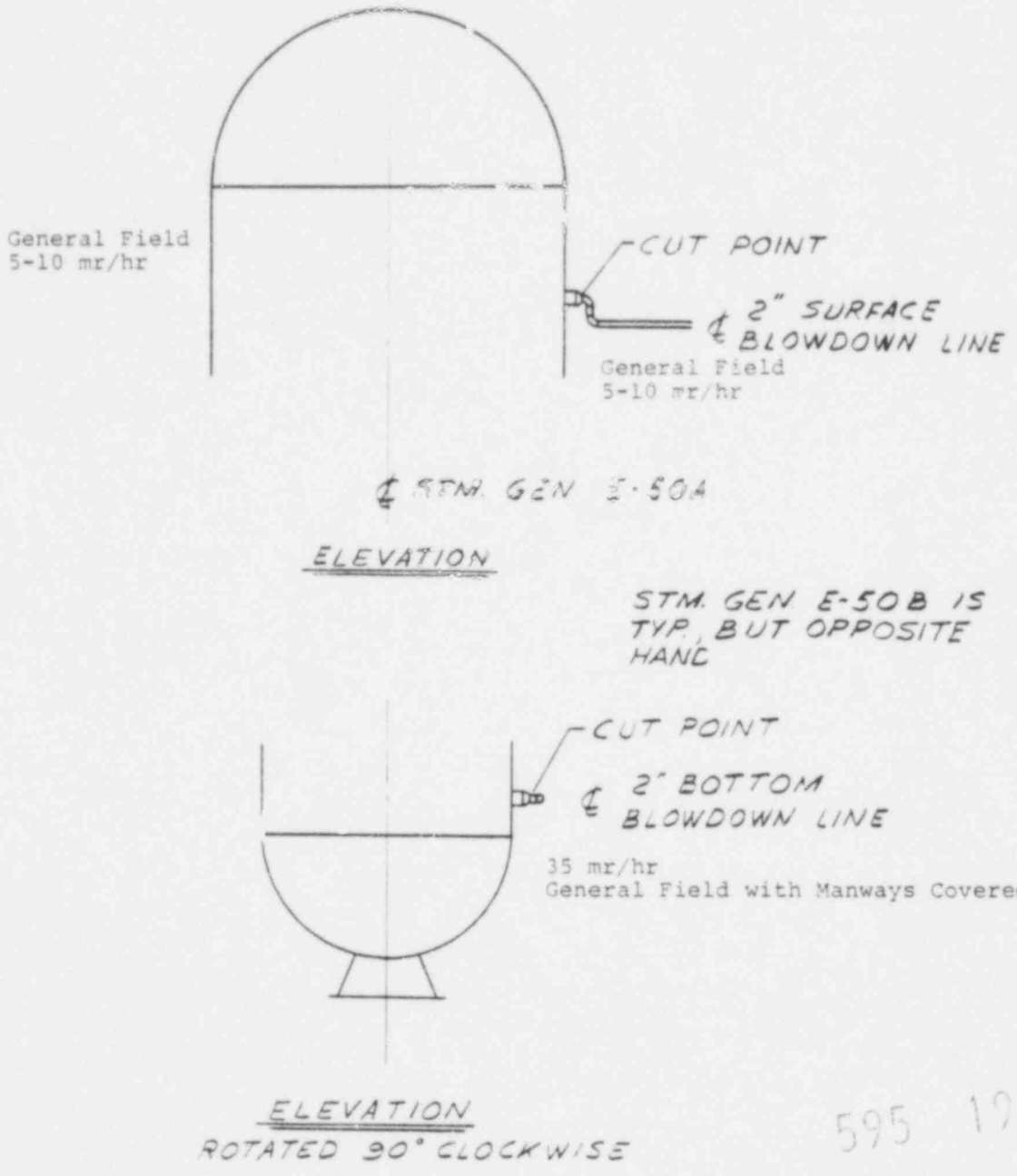


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| PALISADES PLANT<br>STEAM GENERATOR REPAIR REPORT |
|---|
| BLOWDOWN PIPING<br>CUT POINTS<br><br>Figure C-3-4 |

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C-4 Discuss briefly how you would avoid imbalance of the permanent ventilation systems due to the additional construction -related ventilation equipment (portable fans, hoods and filters, etc).

RESPONSE:

Additional construction - related ventilation equipment will be used to supplement the permanent ventilation system and will remove fumes associated with welding and cutting operation as well as ventilating temporary enclosures. Significant imbalance of the permanent ventilation system is not expected since the construction related ventilation equipment will exhaust inside the containment after filtration, and/or have relatively low flowrate. However, should imbalance of the permanent ventilation system occur, balance can be restored by controlling the dampers on the permanent ventilation system.

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C-5 Your description of compliance with Regulatory Guide 8.8, "Information Relevant to Ensuring that Occupational Exposure at Nuclear Power Stations Will Be As Low As Reasonably Achievable", Revision 3, June 1978, states that the following considerations were not implemented:

1. Radiation zones in the containment work areas, identifying the exposure levels in each work zone. C.2.(a)

2. Streaming or scattering of radiation from installed shielding, such as plugs in open ended pipe lines following cutting. C.2.b.(4)

3. Outleakage of airborne contamination from the containment due to steam generator replacement/repair activities when the equipment hatch is open.

4. Operating experiences should be recorded, evaluated, and reflected in the selection of replacement instrumentation. C.2.(c)(3).

5. Provision to be implemented to minimize exposure of station personnel in performing code inspection, such as removable insulation, smooth welds, etc. (C.2.(i)(11)

6. An adequate emergency lighting system can reduce potential exposures of station personnel by permitting prompt egress from high radiation areas if the station lighting system fails.

7. A staff member who is a specialist in radiation protection assigned the responsibility for contributing to and coordinating ALARA efforts in support of operation that could result in substantial individual and collective dose levels.

8. ...Station work areas to limit the average concentration of radioactive material in air to levels below... in Appendix B, Table 1, Column of 10 CFR Part 20. C.2.d

Provide justification for not implementing these provisions of Regulatory Guide 8.8, and demonstrate that alternative precautions you have taken will provide comparable levels of protection.

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RESPONSE:

The philosophy of the radiation protection group is to maintain the occupational dose to all personnel as low as is reasonably achievable (ALARA). This has been stated as a policy in the Palisades Plant Radiation Protection Manual. In order to ensure that the various provisions of Regulatory Guide 8.8 are evaluated adequately, a third party ALARA review of the repair effort has been utilized. The reviewers' responsibilities are to develop ALARA "checklists" to be used in conjunction with the work package descriptions for each of the repair tasks. The "cnecklists" will evaluate and recommend any measure found appropriate to maintaining the personnel exposure ALARA as defined in Regulatory Guide 8.8 (Revision 3).

Although the detailed work packages are presently in the development stage, each of the following specific provisions will necessarily be given complete consideration for use during any replacement/repair activity:

1. The identification of exposure levels in any work zone is presently implemented per Palisades Plant health physics procedures. The Repair Report Section 4.3.5.4 describes the low background radiation waiting areas that will be used near each containment work area. As specified, special signs, tape, or rope-off areas will be utilized to designate these zones. Intermediate zones could be utilized, if found ALARA, as individual work packages are developed.

2. The effective streaming or scattering of radiation from installed shielding, such as plugs in open ended pipe lines, can be minimized through the use of local decontaminating of pipe stubs, use of temporary shielding, or exposure control by controlling ingress or egress to work areas. (See Repair Report Sections 4.3.5.2 and 4.3.5.3). All of these ALARA techniques are being evaluated for use with the individual work packages per third party ALARA review described above.

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3. In addition to the temporary enclosure on the construction opening, airborne radioactivity inside containment during the steam generator repair effort will be controlled, monitored, and ultimately released via the plant vent stack. The air will be drawn through the hatches and construction opening and exhausted by the purge system via the plant ventilation stack, thus precluding airborne radioactive particles or gases from leaving containment openings utilized for construction activities. (See Repair Report Section 4.3.3).

4. Continuous air monitors, area radiation monitors, and portable survey instruments will be used in accordance with Palisades Plant health physics procedures. Daily and weekly operational checks, calibration, and response settings will be implemented and recorded as required per Palisades Plant health physics procedures.

5. Appropriate provisions will be implemented to minimize exposure of station personnel in performing code inspection, such as removable insulation, smooth welds, etc. Design features to improve maintenance and inspection are discussed in the Repair Report Section 2.2.2.

6. An emergency lighting system will be available for the steam generator replacement activities.

7. A staff member who is a specialist in radiation protection will be assigned to the responsibility for coordinating ALARA efforts.

8. Special measures will be implemented to minimize and control the average concentration of radioactive material in air to below those specified in Appendix B, Table 1, Column 1 of 10 CFR Part 29. In addition to temporary enclosures in areas where cutting will occur, containment air will be conditioned for the removal of airborne radioactivity by use of filters.

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C-6 Explain what steps you plan to take to help maintain doses ALARA in this project. Indicate what use will be made of contaminations tents, lead wool blankets, gloveboxes, remote cutting and welding equipment, temporary shielding and ventilation systems. Also indicate what equipment will be mocked-up for training purposes.

RESPONSE:

An independent ALARA review of the steam generator repair effort has been utilized to make recommendations for maintaining doses ALARA (see question C-5). The ALARA recommendations made will be incorporated into the various work packages. Each of the following items will be used where appropriate to maintaining doses ALARA.

1. Contamination Tents - The cutting of primary coolant piping will be contained within specially designed contamination control envelopes. The envelopes will be provided with high efficiency filtration.

2. Temporary shielding in the form of; lead wool blankets, lead shield plugs and sheet lead will be used where effective to maintaining doses ALARA. Experience has shown that lead wool blankets can effectively reduce streaming around shield plug and sheet lead fittings.

3. Gloveboxes - As yet, there are no repair/replacement activities described, which can effectively use glovebox enclosures for maintaining doses ALARA. As work procedures develop, glovebox techniques will remain a viable option.

4. Remote cutting and welding equipment - Automatic welding machines with remote viewing will be used for welding operations made to interior located stainless steel cladding. Measuring equipment for determining the location of reactor vessel and steam generator during weld-up and cutting operations will utilize remote indicators.

   Although the cutting techniques have not been finalized, the ALARA considerations will be one of the determining factors for final selection.

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5. Ventilation Systems - Local construction related ventilation equipment will be used to supplement the permanent ventilation system and will remove fumes associated with welding and cutting operation as well as controlling the airborne contamination existing in the temporary enclosures.

6. Mock-Ups of reactor coolant pipe, and the steam generator primary head as well as the actual cutting and welding equipment will be utilized for training and work planning.

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C-7 Provide a table showing the occupational collective whole body dose estimates for the following phases of the steam generator replacement repair acitivities: (1) preparation, (2) removal, (3) installation and (4) storage.

Discuss briefly your procedure for calculating these doses, taking into account the dose reduction measures proposed to maintain doses as low as reasonably achievable (ALARA), including local decontamination, temporary lead shielding, pre-job planning, pre-job training and use of remote tools where practicable.

RESPONSE:

Table C-7-1 provides the requested information. The table groups the various tasks into preparation, removal, installation, and storage phases of the replacement/repair effort. The man-rem is the product of (man-hours) X (average radiation field) for each task. It should be noted that each task consists of man-hours accumulated in several locations, and each location has a corresponding radiation field. A description of locations and average radiation fields is presented in Table C-1-5, credit taken for decontamination and temporary shielding is incorporated into the radiation field estimates. Reduction factors for shielding and/or decontamination are presented in the repair report, Table 4.3.2.



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TABLE C-7-1
MAN-REM ESTIMATE
(Preparation, Installation, Removal, and Storage)

| Preparation | | | Removal | | | Installation | | | Storage | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Task No. | MHs | Man-Rem | Task No. | MHs | Man-Rem | Task No. | MHs | Man-Rem | Task No. | MHs | Man-Rem |
| 1 | 1,578 | 2.32 | 1 | 1,416 | 31.26 | 2 | 1,993 | 2.90 | 46 | 620 | 12.4 |
| 3 | 4,382 | 11.58 | 13 | 15 | 27.36 | 5 | 4,176 | 111.69 | 55 | 4,060 | 0.02 |
| 34 | 140 | 2.60 | 15 | 120 | 26.52 | 6 | 3,360 | 89.85 | | | |
| 35 | 21,500 | 0.11 | 16 | 324 | 79.38 | 7 | 6,008 | 32.13 | | | |
| 37 | 11,606 | 0.06 | 19 | 1,016 | 10.72 | 8 | 648 | 2.88 | | | |
| 38 | 8,304 | 0.01 | 21 | 115 | 3.02 | 9 | 8,224 | 44.88 | | | |
| 39 | 1,500 | 0.01 | 22 | 476 | .912 | 10 | 1,184 | 5.28 | | | |
| 40 | 1,500 | 0.01 | 24 | 577 | 1.91 | 11 | 3,096 | 19.08 | | | |
| 41 | 744 | 0.01 | 26 | 240 | 4.03 | 12 | 1,944 | 13.44 | | | |
| 42 | 936 | 0.01 | 27 | 300 | 1.00 | 14 | 12 | .42 | | | |
| 43 | 936 | 0.01 | 31 | 550 | 8.68 | 17 | 96 | .78 | | | |
| 44 | 5,625 | 17.62 | 45 | 3,360 | 52.95 | 18 | 180 | 1.53 | | | |
| 47 | 100 | 0.01 | 56 | 80 | .34 | 20 | 4,800 | 9.60 | | | |
| 48 | 3,160 | 0.01 | 57 | 48 | .24 | 21 | 269 | 1.00 | | | |
| 49 | 480 | 0.01 | 58 | 320 | 1.30 | 22 | 4,762 | 14.27 | | | |
| | | | 59 | 48 | .79 | 23 | 520 | 1.16 | | | |
| (1) | (1) | 165.28 | 60 | 180 | 3.02 | 24 | 1,579 | 3.33 | | | |
| | | | | | | 25 | 260 | 16.18 | | | |
| | | | | | | 26 | 560 | 5.37 | | | |
| | | | | | | 27 | 700 | 1.25 | | | |
| | | | | | | 28 | 381 | .80 | | | |
| | | | | | | 29 | 2,424 | 15.00 | | | |
| | | | | | | 30 | 3,858 | 8.67 | | | |
| | | | | | | 32 | 2,400 | 10.8 | | | |
| | | | | | | 33 | 1,236 | 3.13 | | | |
| | | | | | | 34 | 130 | 2.6 | | | |
| | | | | | | 36 | 19,125 | 0.09 | | | |
| | | | | | | 50 | 2,670 | 10.72 | | | |
| | | | | | | 51 | 3,375 | .01 | | | |
| | | | | | | 52 | 3,750 | 11.73 | | | |
| | | | | | | 53 | 945 | 0.01 | | | |
| | | | | | | 54 | 759 | 0.01 | | | |
| | | | | | | 61 | 120 | 0.81 | | | |
| | | | | | | 62 | 600 | 4.05 | | | |
| | | | | | | 63 | 1,440 | 3.24 | | | |
| | | | | | | 64 | 480 | 1.08 | | | |
| | | | | | | 65 | 1,920 | 4.32 | | | |
| Subtotal | 62,491 | 199.66 | | 9,185 | 253.43 | | 89,980 | 454.09 | | 4,680 | 12.42 |
| 66 | 25,058 | 75.82 | 66 | 1,584 | 4.67 | 66 | 20,126 | 60.94 | | | |
| Total Directs | 87,549 | 275.48 | | 10,769 | 258.10 | | 110,106 | 515.03 | | 4,680 | 12.42 |
| Distributables | | | | | | | | | | | |
| 67 | 22,597 | 124 | | 2,779 | 15.28 | | 28,416 | 156.3 | | 1,208 | 6.64 |
| Nonmanual | | | | | | | | | | | |
| 68 | 49,301 | 73.86 | | 6,064 | 8.98 | | 62,600 | 92.33 | | 2,635 | 3.95 |
| Total | 159,447 | 473.34 | | 19,612 | 282.36 | | 200,522 | 763.66 | | 8,523 | 23.01 |

(1) Decontamination/Shielding Installation

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C-8 Discuss your cutting and welding operations and cleanup of surface contamination in respect to "ALARA" guidelines (Section 4.3.3).

RESPONSE:

We note that a definite schedule has not been set for the cutting and welding, that experience is being gained by way of similar operations at other plants, and that detailed work plans have not been completed. The final operations will reflect applicable experience, and ALARA considerations. The following is an outline of operations under consideration at this time.

1. Cutting of Reactor Coolant Pipe

   Since the Palisades reactor coolant pipe is carbon steel w/stainless steel cladding, a plan is to utilize a track mounted oxygen-acetylene torch to cut the pipe. Consideration is also being given to mechanically cutting the pipe in order to minimize the pipe lost during the cutting process and to facilitate the machining operation. The cutting operation will be accomplished in an enclosure to limit spread of contamination.

2. Handling of Pipe to Decontamination Area

   After the pipe has been cut, temporary shield plugs will be secured to each open end of the reactor coolant pipe and the short pieces of pipe moved to a decontamination area. The temporary shield plugs will be mechanically attached to the pipe in order to reduce the number of welding and cutting operations.

3. Field Machining of the RC Pipe Attached to Reactor and Reactor Coolant Pumps

   Temporary shield plugs will be inserted a short distance into the pipe. The pipe between the shield plug and the end of the pipe will then be decontaminated to the extent practical. The pipe weld preparations would then be field machined.

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4. Field Machining of the Short Pieces of Reactor Coolant Pipe

After the new steam generator has been placed, the dimensions between the existing reactor coolant pipe and the new steam generator nozzles will be transferred to the short pieces of reactor coolant pipe and the pipe weld preparations machined.

5. Welding of RC Pipe

After set-up of the reactor coolant pipe the joints may be welded by one of the following methods:

1. Manually weld the carbon steel portion of the reactor coolant pipe and utilize an automatic welding machine with remote viewing for welding the stainless steel interior cladding.

2. Utilize an automatic welding machine with remote viewing to weld both the carbon steel and stainless steel interior cladding.

6. Clean-up of Surface Contamination

Loose surface contamination will be removed manually from the outside of reactor coolant pipe pieces, prior to cutting operations and again, prior to removal from contamination control envelopes. Plastic or other impervious sheeting will be used to cover pipe pieces before relocating to decontamination area.

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C-9 Your estimated dose range of 1,200 to 5,000 man-rem for the steam generator replacement/ repair activities is too wide to assure that occupational exposure will be as low as reasonably practicable. Justify the high end of the range as being ALARA. Experiences with other designs indicate the feasibility of performing such work with substantially lower total doses than the high end of range you have predicted.

RESPONSE:

As presented in the task description (Question C-1), there are two welding techniques being considered for reactor coolant piping. One technique utilizes manual welding of reactor coolant carbon steel pipe with a machine weld-up of the stainless steel cladding. This technique would result in an estimated 1,547-2,808 man-rem for the repair. The second technique utilizes a machine weld-up of both carbon steel pipe and stainless steel cladding. This alternative results in an estimated 1,537-2,663 man-rem for the repair effort.

The high end of the range presented in Table 4.3.2, 5,000 man-rem, resulted from a manual weld-up of carbon steel pipe and cladding entirely from the inside. Due to the technical feasibility of the two welding techniques described above, this third alternative is no longer considered ALARA and has since been eliminated.

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C-10 Provide a rough breakdown of the activities, person-hour occupancies, and projected dose rates which are used in deriving the estimated total of 40,250 man-rems per unit for retubing in place (Section 8.7).

RESPONSE:

Refer to Appendix A of the SGRR response to Question A-2, as transmitted to the USNRC by the Consumer Power Company letter dated June 11, 1979. That analysis is currently under reevaluation.

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