

**DEVELOPMENT WORK FOR AN ADVANCED COAL GASIFICATION SYSTEM  
FOR  
ELECTRIC POWER GENERATION FROM COAL DIRECTED TOWARD  
A COMMERCIAL GASIFICATION GENERATING PLANT  
PHASE II**

**DESIGN REPORT**

**VOLUME 4  
SECTION 200 — WATER WASH,  
SOUR WATER STRIPPING, AND SLURRY PROCESSING**

Under Contract No. E(49-18)-1521

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**FOSTER WHEELER ENERGY  
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## SECTION 200 - WATER WASH

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## Section 1

### INTRODUCTION

#### 1.1 SCOPE

This section of the plant basically consists of water wash, sour water stripping, and slurry processing components.

##### 1.1.1 Water Wash

The water wash section contains a Gas Scrubber (S-202), a Water Wash Tower (T-201), a Water Wash Intercooler (E-214), and associated pumps. In this equipment any fine, entrained char in the gas from Section 100 is washed out, and the gas is cooled from 300 to 110°F with resulting condensation of water. The slurry is sent to filtration. In addition to this final solids removal, this system scrubs the low-Btu gas with clean water and serves the important functions of removing ammonia to a level suitable for the Selexol system, aiding to minimize nitrogen oxides in the ultimate gas turbine exhaust, and promoting removal of phenols and other trace components which may be present.

##### 1.1.2 Sour Water Stripping

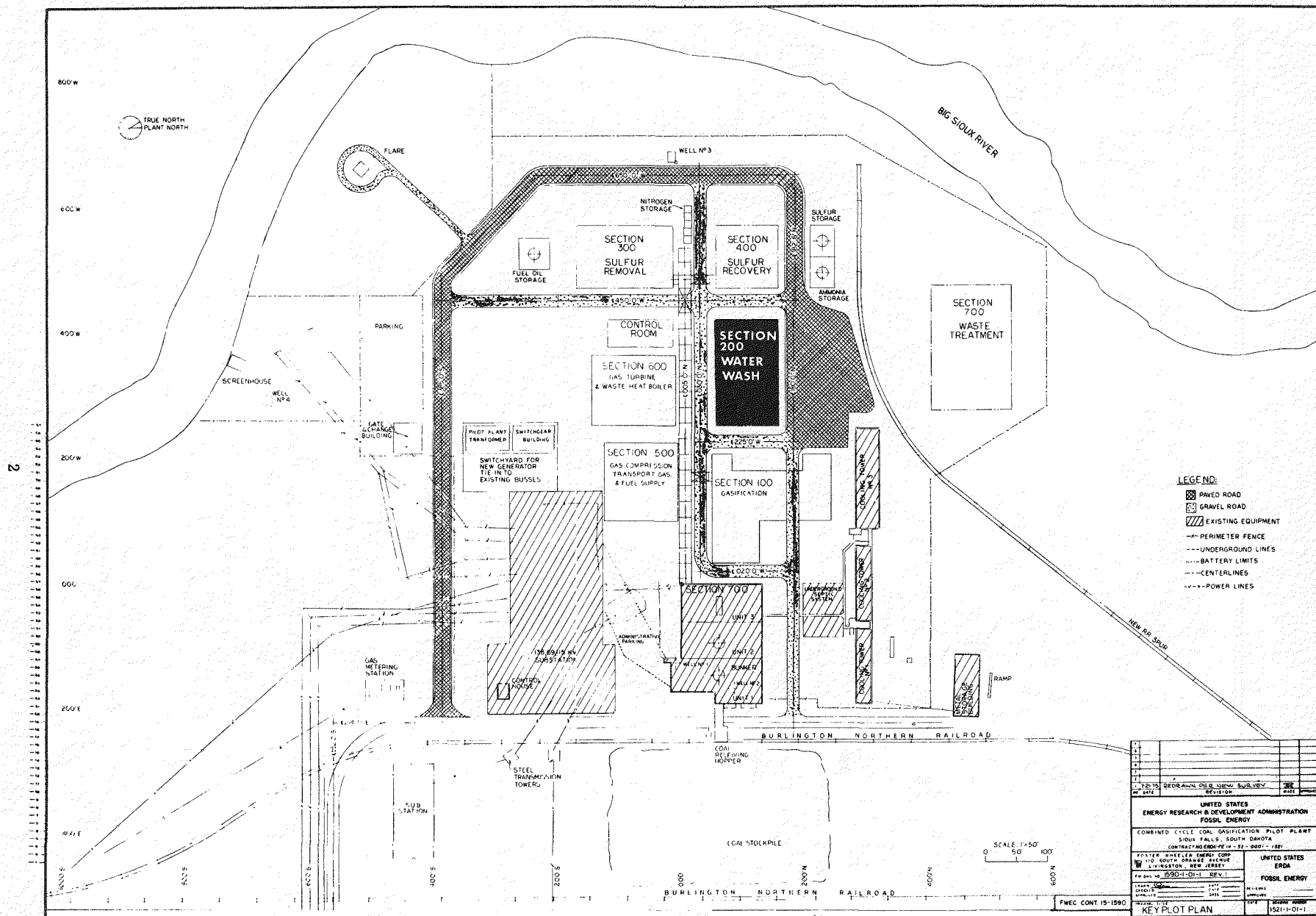
The sour water stripping section consists of Sour Water Strippers (SWS) (T-202 and T-203) and associated pumps, exchangers, and drums. Its function is stripping hydrogen sulfide, carbon dioxide, and ammonia from the rich solution in the middle section of the water wash tower and from the excess water which goes to the municipal sewer. The stripped gases are sent to Section 400 for sulfur recovery.

##### 1.1.3 Slurry Processing

The slurry processing section consists of the Slurry Filtration Package (A-202) and associated Flash Strippers (T-204 and T-205), Vacuum System (A-203), and auxiliaries.

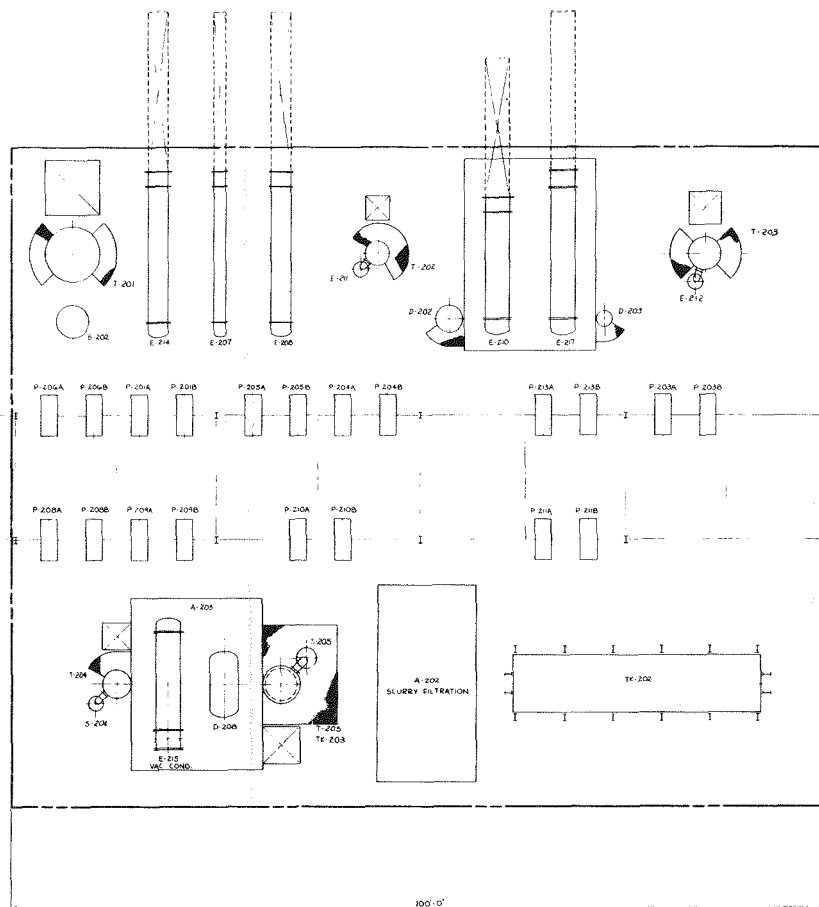
In this equipment slurry from the water wash and a similar slurry from the Section 100 recycle gas scrubber are filtered. The solid filter cake is trucked to the landfill for disposal. The water filtrate is sent to sour water stripping for final stripping of dissolved gases before sending it to the municipal sewer. In plant start-up this section handles slurry from the start-up system of Section 100 in a similar manner.







ROAD

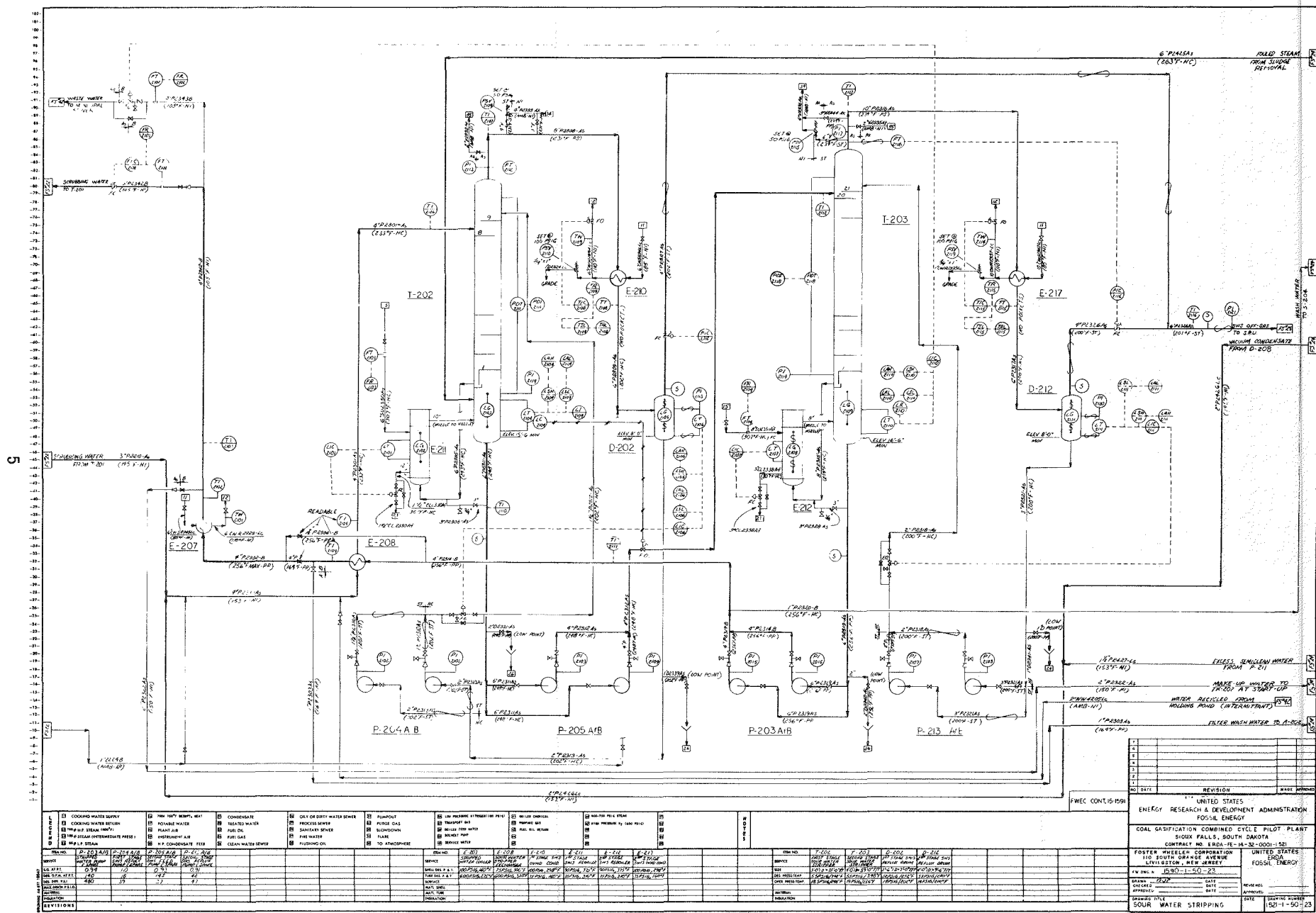
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FWEC CONT. 15-1592

FEBRUARY 1960

THE FOLLOWING SUPERSEDES





|                                                                                                                                                                                                                                                                                                                 |  |                                                                                                                                                                                                                                                                                                                                           |  |                                                                                                                                                                                                                  |  |                                                                                                                                                                                                                                                                                                                                                                                                             |  |                                                                                                                                                                                 |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |
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| <b>COOLING WATER SUPPLY</b><br>1. COOLING WATER SUPPLY<br>2. COOLING WATER RETURN<br>3. COOLING WATER PUMP<br>4. COOLING WATER TANK<br>5. COOLING WATER FILTER<br>6. COOLING WATER VALVE<br>7. COOLING WATER PIPING<br>8. COOLING WATER ELECTRICAL<br>9. COOLING WATER INSTRUMENTS<br>10. COOLING WATER RECORDS |  | <b>PROPERTY OF THE SUPPLY</b><br>11. PROPERTY OF THE SUPPLY<br>12. PROPERTY OF THE SUPPLY<br>13. PROPERTY OF THE SUPPLY<br>14. PROPERTY OF THE SUPPLY<br>15. PROPERTY OF THE SUPPLY<br>16. PROPERTY OF THE SUPPLY<br>17. PROPERTY OF THE SUPPLY<br>18. PROPERTY OF THE SUPPLY<br>19. PROPERTY OF THE SUPPLY<br>20. PROPERTY OF THE SUPPLY |  | <b>CONNECTIONS</b><br>21. CONNECTIONS<br>22. CONNECTIONS<br>23. CONNECTIONS<br>24. CONNECTIONS<br>25. CONNECTIONS<br>26. CONNECTIONS<br>27. CONNECTIONS<br>28. CONNECTIONS<br>29. CONNECTIONS<br>30. CONNECTIONS |  | <b>ONLY ONE DIRECT WATER SUPPLY</b><br>31. ONLY ONE DIRECT WATER SUPPLY<br>32. ONLY ONE DIRECT WATER SUPPLY<br>33. ONLY ONE DIRECT WATER SUPPLY<br>34. ONLY ONE DIRECT WATER SUPPLY<br>35. ONLY ONE DIRECT WATER SUPPLY<br>36. ONLY ONE DIRECT WATER SUPPLY<br>37. ONLY ONE DIRECT WATER SUPPLY<br>38. ONLY ONE DIRECT WATER SUPPLY<br>39. ONLY ONE DIRECT WATER SUPPLY<br>40. ONLY ONE DIRECT WATER SUPPLY |  | <b>FLUORIDE</b><br>41. FLUORIDE<br>42. FLUORIDE<br>43. FLUORIDE<br>44. FLUORIDE<br>45. FLUORIDE<br>46. FLUORIDE<br>47. FLUORIDE<br>48. FLUORIDE<br>49. FLUORIDE<br>50. FLUORIDE |  | <b>NO OTHER PREVIOUS EXTENSION FROM THIS</b><br>51. NO OTHER PREVIOUS EXTENSION FROM THIS<br>52. NO OTHER PREVIOUS EXTENSION FROM THIS<br>53. NO OTHER PREVIOUS EXTENSION FROM THIS<br>54. NO OTHER PREVIOUS EXTENSION FROM THIS<br>55. NO OTHER PREVIOUS EXTENSION FROM THIS<br>56. NO OTHER PREVIOUS EXTENSION FROM THIS<br>57. NO OTHER PREVIOUS EXTENSION FROM THIS<br>58. NO OTHER PREVIOUS EXTENSION FROM THIS<br>59. NO OTHER PREVIOUS EXTENSION FROM THIS<br>60. NO OTHER PREVIOUS EXTENSION FROM THIS |  | <b>BE PREVIOUS EXTENSION FROM THIS</b><br>61. BE PREVIOUS EXTENSION FROM THIS<br>62. BE PREVIOUS EXTENSION FROM THIS<br>63. BE PREVIOUS EXTENSION FROM THIS<br>64. BE PREVIOUS EXTENSION FROM THIS<br>65. BE PREVIOUS EXTENSION FROM THIS<br>66. BE PREVIOUS EXTENSION FROM THIS<br>67. BE PREVIOUS EXTENSION FROM THIS<br>68. BE PREVIOUS EXTENSION FROM THIS<br>69. BE PREVIOUS EXTENSION FROM THIS<br>70. BE PREVIOUS EXTENSION FROM THIS |  | <b>TO BE PROVIDED WITH ADEQUATE CLEAN-OUT CONNECTIONS AT LOW POINTS &amp; ELBOWS</b><br>71. TO BE PROVIDED WITH ADEQUATE CLEAN-OUT CONNECTIONS AT LOW POINTS & ELBOWS<br>72. TO BE PROVIDED WITH ADEQUATE CLEAN-OUT CONNECTIONS AT LOW POINTS & ELBOWS<br>73. TO BE PROVIDED WITH ADEQUATE CLEAN-OUT CONNECTIONS AT LOW POINTS & ELBOWS<br>74. TO BE PROVIDED WITH ADEQUATE CLEAN-OUT CONNECTIONS AT LOW POINTS & ELBOWS<br>75. TO BE PROVIDED WITH ADEQUATE CLEAN-OUT CONNECTIONS AT LOW POINTS & ELBOWS<br>76. TO BE PROVIDED WITH ADEQUATE CLEAN-OUT CONNECTIONS AT LOW POINTS & ELBOWS<br>77. TO BE PROVIDED WITH ADEQUATE CLEAN-OUT CONNECTIONS AT LOW POINTS & ELBOWS<br>78. TO BE PROVIDED WITH ADEQUATE CLEAN-OUT CONNECTIONS AT LOW POINTS & ELBOWS<br>79. TO BE PROVIDED WITH ADEQUATE CLEAN-OUT CONNECTIONS AT LOW POINTS & ELBOWS<br>80. TO BE PROVIDED WITH ADEQUATE CLEAN-OUT CONNECTIONS AT LOW POINTS & ELBOWS |  | <b>NO OTHER PREVIOUS EXTENSION FROM THIS</b><br>81. NO OTHER PREVIOUS EXTENSION FROM THIS<br>82. NO OTHER PREVIOUS EXTENSION FROM THIS<br>83. NO OTHER PREVIOUS EXTENSION FROM THIS<br>84. NO OTHER PREVIOUS EXTENSION FROM THIS<br>85. NO OTHER PREVIOUS EXTENSION FROM THIS<br>86. NO OTHER PREVIOUS EXTENSION FROM THIS<br>87. NO OTHER PREVIOUS EXTENSION FROM THIS<br>88. NO OTHER PREVIOUS EXTENSION FROM THIS<br>89. NO OTHER PREVIOUS EXTENSION FROM THIS<br>90. NO OTHER PREVIOUS EXTENSION FROM THIS |  | <b>BE PREVIOUS EXTENSION FROM THIS</b><br>91. BE PREVIOUS EXTENSION FROM THIS<br>92. BE PREVIOUS EXTENSION FROM THIS<br>93. BE PREVIOUS EXTENSION FROM THIS<br>94. BE PREVIOUS EXTENSION FROM THIS<br>95. BE PREVIOUS EXTENSION FROM THIS<br>96. BE PREVIOUS EXTENSION FROM THIS<br>97. BE PREVIOUS EXTENSION FROM THIS<br>98. BE PREVIOUS EXTENSION FROM THIS<br>99. BE PREVIOUS EXTENSION FROM THIS<br>100. BE PREVIOUS EXTENSION FROM THIS |  |
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| FOSTER WHEELER CORP.<br>PROCESS PLANTS DIVISION |         |          |      | CONTRACT NO: 15-1591<br>SECTION: 200 |          | LINE CLASSIFICATION<br>LIST |               |            |               | FLOWSHEET NUMBER<br>DWG NO 1521-1-50-22 |      | REV                         | BY                   | PAGE    |
|-------------------------------------------------|---------|----------|------|--------------------------------------|----------|-----------------------------|---------------|------------|---------------|-----------------------------------------|------|-----------------------------|----------------------|---------|
| REVISION                                        | 0       |          |      | 1                                    | 2        | 3                           | 4             | 5          | 6             | 7                                       | 8    | 9                           | 10                   |         |
| DATE                                            | 4-22-76 |          |      |                                      |          |                             |               |            |               |                                         |      |                             |                      |         |
| LINE NUMBER                                     |         |          |      | LINE EXTREMITIES                     |          | OPERATING                   |               | DESIGN     |               | INSULATION                              |      | PLAN OR ISO.<br>DRAWING NO. | PIPE<br>WALL<br>TKN. | REMARKS |
| SIZE                                            | SERIAL  | SPEC     |      | FROM                                 | TO       | TEMP<br>°F                  | PRESS<br>PSIG | TEMP<br>°F | PRESS<br>PSIG | TYPE                                    | TKN. |                             |                      |         |
| 12"                                             | P       | 2205     | B    | S 202                                | T 201    |                             |               | 265        | 470           | PP                                      |      |                             |                      |         |
| 8"                                              | P       | 2206     | B    | T 201                                | P 201A/B |                             |               | 180        | 414           | PP                                      |      |                             |                      |         |
| 8"                                              | P       | 2207     | B    | P 201A/B                             | E 214    |                             |               | 180        | 456           | PP                                      |      |                             |                      |         |
| 2"                                              | P       | 2208     | B    | P2207                                | A 204    |                             |               | 180        | 456           | PP                                      |      |                             |                      |         |
| 8"                                              | P       | 2209     | B    | E 214                                | T 201    |                             |               | 98         | 500           | NI                                      |      |                             |                      |         |
| 3"                                              | P       | 2210B/As |      | T 201                                | E 208    |                             |               | 145        | 414           | NI                                      |      |                             |                      |         |
| 1 1/2"                                          | P       | 2212     | B    | P2342                                | P2207    |                             |               | 105        | 600           | NI                                      |      |                             |                      |         |
| 12"                                             | P       | 2213     | B    | T 201                                | E 302    |                             |               | 110        | 414           | NI                                      |      |                             |                      |         |
| 2"/4"                                           | P       | 2214     | B/As | A 204                                | T 204    |                             |               | 265        | 470           | PP                                      |      |                             |                      |         |
| 8"/10"                                          | V       | 2215     | B/As | P2205                                | 34       |                             |               | 265        | 470           | PP                                      |      |                             |                      |         |
| 6"/10"                                          | P       | 2216     | B/As | P2205                                | P2215    |                             |               | 265        | 470           | PP                                      |      |                             |                      |         |
| 2"                                              | V       | 2217     | B/As | P2213                                | ATM      |                             |               | 110        | 414           | NI                                      |      |                             |                      |         |
| 2"                                              | D       | 2218     | B/As | P2206                                | 26       |                             |               | 180        | 414           | PP                                      |      |                             |                      |         |
| 10"                                             | CWR     | 2219     | Lc   | E 214                                | 12       |                             |               | 110        | 100           | NI                                      |      |                             |                      |         |
| 10"                                             | CWS     | 2220     | Lc   | 11                                   | E 214    |                             |               | 85         | 100           | NI                                      |      |                             |                      |         |
| 1"                                              | NH      | 2221     | Bk   | 47                                   | P2205    |                             |               | AMB        | 600           | NI                                      |      |                             |                      |         |
| 1"                                              | NL      | 2222     | Ak   | 35                                   | P2205    |                             |               | AMB        | 100           | NI                                      |      |                             |                      |         |
| 1"                                              | W       | 2223     | Lc   | 40                                   | A 205    |                             |               | AMB        | 100           | NI                                      |      |                             |                      |         |
| 1"                                              | P       | 2224     | B    | A 205                                | FS 23    |                             |               | AMB        | 470           | NI                                      |      |                             |                      |         |
| 1"                                              | P       | 2225     | B    | P2224                                | P2205    |                             |               | AMB        | 470           | NI                                      |      |                             |                      |         |
| 12"                                             | P       | 1408     | Bd   | FS 14                                | S 202    |                             |               | 300°       | 470           | NI                                      |      |                             |                      |         |
| 4"/3"                                           | P       | 2342     | B/As | E 207                                | T 201    |                             |               | 105        | 600           | NI                                      |      |                             |                      |         |

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|-------------------------------------------------|---------|------|------|--------------------------------------|------------|-----------------------------|------------|---------------|------|-------------------------------------------|---|-----------------------------|----------------------|---------|----|------|
| REVISION                                        | 0       |      |      | 1                                    | 2          | 3                           | 4          | 5             | 6    | 7                                         | 8 | 9                           | 10                   |         |    |      |
| DATE                                            | 3-17-76 |      |      |                                      |            |                             |            |               |      |                                           |   |                             |                      |         |    |      |
| LINE NUMBER                                     |         |      |      | LINE EXTREMITIES                     |            | OPERATING                   |            | DESIGN        |      | INSULATION                                |   | PLAN OR ISO.<br>DRAWING NO. | PIPE<br>WALL<br>TKN. | REMARKS |    |      |
| SIZE                                            | SERIAL  | SPEC | FROM | TO                                   | TEMP<br>°F | PRESS<br>PSIG               | TEMP<br>°F | PRESS<br>PSIG | TYPE | TKN.                                      |   |                             |                      |         |    |      |
| 4"                                              | P       | 2301 | As   | E 208                                | T 202      |                             |            | 233           | 55   | HC                                        |   |                             |                      |         |    |      |
| 4"                                              | P       | 2302 | B    | E 208                                | E 207      |                             |            | 256           | 600  | PP                                        |   |                             |                      |         |    |      |
| 1"                                              | P       | 2303 | As   | P 2302                               | A 202      |                             |            | 164           | 55   | PP                                        |   |                             |                      |         |    |      |
| 1½"                                             | P       | 2304 | B    | P 2314                               | P2302      |                             |            | 256           | 600  | PP                                        |   |                             |                      |         |    |      |
| 8"                                              | P       | 2305 | As   | T 202                                | E 211      |                             |            | 243           | 55   | HC                                        |   |                             |                      |         |    |      |
| 3"                                              | P       | 2306 | As   | P2305                                | P2311      |                             |            | 243           | 55   | HC                                        |   |                             |                      |         |    |      |
| 8"                                              | P       | 2308 | As   | T 202                                | E 210      |                             |            | 231           | 55   | PS                                        |   |                             |                      |         |    |      |
| 6"                                              | P       | 2309 | As   | E 210                                | D 202      |                             |            | 202           | 55   | HC                                        |   |                             |                      |         |    |      |
| 1½"                                             | P       | 2310 | As   | P 204A/B                             | T 202      |                             |            | 202           | 55   | HC                                        |   |                             |                      |         |    |      |
| 6"                                              | P       | 2311 | As   | T 202                                | P 205A/B   |                             |            | 248           | 55   | HC                                        |   |                             |                      |         |    |      |
| 4"                                              | P       | 2312 | As   | P 205A/B                             | T 203      |                             |            | 248           | 37   | HC                                        |   |                             |                      |         |    |      |
| 2"                                              | P       | 2313 | As   | D 202                                | P 204A/B   |                             |            | 202           | 52   | HC                                        |   |                             |                      |         |    |      |
| 4"                                              | P       | 2314 | B    | P 203A/B                             | E 208      |                             |            | 256           | 480  | PP                                        |   |                             |                      |         |    |      |
| 8"                                              | P       | 2315 | As   | T 203                                | E 212      |                             |            | 254           | 55   | HC                                        |   |                             |                      |         |    |      |
| 10"                                             | P       | 2316 | As   | T 203                                | E 217      |                             |            | 234           | 55   | PC                                        |   |                             |                      |         |    |      |
| 6"                                              | P       | 2317 | As   | E 217                                | D 212      |                             |            | 200           | 55   | HC                                        |   |                             |                      |         |    |      |
| 2"                                              | P       | 2318 | As   | P 213                                | T 203      |                             |            | 200           | 47   | HC                                        |   |                             |                      |         |    |      |
| 6"                                              | P       | 2319 | As   | T 203                                | P 203A/B   |                             |            | 256           | 55   | PP                                        |   |                             |                      |         |    |      |
| 1"                                              | P       | 2320 | B    | P2314                                | S 204      |                             |            | 256           | 480  | HC                                        |   |                             |                      |         |    |      |
| 3"                                              | P       | 2321 | As   | D 212                                | P 213 A/B  |                             |            | 200           | 53   | HC                                        |   |                             |                      |         |    |      |
| 2"                                              | P       | 2322 | B/As | P2342                                | TK203      |                             |            | 150           | 600  | NI                                        |   |                             |                      |         |    |      |
| 1"                                              | D       | 2324 | Lc   | CWR2334                              | Drain      |                             |            | 110           | 50   | NI                                        |   |                             |                      |         |    |      |
| 4"/6"                                           | P       | 2326 | As   | D 212                                | FS 25      |                             |            | 201           | 53   | ST                                        |   |                             |                      |         |    |      |
| 4"                                              | P       | 2327 | As   | D 202                                | P 2326     |                             |            | 202           | 52   | ST                                        |   |                             |                      |         |    |      |
| 3"                                              | P       | 2328 | As   | E 212                                | P2319      |                             |            | 254           | 55   | HC                                        |   |                             |                      |         |    |      |
| 6"                                              | CWR     | 2329 | Lc   | E 207                                | 12         |                             |            | 110           | 100  | NI                                        |   |                             |                      |         |    |      |
| 1½"                                             | CL      | 2330 | As   | E 211                                | 21         |                             |            | 207           | 90   | HC                                        |   |                             |                      |         |    |      |
| 2"                                              | D       | 2331 | As   | P2311                                | 26         |                             |            | 248           | 50   | PP                                        |   |                             |                      |         |    |      |
| 2"                                              | V       | 2332 | As   | P2308                                | ATM        |                             |            | AMB           |      | NI                                        |   |                             |                      |         |    |      |
| 1"                                              | D       | 2333 | Lc   | CWR2337                              | Drain      |                             |            | 110           |      | NI                                        |   |                             |                      |         |    |      |

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|-------------------------------------------------|----------|----------|--------------|----------------------------------|--|-----------------------------|------------|---------------|------------|-----------------------------------------|------|------------|--|-----------------------------|----|----------------------|--|---------|--|---|--|----|--|
| REVISION                                        |          | 0        |              | 1                                |  | 2                           |            | 3             |            | 4                                       |      | 5          |  | 6                           |    | 7                    |  | 8       |  | 9 |  | 10 |  |
| DATE                                            |          | 11-17-76 |              |                                  |  |                             |            |               |            |                                         |      |            |  |                             |    |                      |  |         |  |   |  |    |  |
| LINE NUMBER                                     |          |          |              | LINE EXTREMITIES                 |  |                             |            | OPERATING     |            | DESIGN                                  |      | INSULATION |  | PLAN OR ISO.<br>DRAWING NO. |    | PIPE<br>WALL<br>TKN. |  | REMARKS |  |   |  |    |  |
| SIZE                                            | SERIAL   | SPEC     | FROM         | TO                               |  |                             | TEMP<br>°F | PRESS<br>PSIG | TEMP<br>°F | PRESS<br>PSIG                           | TYPE | TKN.       |  |                             |    |                      |  |         |  |   |  |    |  |
| 6"                                              | CWR 2334 | Lc       | E 210        | 11                               |  |                             |            |               | 110        | 100                                     | NI   |            |  |                             |    |                      |  |         |  |   |  |    |  |
| 2"                                              | V 2335   | As       | P2316        | ATM                              |  |                             |            |               | AMB        |                                         | NI   |            |  |                             |    |                      |  |         |  |   |  |    |  |
| 6"                                              | V 2336   | As       | P2316        | 34                               |  |                             |            |               | AMB        |                                         | NI   |            |  |                             |    |                      |  |         |  |   |  |    |  |
| 10"                                             | CWR 2337 | Lc       | E 217        | 12                               |  |                             |            |               | 110        | 100                                     | NI   |            |  |                             |    |                      |  |         |  |   |  |    |  |
| 3"                                              | CL 2338  | Af       | E 212        | 21                               |  |                             |            |               | 307        | 90                                      | HC   |            |  |                             |    |                      |  |         |  |   |  |    |  |
| 1"                                              | D 2339   | As       | P2313        | 26                               |  |                             |            |               | 202        |                                         | PP   |            |  |                             |    |                      |  |         |  |   |  |    |  |
| 2"                                              | D 2340   | As       | P2319        | 26                               |  |                             |            |               | 256        |                                         | PP   |            |  |                             |    |                      |  |         |  |   |  |    |  |
| 1"                                              | D 2341   | As       | P2321        | 26                               |  |                             |            |               | 200        |                                         | PP   |            |  |                             |    |                      |  |         |  |   |  |    |  |
| 4"/3"                                           | P 2342   | B        | E 207        | T 201                            |  |                             |            |               | 105        | 600                                     | NI   |            |  |                             |    |                      |  |         |  |   |  |    |  |
| 3"                                              | P 2343   | B/As     | P 2342       | (FS 42)                          |  |                             |            |               | 105        |                                         | NI   |            |  |                             |    |                      |  |         |  |   |  |    |  |
| 3"                                              | V 2344   | As       | P2316        | V2336                            |  |                             |            |               | 234        |                                         | PP   |            |  |                             |    |                      |  |         |  |   |  |    |  |
| 6"                                              | CWS 2345 | Lc       | 11           | E 207                            |  |                             |            |               | 85         | 100                                     | NI   |            |  |                             |    |                      |  |         |  |   |  |    |  |
| 6"                                              | CWS 2346 | Lc       | 11           | E 210                            |  |                             |            |               | 85         | 100                                     | NI   |            |  |                             |    |                      |  |         |  |   |  |    |  |
| 10"                                             | CWS 2347 | Lc       | 11           | E 217                            |  |                             |            |               | 85         | 100                                     | NI   |            |  |                             |    |                      |  |         |  |   |  |    |  |
| 4"                                              | V 2349   | AK       | P2308        | 34                               |  |                             |            |               | AMB        |                                         | NI   |            |  |                             |    |                      |  |         |  |   |  |    |  |
| 6"                                              | SU 2350  | Af       | 15           | E 211                            |  |                             |            |               | 307        | 90                                      | HC   |            |  |                             |    |                      |  |         |  |   |  |    |  |
| 8"                                              | SU 2351  | Af       | 15           | E 212                            |  |                             |            |               | 307        | 90                                      | HC   |            |  |                             |    |                      |  |         |  |   |  |    |  |
| 1"                                              | B 2352   | B        | P2224        | P2210                            |  |                             |            |               | AMB        | 470                                     | NI   |            |  |                             |    |                      |  |         |  |   |  |    |  |
| 6"                                              | P 2425   | As       | P2418        | T 202                            |  |                             |            |               | 153        | 56                                      | NI   |            |  |                             |    |                      |  |         |  |   |  |    |  |
| 2"                                              | P 2426   | Lc       | P 209A/B     | P2210                            |  |                             |            |               | 145        | 27                                      | NI   |            |  |                             |    |                      |  |         |  |   |  |    |  |
| 1 1/2"                                          | P 2427   | B/Lc     | P2418        | P2426                            |  |                             |            |               | 153        |                                         | NI   |            |  |                             |    |                      |  |         |  |   |  |    |  |
| 3"/4"                                           | P 2210   | B/As     | T 201        | E 208                            |  |                             |            |               | 153        | 75                                      | NI   |            |  |                             |    |                      |  |         |  |   |  |    |  |
| 1"                                              | B 2224   | B        | A 205        | P2309                            |  |                             |            |               | AMB        | 470                                     | NI   |            |  |                             |    |                      |  |         |  |   |  |    |  |
| 2"                                              | WW 4205  | Lc       | POND (FS 42) | P2210                            |  |                             |            |               | AMB        | 75                                      | NI   |            |  |                             |    |                      |  |         |  |   |  |    |  |



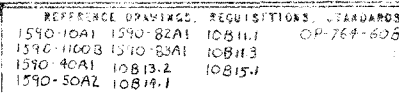
| FOSTER WHEELER CORP.<br>PROCESS PLANTS DIVISION |        |         |      | CONTRACT NO: 15-1591<br>SECTION: 200 |          | LINE CLASSIFICATION<br>LIST |            |               |            | FLOWSHEET NUMBER<br>1590-1-50-24 |      |            |  | REV                         | BY | PAGE                 |  |         |  |   |  |    |  |
|-------------------------------------------------|--------|---------|------|--------------------------------------|----------|-----------------------------|------------|---------------|------------|----------------------------------|------|------------|--|-----------------------------|----|----------------------|--|---------|--|---|--|----|--|
| REVISION                                        |        | 0       |      | 1                                    |          | 2                           |            | 3             |            | 4                                |      | 5          |  | 6                           |    | 7                    |  | 8       |  | 9 |  | 10 |  |
| DATE                                            |        | 3-17-76 |      |                                      |          |                             |            |               |            |                                  |      |            |  |                             |    |                      |  |         |  |   |  |    |  |
| LINE NUMBER                                     |        |         |      | LINE EXTREMITIES                     |          |                             |            | OPERATING     |            | DESIGN                           |      | INSULATION |  | PLAN OR ISO.<br>DRAWING NO. |    | PIPE<br>WALL<br>TKN. |  | REMARKS |  |   |  |    |  |
| SIZE                                            | SERIAL | SPEC    | FROM | TO                                   |          |                             | TEMP<br>°F | PRESS<br>PSIG | TEMP<br>°F | PRESS<br>PSIG                    | TYPE | TKN.       |  |                             |    |                      |  |         |  |   |  |    |  |
| 1"                                              | P      | 2401    | As   | S 204                                | T 204    |                             |            |               |            | 260                              | 56   | HC         |  |                             |    |                      |  |         |  |   |  |    |  |
| 6"                                              | P      | 2402    | As   | T 204                                | P 208A/B |                             |            |               |            | 260                              | 56   | HC         |  |                             |    |                      |  |         |  |   |  |    |  |
| 4"                                              | P      | 2403    | As   | P 208A/B                             | T 205    |                             |            |               |            | 260                              | 57   | HC         |  |                             |    |                      |  |         |  |   |  |    |  |
| 6"                                              | P      | 2404    | As   | P2403                                | T 204    |                             |            |               |            | 260                              | 57   | HC         |  |                             |    |                      |  |         |  |   |  |    |  |
| 8"                                              | CWR    | 2405    | Lc   | E 215                                | 12       |                             |            |               |            | 110                              | 100  | NI         |  |                             |    |                      |  |         |  |   |  |    |  |
| 6"                                              | P      | 2406    | As   | T 205                                | TK203    |                             |            |               |            | 153                              | 16   | NI         |  |                             |    |                      |  |         |  |   |  |    |  |
| 16"                                             | P      | 2407    | As   | S 205                                | E 215    |                             |            |               |            | 153                              | 16   | NI         |  |                             |    |                      |  |         |  |   |  |    |  |
| 3"                                              | P      | 2408    | As   | J 202                                | P2425    |                             |            |               |            | 300                              | 56   | HC         |  |                             |    |                      |  |         |  |   |  |    |  |
| 1"                                              | P      | 2409    | As   | S 205                                | TK203    |                             |            |               |            | 153                              | 16   | NI         |  |                             |    |                      |  |         |  |   |  |    |  |
| 6"                                              | P      | 2410    | As   | TK203                                | P 210A/B |                             |            |               |            | 153                              |      | NI         |  |                             |    |                      |  |         |  |   |  |    |  |
| 4"                                              | P      | 2411    | As   | P 210A/B                             | A 202    |                             |            |               |            | 153                              | 65   | NI         |  |                             |    |                      |  |         |  |   |  |    |  |
| 4"                                              | P      | 2412    | As   | P2411                                | TK712    |                             |            |               |            | 250                              | 65   | PP         |  |                             |    |                      |  |         |  |   |  |    |  |
| 3"                                              | P      | 2413    | Lc   | D 208                                | P 209A/B |                             |            |               |            | 145                              | 27   | NI         |  |                             |    |                      |  |         |  |   |  |    |  |
| 4"                                              | P      | 2414    | As   | P5010                                | P2214    |                             |            |               |            | 343                              | 65   | HC         |  |                             |    |                      |  |         |  |   |  |    |  |
| 6"                                              | P      | 2415    | As   | A 202                                | T 203    |                             |            |               |            | 153                              | 10   | NI         |  |                             |    |                      |  |         |  |   |  |    |  |
| 4"                                              | P      | 2416    | As   | A 202                                | TK202    |                             |            |               |            | 153                              | 10   | NI         |  |                             |    |                      |  |         |  |   |  |    |  |
| 1 1/2"                                          | P      | 2417    | As   | P2418                                | E 216    |                             |            |               |            | 153                              | 580  | NI         |  |                             |    |                      |  |         |  |   |  |    |  |
| 3"/1"                                           | P      | 2418    | As   | P 211A/B                             | CL 101   |                             |            |               |            | 153                              | 580  | NI         |  |                             |    |                      |  |         |  |   |  |    |  |
| 1 1/2"                                          | P      | 2419    | B    | P2418                                | S 109    |                             |            |               |            | 153                              |      | NI         |  |                             |    |                      |  |         |  |   |  |    |  |
| 4"                                              | P      | 2420    | As   | TK202                                | P 211A/B |                             |            |               |            | 153                              | 5    | NI         |  |                             |    |                      |  |         |  |   |  |    |  |
| 2"                                              | V      | 2421    | As   | A 202                                | ATM      |                             |            |               |            | AMB                              |      | NI         |  |                             |    |                      |  |         |  |   |  |    |  |
| 2"                                              | P      | 2422    | B/As | P 211A/B                             | TW3606   |                             |            |               |            | 153                              |      | NI         |  |                             |    |                      |  |         |  |   |  |    |  |
| 1"                                              | P      | 2433    | As   | TK202                                | TK718    |                             |            |               |            | AMB                              | 50   | NI         |  |                             |    |                      |  |         |  |   |  |    |  |
| 1"                                              | P      | 2424    | As   | P2418                                | S 205    |                             |            |               |            | 153                              | 580  | NI         |  |                             |    |                      |  |         |  |   |  |    |  |
| 2"                                              | CWR    | 2425    | Lc   | E 216                                | 12       |                             |            |               |            | 110                              |      | NI         |  |                             |    |                      |  |         |  |   |  |    |  |
| 2"                                              | C      | 2426    | Lc   | P 209A/B                             | T 202    |                             |            |               |            | 145                              | 81   | NI         |  |                             |    |                      |  |         |  |   |  |    |  |
| 1 1/2"                                          | P      | 2427    | As   | P2418                                | T 202    |                             |            |               |            | 153                              |      | NI         |  |                             |    |                      |  |         |  |   |  |    |  |
| 2"                                              | CWS    | 2428    | Lc   | 11                                   | E 216    |                             |            |               |            | 85                               |      | NI         |  |                             |    |                      |  |         |  |   |  |    |  |



| FW ENERGY CORPORATION<br>PROCESS PLANTS DIVISION |          | CONTRACT<br>15-1591              | SECTION<br>200 | EQUIPMENT LIST |          |           | TYPE OF UNIT<br>COAL GASIFICATION PROJECT |        |         | PAGE<br>OF 17 |
|--------------------------------------------------|----------|----------------------------------|----------------|----------------|----------|-----------|-------------------------------------------|--------|---------|---------------|
| CUSTOMER ERDA-FE                                 |          |                                  |                | REVISION       | 6        | 7         | 2                                         | 3      | 4       | 5             |
| LOCATION                                         |          |                                  |                | DATE           | 1/14/76  | 4/7/76    | 6/18/75                                   | 9/2/75 | 9/15/75 | 12/11/75      |
| CLASS                                            | ITEM NO. | DESCRIPTION                      | FD #           | REQ'N. NO.     | P.O. NO. | ELEVATION |                                           |        |         |               |
| TOWERS                                           | T-201    | Water Wash Tower                 |                | 1112A          |          |           |                                           |        |         |               |
|                                                  | T-202    | First Stage Sour Water Stripper  |                | 1113A          |          |           |                                           |        |         |               |
|                                                  | T-203    | Second Stage Sour Water Stripper |                | 1114A          |          |           |                                           |        |         |               |
|                                                  | T-204    | Slurry Stripper                  |                | 1115A          |          |           |                                           |        |         |               |
|                                                  | T-205    | Slurry Vacuum Flasher            |                | 1116A          |          |           |                                           |        |         |               |
| DRUMS                                            | D-202    | 1st Stage SWS Reflux Drum        |                | 1131G          |          |           |                                           |        |         |               |
|                                                  | D-208    | Vacuum Condensate Drum           |                | 1131L          |          |           |                                           |        |         |               |
|                                                  | D-212    | 2nd Stage SWS Reflux Drum        |                | 1131N          |          |           |                                           |        |         |               |
|                                                  | D-213*   | Slurry Vacuum Separator          |                |                |          |           | In Pkg. A-203                             |        |         |               |
| TANKS                                            | TK-202   | Slurry Fil. Tank/Oil Sep.        |                | 1141C          |          |           |                                           |        |         |               |
|                                                  | TK-203   | Slurry Tank                      |                | 1141D          |          |           |                                           |        |         |               |
|                                                  | TK-204   | Inhibitor Storage Tank           |                |                |          |           | In Pkg. A-205                             |        |         |               |
| EXCHANGERS                                       | E-207    | Stripped Water Cooler            |                | 1211Q          |          |           |                                           |        |         |               |
|                                                  | E-208    | Sour Water Strip. Exch.          |                | 1211R          |          |           |                                           |        |         |               |
|                                                  | E-210    | 1st Stage SWS Ovhd Cond.         |                | 1211T          |          |           |                                           |        |         |               |
|                                                  | E-211    | First Stage SWS Reboiler         |                | 1211U          |          |           |                                           |        |         |               |
|                                                  | E-212    | Second Stage SWS Reboiler        |                | 1211V          |          |           |                                           |        |         |               |
|                                                  | E-214    | Water Wash Intercooler           |                | 1211W          |          |           |                                           |        |         |               |
|                                                  | E-215*   | Slurry Vacuum Cond.              |                |                |          |           | In Pkg. A-203                             |        |         |               |
|                                                  | E-216*   | Barometric Water Cooler          |                |                |          |           | In Pkg. A-203                             |        |         |               |
|                                                  | E-217    | 2nd Stage SWS Ovhd Cond.         |                | 1211Z          |          |           |                                           |        |         |               |
| PUMPS                                            | P-201A   | Water Wash Circulating Pump      |                | 1311F          |          |           |                                           |        |         |               |
|                                                  | P-201B   | Water Wash Circ. Pump Spare      |                | 1311F          |          |           |                                           |        |         |               |
|                                                  | P-203A   | Strip. Water Pump                |                | 1311H          |          |           |                                           |        |         |               |
|                                                  | P-203B   | Strip. Water Pump Spare          |                | 1311H          |          |           |                                           |        |         |               |
|                                                  | P-204A   | 1st Stage SWS Reflux Pump        |                | 1311J          |          |           |                                           |        |         |               |
|                                                  | P-204B   | 1st Stage SWS Reflux Pump Spare  |                | 1311J          |          |           |                                           |        |         |               |
|                                                  | P-205A   | Second Stage SWS Feed Pump       |                | 1311K          |          |           |                                           |        |         |               |
|                                                  | P-205B   | Second Stage SWS Feed Pump Spare |                | 1311K          |          |           |                                           |        |         |               |
|                                                  | P-206A*  | Gas Scrubber Pump                |                |                |          |           | In Pkg. A-204                             |        |         |               |
|                                                  | P-206B*  | Gas Scrubber Pump Spare          |                |                |          |           | In Pkg. A-204                             |        |         |               |
|                                                  | P-207*   | Injection Pump                   |                |                |          |           | In Pkg. A-205                             |        |         |               |

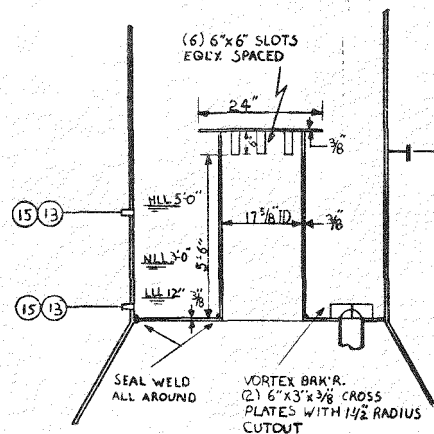
| FW ENERGY CORPORATION<br>PROCESS PLANTS DIVISION |          | CONTRACT<br>15-1591              | SECTION<br>200 | EQUIPMENT LIST  |          | TYPE OF UNIT<br>COAL GASIFICATION PROJECT |               |         |          |  | PAGE<br>OF 17 |
|--------------------------------------------------|----------|----------------------------------|----------------|-----------------|----------|-------------------------------------------|---------------|---------|----------|--|---------------|
| CUSTOMER ERDA-FE                                 |          |                                  |                | REVISION<br>6   | 7        | 2                                         | 3             | 4       | 5        |  |               |
| LOCATION SIOUX FALLS, SOUTH DAKOTA               |          |                                  |                | DATE<br>1/14/76 | 4/7/76   | 6/18/75                                   | 9/2/75        | 9/15/75 | 12/11/75 |  |               |
| CLASS                                            | ITEM NO. | DESCRIPTION                      | FD #           | REQ'N. NO.      | P.O. NO. | ELEVATION                                 |               |         |          |  |               |
| PUMPS<br>(Cont'd)                                | P-208A   | Slurry Strip. Bottoms Pump       |                | 1311N           |          |                                           |               |         |          |  |               |
|                                                  | P-208B   | Slurry Strip. Bottoms Pump Spare |                | 1311N           |          |                                           |               |         |          |  |               |
|                                                  | P-209A   | Vacuum Cond. Water Pump          |                | 1311P           |          |                                           |               |         |          |  |               |
|                                                  | P-209B   | Vacuum Cond. Water Pump Spare    |                | 1311P           |          |                                           |               |         |          |  |               |
|                                                  | P-210A   | Slurry Filtration Feed Pump      |                | 1311Q           |          |                                           |               |         |          |  |               |
|                                                  | P-210B   | Slurry Filt. Feed Pump Spare     |                | 1311Q           |          |                                           |               |         |          |  |               |
|                                                  | P-211A   | Semi Clean Water Pump            |                | 1311R           |          |                                           |               |         |          |  |               |
|                                                  | P-211B   | Semi Clean Water Pump Spare      |                | 1311R           |          |                                           |               |         |          |  |               |
|                                                  |          |                                  |                |                 |          |                                           |               |         |          |  |               |
|                                                  |          |                                  |                |                 |          |                                           |               |         |          |  |               |
|                                                  | P-213A   | 2nd Stage SWS Reflux Pump        |                | 1311S           |          |                                           |               |         |          |  |               |
|                                                  | P-213B   | 2nd Stage SWS Reflux Pump Spare  |                | 1311S           |          |                                           |               |         |          |  |               |
|                                                  |          |                                  |                |                 |          |                                           |               |         |          |  |               |
| SCRUBBER                                         | S-202*   | Gas Scrubber                     |                |                 |          |                                           | In Pkg. A-204 |         |          |  |               |
|                                                  |          |                                  |                |                 |          |                                           |               |         |          |  |               |
| MISC.                                            | BC-201*  | Barometric Condenser             |                |                 |          |                                           | In Pkg. A-203 |         |          |  |               |
|                                                  | J-201*   | First Stage Jet                  |                |                 |          |                                           | In Pkg. A-203 |         |          |  |               |
|                                                  | J-202*   | Second Stage Jet                 |                |                 |          |                                           | In Pkg. A-203 |         |          |  |               |
|                                                  |          |                                  |                |                 |          |                                           |               |         |          |  |               |
|                                                  |          |                                  |                |                 |          |                                           |               |         |          |  |               |
|                                                  |          |                                  |                |                 |          |                                           |               |         |          |  |               |
|                                                  | S-204    | Solids Stripper Entrainment Sep. |                | 1342A           |          |                                           |               |         |          |  |               |
|                                                  | S-205    | Vacuum Flash Entrainment Sep.    |                | 1342E           |          |                                           |               |         |          |  |               |
|                                                  |          |                                  |                |                 |          |                                           |               |         |          |  |               |
|                                                  |          |                                  |                |                 |          |                                           |               |         |          |  |               |





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|                                                                                                                        |                     |                       |      |
|------------------------------------------------------------------------------------------------------------------------|---------------------|-----------------------|------|
| 2                                                                                                                      |                     |                       |      |
| A 19-176 CONN. #7 WRS B, ADD ELEV. OF CONN. 11.47 M                                                                    |                     | REVISION              | MADE |
| UNITED STATES<br>ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION<br>FOSSIL ENERGY                                         |                     |                       |      |
| COAL GASIFICATION COMBINED CYCLE PILOT PLANT<br>SIOUX FALLS, SOUTH DAKOTA<br>CONTRACT NO ERDA-FE 14 - 32 - 0001 - 1521 |                     |                       |      |
| FOUR WHEELER ENERGY CORP<br>10 SOUTH ORANGE AVENUE<br>LIVINGSTON, NEW JERSEY                                           |                     | UNITED STATES<br>ERDA |      |
| FW DGC NO. 0P-764-607-A                                                                                                |                     | FOSSIL ENERGY         |      |
| DRAWN <u>RLK</u>                                                                                                       | DATE <u>3/26/78</u> | REVIEWED _____        |      |
| CHECKED _____                                                                                                          | DATE _____          | APPROVED _____        |      |
| APPROVED _____                                                                                                         | DATE _____          | DRAWING NUMBER _____  |      |
| DRAWING TITLE<br>WATER WASH TOWER T201                                                                                 |                     |                       |      |
| FWIC CONT. 15-1591                                                                                                     |                     | REQ. NO. 1591-1112A   |      |



DETAIL-TOWER MIDSECTION

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## RELEASES

| CHG. REV. | DATE          | ISSUED FOR                                                                                                                                                                                  |
|-----------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           | DATE OF ORDER | (A) PURCHASE SHELL AND HEAD MATERIAL. PREPARE BUT DO NOT SUBMIT SHOP DETAIL DRAWINGS.                                                                                                       |
|           |               | (B) ISSUE CHECKED FOSTER WHEELER DRAWING. PURCHASE ALL OTHER MATERIALS. FINALIZE AND SUBMIT CHECKED SHOP DETAIL DRAWING WITHIN ONE WEEK OF RELEASE DATE. PROCEED WITH COMPLETE FABRICATION. |
|           |               | (C) VENDOR'S DRAWING RETURNED                                                                                                                                                               |
|           |               | (D) FIELD CONSTRUCTION                                                                                                                                                                      |
|           |               | (E)                                                                                                                                                                                         |

## NOZZLE CHART

| CON. NO. | SIZE   | USAS. RATING | SERVICE               | NO. REQD. |
|----------|--------|--------------|-----------------------|-----------|
| 1        | 20"    | 300° RF      | MANWAY/DRAWIT         | 5         |
| 2        | 8"     |              | CIRCULATING LIQ. OUT  | 1         |
| 3        | 8"     |              | CIRCULATING LIQ. IN   | 1         |
| 4        | 12"    |              | GAS OUTLET            | 1         |
| 5        | 3"     |              | SCRUBBING LIQ. INLET  | 1         |
| 6        | 3"     |              | SCRUBBING LIQ. OUTLET | 1         |
| 7        | 3/4"   | 6000° C PLG  | P.D.T.                | 4         |
| 8        | 3/4"   |              | LT (LOWER SECTION)    | 2         |
| 9        | 3/4"   |              | LG (LOWER SECTION)    | 2         |
| 10       | 1 1/2" |              | TI                    | 1         |
| 11       | 12"    | 300° RF      | GAS INLET             | 1         |
| 12       | 10"    | 300° RF      | PACKING DUMP          | 3         |
| 13       | 3/4"   | 6000° C PLG  | LT (UPPER SECTION)    | 2         |
| 14       | 1"     | 300° RF      | GAS SAMPLE CONN.      | 1         |
| 15       | 3/4"   | 6000° C PLG  | LG (UPPER SECTION)    | 2         |

## VESSEL DATA

|    |                                  |                                   |             |     |
|----|----------------------------------|-----------------------------------|-------------|-----|
| 1  | ITEM NO.                         | T-201                             | NO. REQ'D.  | ONE |
| 2  | SERVICE                          | WATER WASH TOWER                  |             |     |
| 3  |                                  |                                   |             |     |
| 4  | DIAMETER                         | 4'-6" x 6'-6"                     |             |     |
| 5  | TANGENT LENGTH                   | 97'-0"                            |             |     |
| 6  | OPER. PRESSURE                   | 373                               | PSIG        |     |
| 7  | ABOVE LIQUID LEVEL MAX.          |                                   | PSI         |     |
| 8  | DESIGN PRESSURE                  | 414                               | PSIG        |     |
| 9  | OPER. LIQUID HOLD-UP PRESS.      | 3                                 | PSI         |     |
| 10 | OPER. PRESS. DROP THRU VESSEL    | 1                                 | PSIG        |     |
| 11 | MAX. RECEIVING PRESS. @ TOP HD.  | 410                               | PSIG        |     |
| 12 | MAX. OPER. TEMPERATURE           | 265° @ TOP                        |             |     |
| 13 | DESIGN TEMPERATURE               | 315° F                            |             |     |
| 14 | SPECIFIC GRAVITY (PROCESS FLUID) | 1.0                               |             |     |
| 15 | CODE                             | ASME SEC. VIII DIV. 1             | STAMPER     | YES |
| 16 | P.W.M.T. FOR CODE                |                                   | FOR PROCESS |     |
| 17 | RADIOGRAPHED                     | (SPOTS FULL) (SEE FIELD)          |             |     |
| 18 | JOINT EFFICIENCY                 | (85%) (100%)                      |             |     |
| 19 | CORROSION ALLOWANCE SHELLS       | 1/8" HEADS: 1/8"                  |             |     |
| 20 | MATL. SHELL                      | SA-516-70                         |             |     |
| 21 | MATL. HEADS                      | SA-516-70                         |             |     |
| 22 | MATL. SUPPORTS                   | SA-283-C                          |             |     |
| 23 | TYPE OF HEADS                    | 2:1 ELLIP                         |             |     |
| 24 | EXTERNAL BOLTING                 | SA-193-B7/SA-194-2H               |             |     |
| 25 | INTERNAL BOLTING                 | SA-307-B                          |             |     |
| 26 | GASKETS                          | D.J. ASBESTOS                     |             |     |
| 27 | BOLT HOLES                       | STRADDLE VESSEL CENTERLINE        |             |     |
| 28 | PAINT                            | PER SPEC 1590-83A                 |             |     |
| 29 | INSULATION                       | YES-PP LOWER 20' ONLY (BY OTHERS) |             |     |
| 30 | SHIPMENT                         | ONE PIECE                         |             |     |
| 31 | INSULATION SUPP. BY VESS. FAB.   |                                   |             |     |
| 32 | EMPTY WGT.                       | 101286                            | LBS         |     |
| 33 | WATER WGT. (ONLY)                | 159678                            | LBS         |     |
| 34 | TRAYS WGT.                       |                                   | LBS         |     |
| 35 | INSULATION WGT.                  | 2000 (EST)                        | LBS         |     |
| 36 | CURITE WGT.                      | 8387                              | LBS         |     |
| 37 | OPER. LIQUID WGT.                | 17000                             | LBS         |     |
| 38 | PACKING WGT.                     | 52253                             |             |     |
| 39 |                                  |                                   |             |     |
| 40 |                                  |                                   |             |     |
| 41 | HYDROTEST: SHOP                  | FIELD                             | PSI         |     |
| 42 | GAGE LOCATION                    |                                   |             |     |
| 43 | MAX. ALLOW. PRESS. (HEAT & COOL) |                                   | PSI         |     |

UNITED STATES  
ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION  
FOSSIL ENERGY

COAL GASIFICATION COMBINED CYCLE PILOT PLANT  
SIOUX FALLS, SOUTH DAKOTA  
CONTRACT NO. ERDA-FE 14-32-0001-1521

FOSTER WHEELER ENERGY CORP.  
110 SOUTH ORANGE AVENUE  
LIVINGSTON, NEW JERSEY

UNITED STATES  
ERDA  
FOSSIL ENERGY

PROJECT NO. OP-764-608-A

DRAWN: RLB DATE: 3/10/76

APPROVED: DATE: 3/10/76

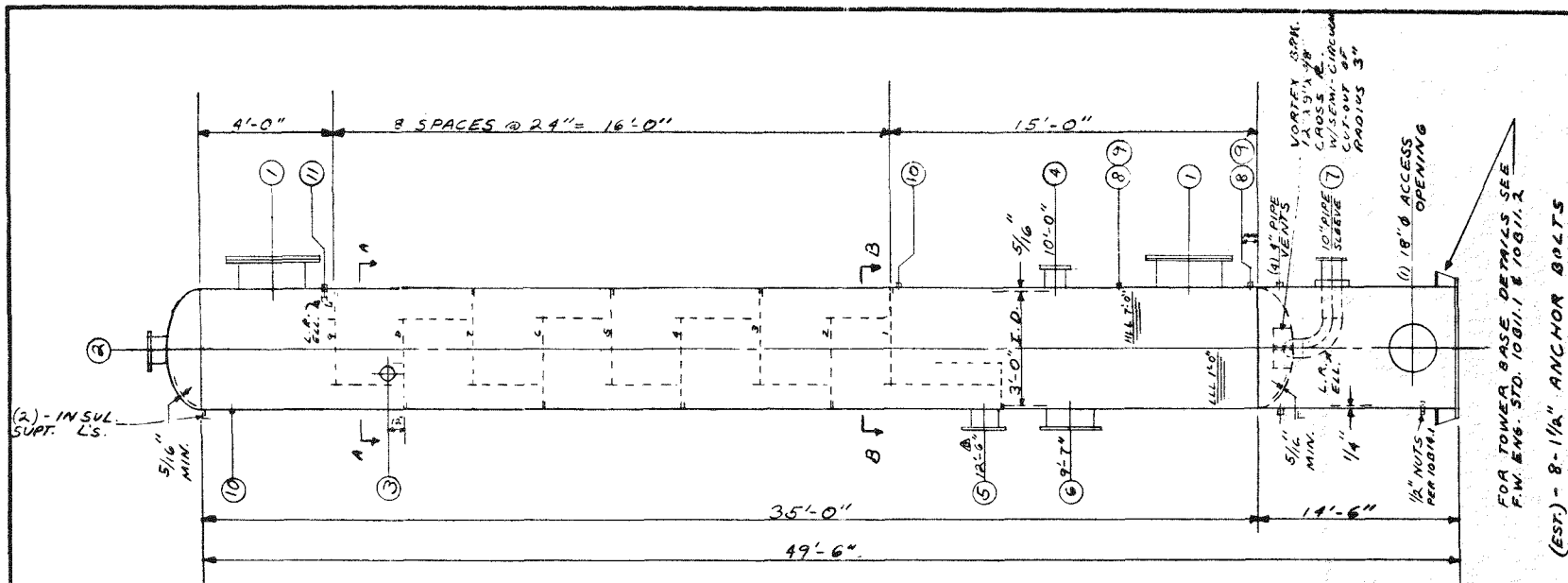
WATER WASH TOWER T-201

FWLC CONT. 15-1591

REQ'N N° 1591-1112A

REFERENCE DRAWINGS, REQUISITIONS, STANDARDS  
OP-764-607





NOTES:

1. TRAYS TO BE VALVE TYPE 11/13" CR FURNISHED BY TRAY VENDOR & INSTALLED BY VESSEL FABRICATOR
2. TRAY SUPPORT RINGS TO BE 2" X 3/8" C.S.
3. DOWNCOMER BARS TO BE 5" X 3/8" C.S.

|                                                                                                                         |                                                          |
|-------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|
| 83376 ELEV. OF CONNS WAS 12.9" ATM<br>A 31716 JORTEX BREAK DTM. CHANGED BS SHAW MS                                      |                                                          |
| NO. DATA                                                                                                                | REVISION                                                 |
| NO.                                                                                                                     | DATE                                                     |
| UNITED STATES<br>ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION<br>FOSSIL ENERGY                                          |                                                          |
| COAL GASIFICATION COMBINED CYCLE PILOT PLANT<br>SIOUX FALLS, SOUTH DAKOTA<br>CONTRACT NO. ERDA-FE 14 - 32 - 0001 - 1521 |                                                          |
| FOSTER WHEELER ENERGY CORP<br>110 SOUTH ORANGE AVENUE<br>WINSTON-SALEM, NEW JERSEY<br>F.W.D.C. NO. <u>OP-764-554-B</u>  | UNITED STATES<br>ERDA<br>FOSSIL ENERGY                   |
| DRAWN <u>ATM</u><br>CHECKED _____<br>APPROVED _____                                                                     | DATE <u>2/18/76</u><br>DATE _____<br>DATE _____          |
| DRAWING TITLE<br><u>F-202</u><br><u>FIRST STAGE SOUP WATER</u><br><u>STRIPPER</u>                                       | REVIEWED _____<br>APPROVED _____<br>DRAWING NUMBER _____ |
| FWEC CONT. 15-1591                                                                                                      | REQ'N NO 1590-1113-A                                     |



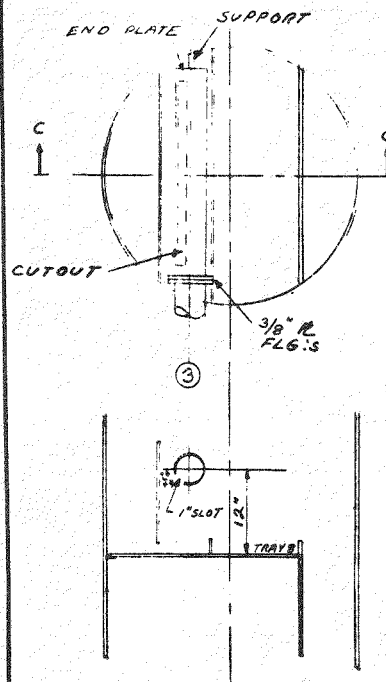
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REFERENCE DRAWINGS, REQUISITIONS, STANDARDS

590-10A1 1590-83A1 10B15.1  
1590-1100B 10B11.1 11B11.1  
1590-40A1 10B11.2 OP-764-553  
1590-50A2 10B13.2 10B14.1  
1590-42A1 10B14.3

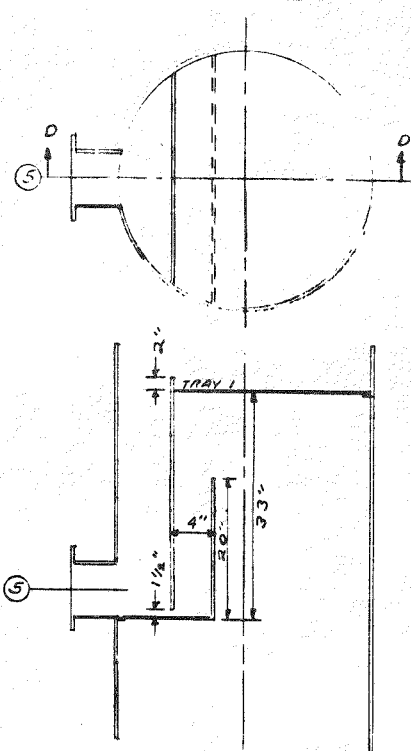


DETAIL A-A



DETAIL C-C

DETAIL B-B



DETAIL D-D



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## RELEASES

| DWG. REV. | DATE | ISSUED FOR                                                                                                                                                                                  |
|-----------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           |      | (A) PURCHASE SHELL AND HEAD MATERIAL, PREPARE BUT DO NOT SUBMIT SHOP DETAIL DRAWINGS.                                                                                                       |
|           |      | (B) ISSUE CHECKED FOSTER WHEELER DRAWING, PURCHASE ALL OTHER MATERIALS, FINALIZE AND SUBMIT CHECKED SHOP DETAIL DRAWING WITHIN ONE WEEK OF RELEASE DATE. PROCEED WITH COMPLETE FABRICATION. |
|           |      | (C) VENDOR'S DRAWING RETURNED                                                                                                                                                               |
|           |      | (D) FIELD CONSTRUCTION                                                                                                                                                                      |
|           |      | (E)                                                                                                                                                                                         |

## NOZZLE CHART

| CON. NO. | SIZE   | USAS. RATING | SERVICE         | NO. REQD. |
|----------|--------|--------------|-----------------|-----------|
| 1        | 20     | 50" RF       | MANWAY DRAWT    | 2         |
| 2        | 2"     |              | VAPOR OUTLET    | 1         |
| 3        | 4"     |              | FEED INLET      | 1         |
| 4        | 6"     |              | VAPOR FEED      | 1         |
| 5        | 6"     |              | REBOILER FEED   | 1         |
| 6        | 10"    |              | REBOILER RETURN | 1         |
| 7        | 6"     |              | BOILERS OUTLET  | 1         |
| 8        | 1"     | 6000" C/LG   | L.T.            | 2         |
| 9        | 3/4"   |              | L.G.            | 2         |
| 10       | 1"     |              | P.D.T.          | 2         |
| 11       | 1 1/2" |              | REFLUX INLET    | 1         |

## VESSEL DATA

|    |                                               |                      |
|----|-----------------------------------------------|----------------------|
| 1  | ITEM NO.                                      | T-202 NO. REQ'D: ONE |
| 2  | ALPHIC: FIRST STAGE SOUP WATER STRIPPER       |                      |
| 3  |                                               |                      |
| 4  | DIAMETER                                      | 3'-0" (INSIDE)       |
| 5  | TARGET LENGTH                                 | 35'-0"               |
| 6  | OPER. PRESSURE: BOPM.                         | 18.5 PSIG            |
| 7  | ALLOW. LIQ. LEVEL, MAX.                       | PSI                  |
| 8  | DESIGN PRESSURE                               | 55 PSIG              |
| 9  | OPER. LIQUID HOLD-UP PRESS.                   | 3.0 PSI              |
| 10 | OPER. PRESS. DRCP THRU VESSEL                 | 1.7 PSI              |
| 11 | MAX. RELIEVING PRESS. @ TOP NO.               | 50 PSIG              |
| 12 | MAX. OPER. TEMPERATURE                        | 298°F                |
| 13 | DESIGN TEMPERATURE                            | 348°F                |
| 14 | SPECIFIC GRAVITY (PROCESS FLUID)              | 1.0                  |
| 15 | CODE: E SECOND DIVI STAMPED: YES              |                      |
| 16 | P.W.M.T. FOR CODE: NO FOR PROCESS: NO         |                      |
| 17 | RADIOGRAPHED                                  | SPOT                 |
| 18 | JOINT EFFICIENCY                              | 85%                  |
| 19 | CORROSION ALLOWANCE: SHELLS: 1/8" HEADS: 1/8" |                      |
| 20 | MATL., SHELL: SA-285 GRC                      |                      |
| 21 | MATL., HEADS: SA-285 GRC                      |                      |
| 22 | M.T.L. SUPPORTS: SA-283 GRC                   |                      |
| 23 | TYPE OF HEADS: 2:1 ELLIPSOIDAL                |                      |
| 24 | EXTERNAL BOLTING: SA-193-B7/SA-193-BM         |                      |
| 25 | INTERNAL BOLTING: 309 S.S.                    |                      |
| 26 | GASKETS: COMP. ASBESTOS                       |                      |
| 27 | BOLT HOLES: STRADDLE VESSEL CENTERLINE        |                      |
| 28 | PAINT: PER SPEC. 1590-83A1                    |                      |
| 29 | INSULATION: YES (2" THK) BY OTHERS            |                      |
| 30 | SHIPMENT: ONE PIECE                           |                      |
| 31 |                                               |                      |
| 32 | EMPTY WGT.                                    | 10700 LBS            |
| 33 | WATER WGT.                                    | 14700 LBS            |
| 34 | TRAYS WGT.                                    | 620 LBS              |
| 35 | INSULATION WGT.                               | 820 LBS              |
| 36 | SURITE WGT.                                   | 3800 LBS             |
| 37 | OPER. LIQUID WGT.                             | 3300 LBS             |
| 38 |                                               |                      |
| 39 | INSUL. SURT.'S BY VESSEL FAB.                 |                      |
| 40 |                                               |                      |
| 41 | HYDROTEST: SHOP: FIELD: PSI                   |                      |
| 42 | GAGE LOCATION:                                |                      |
| 43 | MAX. ALLOW. PRESS. (HEAT & COLD): PSI         |                      |

UNITED STATES  
ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION  
FOSSIL ENERGY

COAL GASIFICATION COMBINED CYCLE PILOT PLANT  
SIOUX FALLS, SOUTH DAKOTA  
CONTRACT NO. ERDA-FC-82-0001-159.

FOSTER WHEELER ENERGY CORP  
110 SOUTH ORANGE AVENUE  
LIVINGSTON, NEW JERSEY

UNITED STATES  
ERDA

FW DNG NO. DP-769-555A

FOSSIL ENERGY

DRAWN: A.T.M. DATE: 11/13/79

REVIEWED: DATE: APPROVED: DATE: DRAWING NUMBER

1ST STAGE SOUP WATER STRIPPER

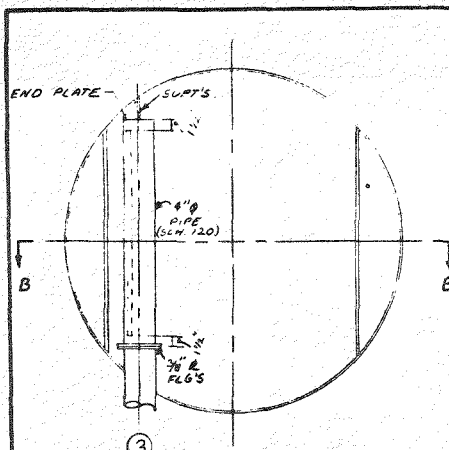
FWC CONT. 15-1591

REQ'N N2/S91/1113-A

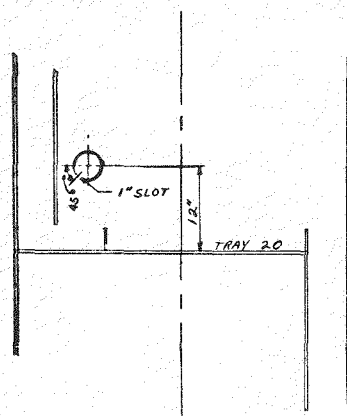
REFERENCE DRAWINGS, REQUISITIONS, STANDARDS

DP-764-554





DETAIL A-A



DETAIL B-B



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# RELEASES

| DWG. REV. | DATE | ISSUED FOR                                                                                                                                                                                  |
|-----------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           |      | (A) PURCHASE SHELL AND HEAD MATERIAL. PREPARE BUT DO NOT SUBMIT SHOP DETAIL DRAWINGS.                                                                                                       |
|           |      | (B) ISSUE CHECKED FOSTER WHEELER DRAWING. PURCHASE ALL OTHER MATERIALS. FINALIZE AND SUBMIT CHECKED SHOP DETAIL DRAWING WITHIN ONE WEEK OF RELEASE DATE. PROCEED WITH COMPLETE FABRICATION. |
|           |      | (C) VENDOR'S DRAWING RETURNED                                                                                                                                                               |
|           |      | (D) FIELD CONSTRUCTION                                                                                                                                                                      |
|           |      | (E)                                                                                                                                                                                         |

## NOZZLE CHART

| CON. NO. | SIZE | USAS. RATING   | SERVICE         | NO. REQD. |
|----------|------|----------------|-----------------|-----------|
| 1        | 20"  | 150" R.F.      | MANWAYS W/DAVIT | 3         |
| 2        | 10"  |                | VAPOR OUTLET    | 1         |
| 3        | 4"   |                | FEED INLET      | 1         |
| 4        | 8"   |                | REBOILER FEED   | 1         |
| 5        | 18"  |                | REBOILER RETURN | 1         |
| 6        | 6"   |                | BOTTOMS OUTLET  | 1         |
| 7        | 1"   | 6000" L.P.E.G. | L.T.            | 2         |
| 8        | 3/4" |                | L.G.            | 2         |
| 9        | 1"   |                | P.D.I.          | 2         |
| 10       | 2"   | 150" R.F.      | REFLUX INLET    | 1         |

# VESSEL DATA

|    |                                   |                            |              |      |
|----|-----------------------------------|----------------------------|--------------|------|
| 1  | ITEM NO.:                         | T-203                      | NO. REQ'D:   | ONE  |
| 2  | SERVICE:                          | SECOND STAGE SOUR          |              |      |
| 3  |                                   | WATER STRIPPER             |              |      |
| 4  | DIAMETER:                         | (INSIDE) 4'-0"             |              |      |
| 5  | TANGENT LENGTH:                   | 59'-6"                     |              |      |
| 6  | SPEC. PRESSURE:                   | NORM.: 19.0                | PSIG         |      |
| 7  | BOVE LIQUID LEVEL, MAX.:          |                            | PSI          |      |
| 8  | DESIGN PRESSURE:                  | 55                         | PSIG         |      |
| 9  | OPER. LIQUID HOLD-UP PRESS:       | 3.0                        | PSI          |      |
| 10 | OPER. PRESS. DROP THRU VESSEL:    | 2.0                        | PSI          |      |
| 11 | MAX. RELIEVING PRESS. @ TOP HD.:  | 50                         | PSIG         |      |
| 12 | MAX. OPER. TEMPERATURE:           | 298°F                      |              |      |
| 13 | DESIGN TEMPERATURE:               | 348°F                      |              |      |
| 14 | SPECIFIC GRAVITY (PROCESS FLUID): | 1.0                        |              |      |
| 15 | CODE ASME SEC. VIII DIV. 1:       | STAMPED: YES               |              |      |
| 16 | P.W.M.T.: FOR CODE:               | NO                         | FOR PROCESS: | NO   |
| 17 | RADIOGRAPHED:                     | SPOT                       |              |      |
| 18 | JOINT EFFICIENCY:                 | 85%                        |              |      |
| 19 | CORROSION ALLOWANCE SHELLS:       | 1/8"                       | HEADS:       | 1/8" |
| 20 | MATL. SHELL:                      | SA-285 GRC                 |              |      |
| 21 | MATL. HEADS:                      | SA-285 GRC                 |              |      |
| 22 | MATL. SUPPORTS:                   | SA-283 GRC                 |              |      |
| 23 | TYPE OF HEADS:                    | 2:1 ELLIPSOIDAL            |              |      |
| 24 | EXTERNAL BOLTING:                 | SA-193-B7 1/2 SA-194-2N    |              |      |
| 25 | INTERNAL BOLTING:                 | S.S.                       |              |      |
| 26 | GASKETS:                          | COMP. ASBESTOS             |              |      |
| 27 | BOLT HOLES:                       | STRADDLE VESSEL CENTERLINE |              |      |
| 28 | PAINT:                            | PER 1590-83A1              |              |      |
| 29 | INSULATION:                       | YES (2" THK.) BY OTHERS    |              |      |
| 30 | SHIPMENT:                         | ONE PIECE                  |              |      |
| 31 |                                   |                            |              |      |
| 32 | EMPTY WGT.:                       | 14800                      | LBS          |      |
| 33 | WATER WGT.:                       | 47800                      | LBS          |      |
| 34 | TRAYS WGT.:                       | 2900                       | LBS          |      |
| 35 | INSULATION WGT.:                  | 1900                       | LBS          |      |
| 36 | GUNITE WGT.:                      | 4600                       | LBS          |      |
| 37 | OPER. LIQUID WGT.:                | 6000                       | LBS          |      |
| 38 |                                   |                            |              |      |
| 39 | INSUL. SUPT'S BY VESSEL FAB.      |                            |              |      |
| 40 |                                   |                            |              |      |
| 41 | HYDROTEST: SHOP:                  | FIELD:                     | PSI          |      |
| 42 | GAGE LOCATION:                    |                            |              |      |
| 43 | MAX. ALLOW. PRESS. (NEW & COLD):  |                            | PSI          |      |

UNITED STATES  
ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION  
FOSSIL ENERGY

COAL GASIFICATION COMBINED CYCLE PILOT PLANT  
SIOUX FALLS, SOUTH DAKOTA  
CONTRACT NO. ERDA-FE 14-32-0001-1521

FOSTER WHEELER ENERGY CORP.  
110 SOUTH ORANGE AVENUE  
LIVINGSTON, NEW JERSEY

UNITED STATES  
ERDA  
FOSSIL ENERGY

FW DWG. NO. OP-764-558

DRAWN: HJM DATE: 1/25/76  
CHECKED: DATE: APPROVED: DATE:

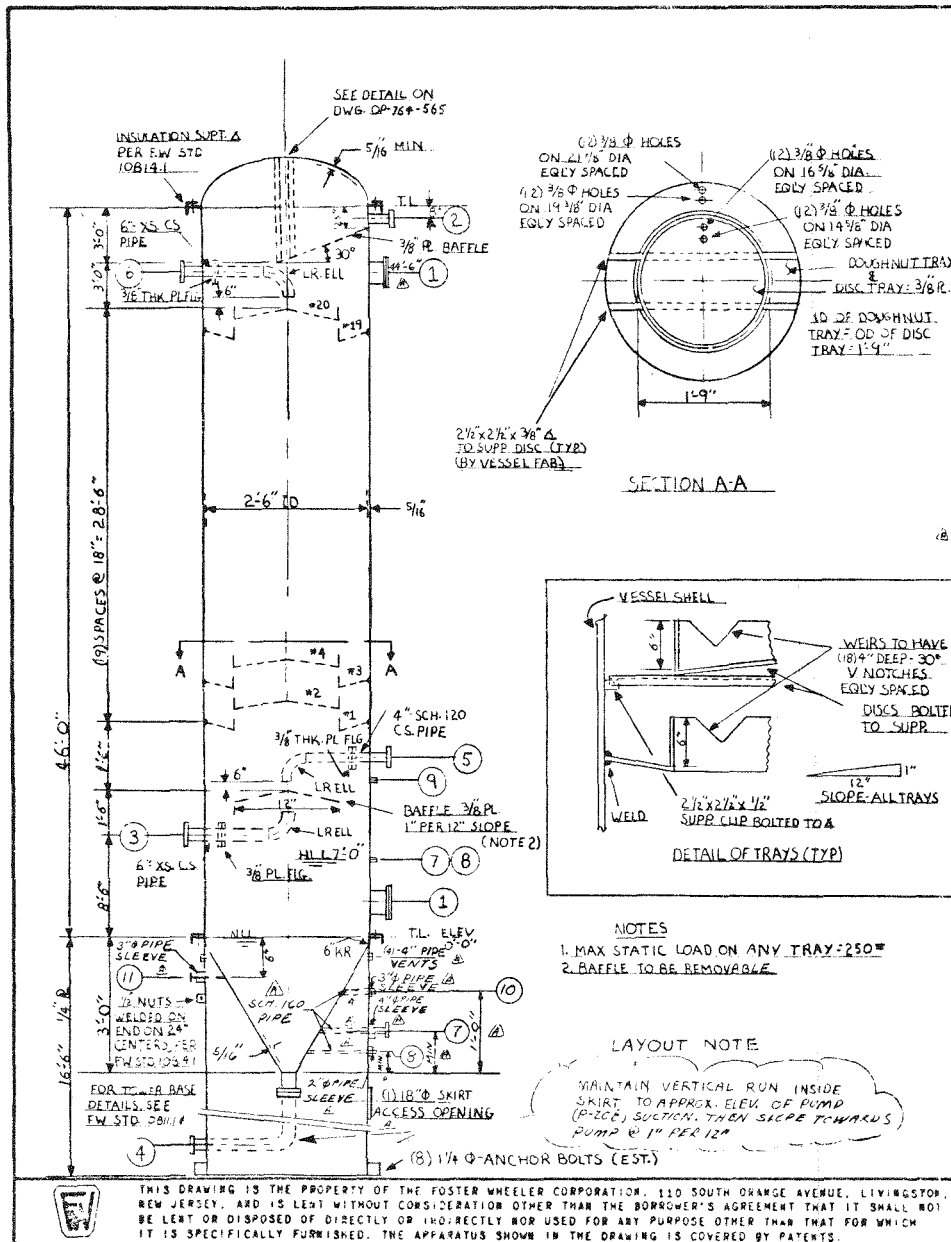
REVIEWED: DATE: APPROVED: DATE:

REFERENCE DRAWINGS, REQUISITIONS, STANDARDS  
OP-764-557

SECOND STAGE SOUR  
WATER STRIPPER T-203

FWEC CONT. 15-1591

REQ'N NO. 1591-1114-A



## RELEASES

| DWG. REV. | DATE | ISSUED FOR                                                                                                                                                                                  |
|-----------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           |      | (A) PURCHASE SHELL AND HEAD MATERIAL. PREPARE BUT DO NOT SUBMIT SHOP DETAIL DRAWINGS.                                                                                                       |
|           |      | (B) ISSUE CHECKED FOSTER WHEELER DRAWING. PURCHASE ALL OTHER MATERIALS. FINALIZE AND SUBMIT CHECKED SHOP DETAIL DRAWING WITHIN ONE WEEK OF RELEASE DATE. PROCEED WITH COMPLETE FABRICATION. |
|           |      | (C) VENDOR'S DRAWING RETURNED                                                                                                                                                               |
|           |      | (D) FIELD CONSTRUCTION                                                                                                                                                                      |

## NOZZLE CHART

| CON. NO. | SIZE   | USAS. RATING | SERVICE           | NO. REQD. |
|----------|--------|--------------|-------------------|-----------|
| 1        | 20"    | 150# RF      | MANWAY W/DOOR     | 2         |
| 2        | 6"     |              | VAPOR OUTLET      | 1         |
| 3        | 6"     |              | STEAM INLET       | 1         |
| 4        | 6"     |              | SLURRY OUTLET     | 1         |
| 5        | 4"     |              | SLURRY PUMPAROUND | 1         |
| 6        | 6"     |              | SLURRY INLET      | 1         |
| 7        | 2"     | 6000# RPLG   | LT                | 2         |
| 8        | 3/4"   |              | LG                | 2         |
| 9        | 3/4"   |              | PI                | 1         |
| 10       | 1 1/2" |              | T                 | 1         |
| 11       | 1"     | 150# RF      | DRAIN FROM S-203  | 1         |

## VESSEL DATA

|    |                                  |                            |           |                 |
|----|----------------------------------|----------------------------|-----------|-----------------|
| 1  | ITEM NO.                         | T-204                      | NO. REQD. | ONE             |
| 2  | SERVICE                          | SLURRY STRIPPER            |           |                 |
| 3  |                                  |                            |           |                 |
| 4  | DIAMETER                         | 2'-6"                      |           |                 |
| 5  | TAG LENGTH                       |                            |           |                 |
| 6  | OPER. PRESSURE                   | NORM.                      | 21        | PSIG            |
| 7  | APPRO. LIQUID LEVEL, MAX.        |                            |           | PSI             |
| 8  | DESIGN PRESSURE                  |                            | 54        | PSIG            |
| 9  | OPER. LIQUID HOLD-UP PRESS.      |                            | 3         | PSI             |
| 10 | OPER. PRESS. DROP THRU VESSEL    |                            |           | PSIG            |
| 11 | MAX. RELIEVING PRESS. @ TOP NO.  |                            | 50        | PSIG            |
| 12 | MAX. OPER. TEMPERATURE           |                            | 340°      | F               |
| 13 | DESIGN TEMPERATURE               |                            | 390°      | F               |
| 14 | SPECIFIC GRAVITY (PROCESS FLUID) |                            | 1.0       |                 |
| 15 | CODE ASME SECVIII DIVI           |                            |           | STAMPED:        |
| 16 | P.W.M.T. FOR CODE                | NO                         |           | FOR PROCESS: NO |
| 17 | RADIOGRAPHED                     | SPOT                       |           |                 |
| 18 | JOINT EFFICIENCY                 | 85%                        |           |                 |
| 19 | CORROSION ALLOWANCE SHELLS       | 1/8"                       |           | HEADS: 1/8"     |
| 20 | MATL. SHELL                      | SA-285-C                   |           |                 |
| 21 | MATL. HEADS                      | SA-285-C                   |           |                 |
| 22 | MATL. SUPPORTS                   | SA-285-C                   |           |                 |
| 23 | TYPE OF HEADS                    | 2:1 ELLIP. & CONICAL       |           |                 |
| 24 | EXTERNAL BOLTING                 | SA-193-B7/SA-194-2H        |           |                 |
| 25 | INTERNAL BOLTING                 | SA-307-13                  |           |                 |
| 26 | GASKETS                          | 1/16" COMP. ASB.           |           |                 |
| 27 | BOLT HOLES                       | STRADDLE VESSEL CENTERLINE |           |                 |
| 28 | PAINT                            | PER 1590-83A1              |           |                 |
| 29 | INSULATION                       | YES (BY OTHERS) *          |           |                 |
| 30 | SHIPMENT                         | ONE PIECE                  |           |                 |
| 31 | INSULATION SUPPLY BY VESSEL FAB. |                            |           |                 |
| 32 | EMPTY WGT.                       | 11712                      |           | LBS             |
| 33 | WATER WGT. (ONLY)                | 14594                      |           | LBS             |
| 34 | TRAYS WGT.                       | 1080 EST                   |           | LBS             |
| 35 | INSULATION WGT.                  | 983 EST                    |           | LBS             |
| 36 | GUNITE WGT.                      | 3227 EST                   |           | LBS             |
| 37 | OPER. LIQUID WGT.                | 4029                       |           | LBS             |
| 38 |                                  |                            |           |                 |
| 39 |                                  |                            |           |                 |
| 40 |                                  |                            |           |                 |
| 41 | HYDROTEST: SHOP                  |                            | FIELD     | PSI             |
| 42 | GAGE LOCATION                    |                            |           |                 |
| 43 | MAX. ALLOW. PRESS. (HEAT & COLD) |                            |           | PSI             |

UNITED STATES  
ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION  
FOSSIL ENERGY

COAL GASIFICATION COMBINED CYCLE PILOT PLANT  
SIOUX FALLS, SOUTH DAKOTA  
CONTRACT NO. ERDA-FE 14-32-0001-1521

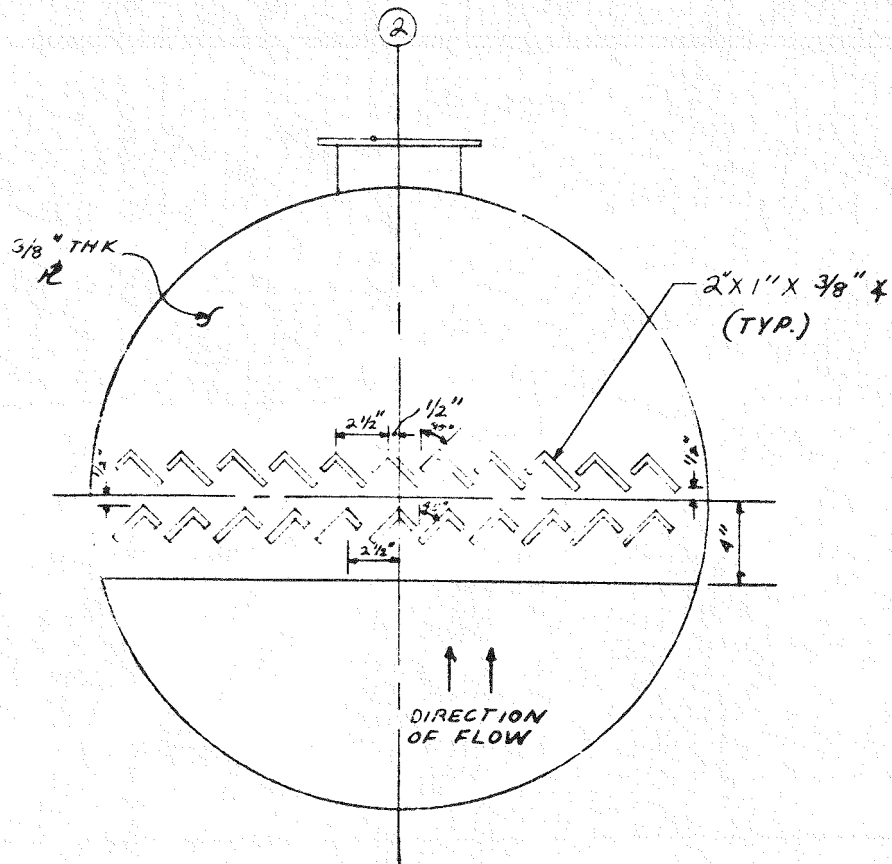
FOSTER WHEELER ENERGY CORP.  
110 SOUTH ORANGE AVENUE  
LIVINGSTON, NEW JERSEY

UNITED STATES  
ERDA  
FOSSIL ENERGY

FW Dwg. No. OP-764-564-A

DRAWN BY: RLR DATE: 3/1/78

APPROVED BY: DATE: 3/1



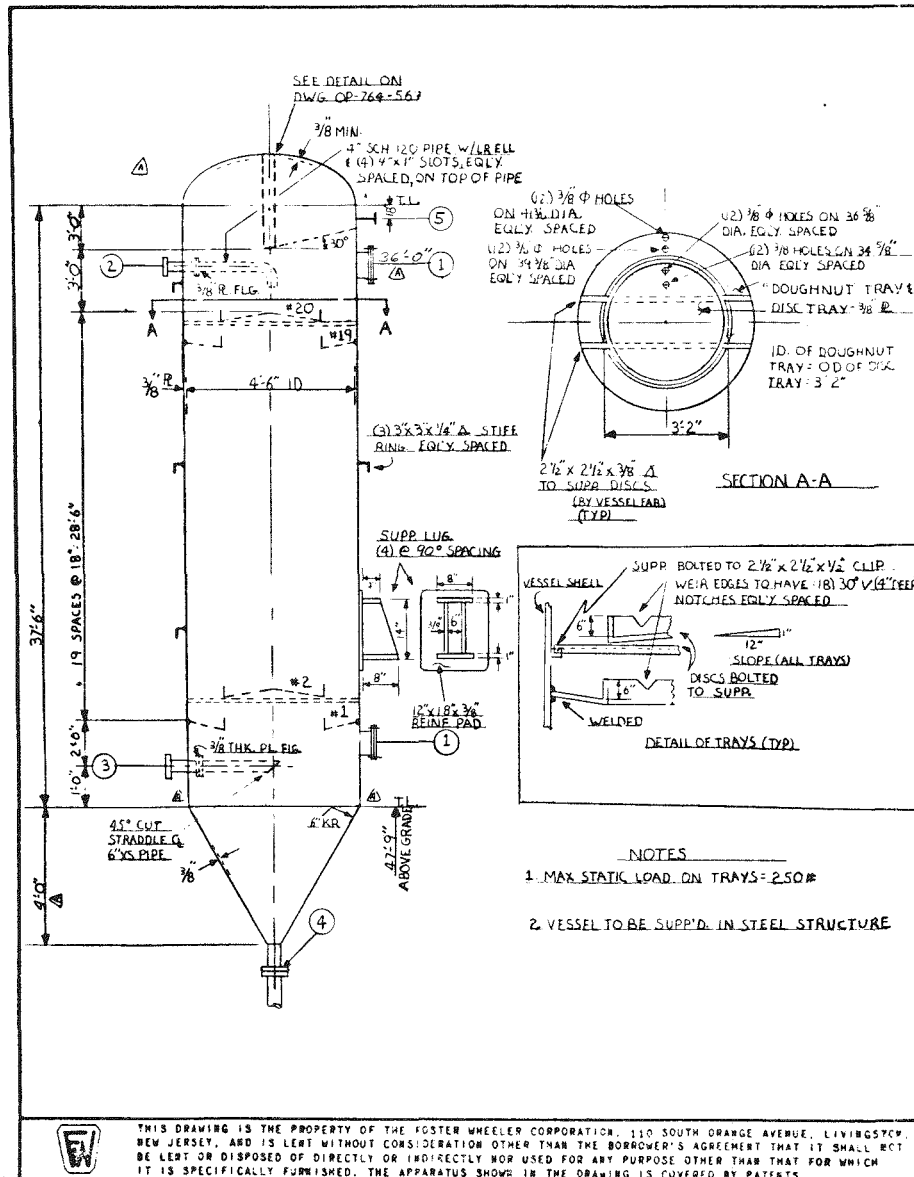
DETAIL OF VAPOR OUTLET

A

|                                                                                                                  |              |                                        |         |
|------------------------------------------------------------------------------------------------------------------|--------------|----------------------------------------|---------|
| 2                                                                                                                |              |                                        |         |
| A 3/25/76 NO. 2 POS. OF 4 CHANGED                                                                                |              | AJM                                    |         |
| NO.                                                                                                              | DATE         | REVISION                               | MADE BY |
| UNITED STATES<br>ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION<br>FOSSIL ENERGY                                   |              |                                        |         |
| COAL GASIFICATION COMBINED CYCLE PILOT PLANT<br>SIOUX FALLS, SOUTH DAKOTA<br>CONTRACT NO ERDA-FE 14-32-0001-1521 |              |                                        |         |
| FOSTER WHEELER ENERGY CORP<br>110 SOUTH ORANGE AVENUE<br>LIVINGSTON, NEW JERSEY                                  |              | UNITED STATES<br>ERDA<br>FOSSIL ENERGY |         |
| FW DWT NO. OP-764-565-A                                                                                          |              |                                        |         |
| DRAWN: RLK                                                                                                       | DATE: 3/1/76 | REVIEWED: _____                        |         |
| CHECKED: _____                                                                                                   | DATE: _____  | APPROVED: _____                        |         |
| APPROVED: _____                                                                                                  |              | DATE: _____                            |         |
| DRAWING TITLE: SLURRY STRIPPER T-204                                                                             |              | DRAWING NUMBER: _____                  |         |
| FWED CONT. 15-1591                                                                                               |              | REQ N NO 1591-1115A                    |         |

REFERENCE DRAWINGS, REQUISITIONS, STANDARDS

OP-764-564



## RELEASES

| DWG. REV. | DATE          | ISSUED FOR                                                                                                                                                                                  |
|-----------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| OP        | DATE OF ORDER | (A) PURCHASE SHELL AND HEAD MATERIAL, PREPARE BUT DO NOT SUBMIT SHOP DETAIL DRAWINGS.                                                                                                       |
|           |               | (B) ISSUE CHECKED FOSTER WHEELER DRAWING. PURCHASE ALL OTHER MATERIALS. FINALIZE AND SUBMIT CHECKED SHOP DETAIL DRAWING WITHIN ONE WEEK OF RELEASE DATE. PROCEED WITH COMPLETE FABRICATION. |
|           |               | (C) VENDOR'S DRAWING RETURNED                                                                                                                                                               |
|           |               | (D) FIELD CONSTRUCTION                                                                                                                                                                      |
|           |               | (E)                                                                                                                                                                                         |

## NOZZLE CHART

| CORN. NO. | SIZE | USAS. RATING | SERVICE        | NO. REQD. |
|-----------|------|--------------|----------------|-----------|
| 1         | 20"  | 150# RF      | MANWAY ~ / DWT | 2         |
| 2         | 4"   |              | SLURRY INLET   | 1         |
| 3         | 6"   |              | STEAM INLET    | 1         |
| 4         | 6"   |              | SLURRY OUTLET  | 1         |
| 5         | 16"  |              | VAPOR OUTLET   | 1         |

## VESSEL DATA

|    |                                   |                            |            |     |
|----|-----------------------------------|----------------------------|------------|-----|
| 1  | ITEM NO.                          | T-205                      | NO. REQ'D: | ONE |
| 2  | SERVICE:                          | SLURRY VACUUM FLASHER      |            |     |
| 3  |                                   |                            |            |     |
| 4  | DIAMETER:                         | 4'-6" ID                   |            |     |
| 5  | TANGENT LENGTH:                   | 37'-6"                     |            |     |
| 6  | OPER. PRESSURE:                   | NORM.: 4 PSIG              |            |     |
| 7  | PERMIT. LIQUID LEVEL MAX.:        | PSIG                       |            |     |
| 8  | DESIGN PRESSURE:                  | FULL VAC. & 16 PSIG        |            |     |
| 9  | OPER. LIQUID HOLD-UP PRESS.:      | PSIG                       |            |     |
| 10 | OPER. PRESS. DROP THRU VESSEL:    | 25 PSIG                    |            |     |
| 11 | MAX. RELIEVING PRESS. @ TOP HD.:  | 15 PSIG                    |            |     |
| 12 | MAX. OPER. TEMPERATURE:           | 280°F                      |            |     |
| 13 | DESIGN TEMPERATURE:               | 330°F                      |            |     |
| 14 | SPECIFIC GRAVITY (PROCESS FLUID): |                            |            |     |
| 15 | CODE: ASME SEC. VIII DIV. I       | STAMPED: YES               |            |     |
| 16 | P.W.N.T.: FOR CODE: NO            | FOR PROCESS: NO            |            |     |
| 17 | RADIOGRAPHED:                     | SPOT                       |            |     |
| 18 | JOINT EFFICIENCY:                 | 85%                        |            |     |
| 19 | CORROSION ALLOWANCE SHELLS:       | 1/8" HEADS: 1/8"           |            |     |
| 20 | MATL. SHELL:                      | SA-285-C                   |            |     |
| 21 | MATL. HEADS:                      | SA-285-C                   |            |     |
| 22 | MATL. SUPPORTS:                   | SA-285-C                   |            |     |
| 23 | TYPE OF HEADS:                    | 2: ELIP. & CONICAL         |            |     |
| 24 | EXTERNAL BOLTING:                 | SA-193-B7/SA-194-2H        |            |     |
| 25 | INTERNAL BOLTING:                 | SA-307-B                   |            |     |
| 26 | GASKETS:                          | COMP. ASBESTOS             |            |     |
| 27 | BOLT HOLES:                       | STRADDLE VESSE: CENTERLINE |            |     |
| 28 | PAINT:                            | PER SPEC 1590-R3A1         |            |     |
| 29 | INSULATION:                       | NONE                       |            |     |
| 30 | SHIPMENT:                         | ONE PIECE                  |            |     |
| 31 |                                   |                            |            |     |
| 32 | EMPTY WGT.:                       | 16000                      | LBS        |     |
| 33 | WATER WGT. (ONLY):                | 37325                      | LBS        |     |
| 34 | TRAYS WGT.:                       |                            | LBS        |     |
| 35 | INSULATION WGT.:                  |                            | LBS        |     |
| 36 | GUNIT WGT.:                       |                            | LBS        |     |
| 37 | OPER. LIQUID WGT.:                |                            | LBS        |     |
| 38 |                                   |                            |            |     |
| 39 |                                   |                            |            |     |
| 40 |                                   |                            |            |     |
| 41 | HYDROTEST: SHOP:                  | FIELD:                     | PSI        |     |
| 42 | GAGE LOCATION:                    |                            |            |     |
| 43 | MAX. ALLOW. PRESS. (HEAT & COLD): |                            | PSI        |     |

UNITED STATES  
ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION  
FOSSIL ENERGY

COAL GASIFICATION COMBINED CYCLE PILOT PLANT  
SIOUX FALLS, SOUTH DAKOTA  
CONTRACT NO. ERDA-FE 14-32-0301-1321

FOSTER WHEELER ENERGY CORP.  
110 SOUTH ORANGE AVENUE  
LIVINGSTON, NEW JERSEY

UNITED STATES  
ERDA  
FOSSIL ENERGY

DWG. NO. OP-764-566-A

DATE 3/24/66

DATE 3/24/66

DATE 3/24/66

DATE 3/24/66

DATE 3/24/66

DATE 3/24/66

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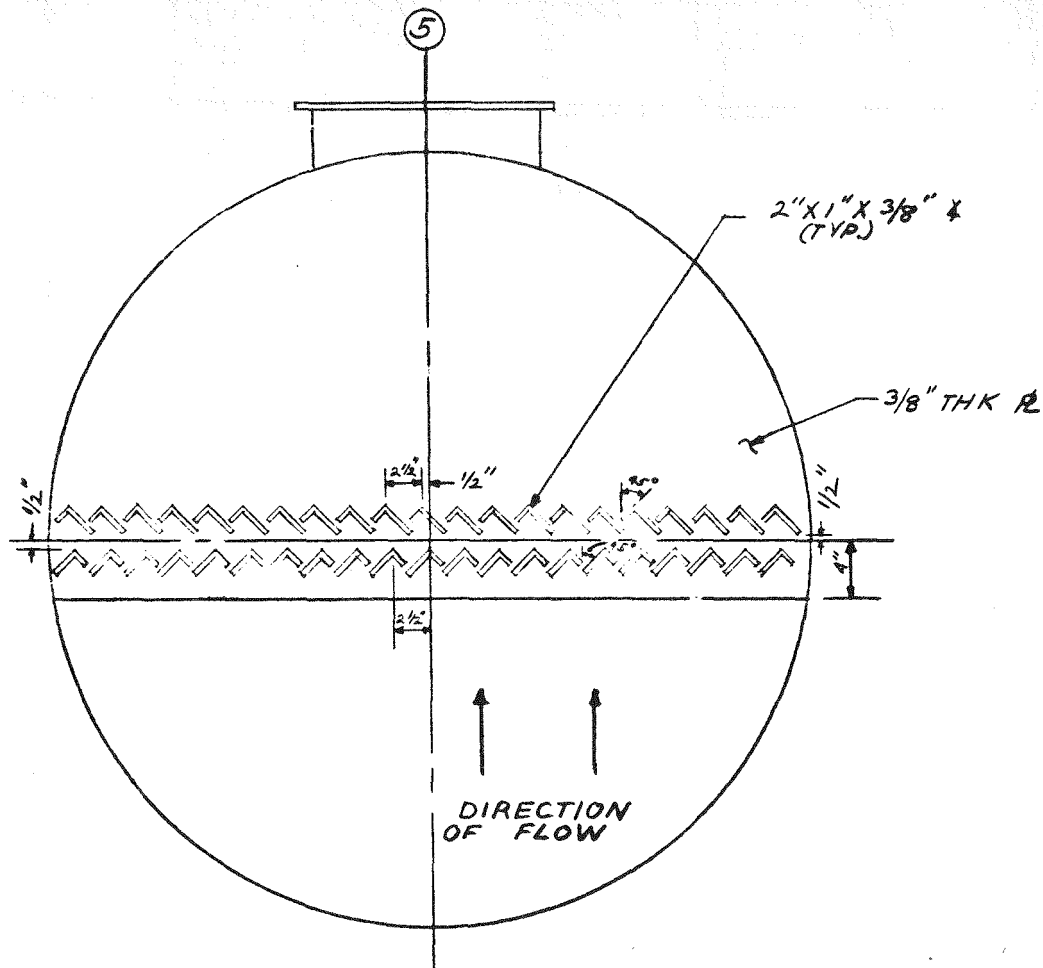
DATE 3/24/66

## REFERENCE DRAWINGS, REQUISITIONS, STANDARDS

1590-10A1 1590-50A2 1590-100B 10B14.1  
1590-11A1 1590-40A1 10B11 OP-764-567  
1590-83A1 1590-82A1 10B132



THIS DRAWING IS THE PROPERTY OF THE FOSTER WHEELER CORPORATION, 110 SOUTH ORANGE AVENUE, LIVINGSTON, NEW JERSEY, AND IS LENT WITHOUT CONSIDERATION OTHER THAN THE BORROWER'S AGREEMENT THAT IT SHALL NOT BE LENT OR DISPOSED OF DIRECTLY OR INDIRECTLY FOR ANY PURPOSE OTHER THAN THAT FOR WHICH IT IS SPECIFICALLY FURNISHED. THE APPARATUS SHOWN IN THE DRAWING IS COVERED BY PATENTS.



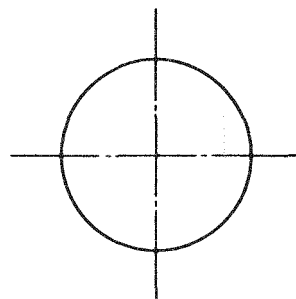
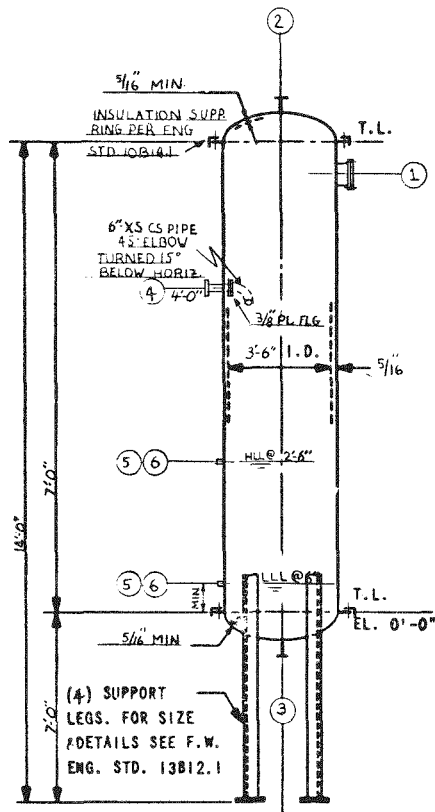
DETAIL OF VAPOR OUTLET

A

|                                                                                                                  |         |                          |                       |                                  |
|------------------------------------------------------------------------------------------------------------------|---------|--------------------------|-----------------------|----------------------------------|
| 2                                                                                                                |         |                          |                       |                                  |
| A                                                                                                                | 3/24/76 | REV DETAIL OF VAP. OUT.  | ADJ                   |                                  |
| NO                                                                                                               | DATE    | REVISION                 | MADE                  | BY                               |
| UNITED STATES<br>ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION<br>FOSSIL ENERGY                                   |         |                          |                       |                                  |
| COAL GASIFICATION COMBINED CYCLE PILOT PLANT<br>SIOUX FALLS, SOUTH DAKOTA<br>CONTRACT NO ERDA-FE 14-32-0001-1521 |         |                          |                       |                                  |
| FOSTER WHEELER ENERGY CORP<br>110 SOUTH ORANGE AVENUE<br>LIVINGSTON, NEW JERSEY                                  |         |                          | UNITED STATES<br>ERDA |                                  |
| FW Dwg NO. <u>OP-764-567-A</u>                                                                                   |         |                          | FOSSIL ENERGY         |                                  |
| DRAWN <u>RLK</u>                                                                                                 |         | DATE <u>3/3/76</u>       |                       | REVIEWED _____<br>APPROVED _____ |
| CHECKED _____<br>APPROVED _____                                                                                  |         | DATE _____<br>DATE _____ |                       |                                  |
| DRAWING TITLE<br>SLURRY VACUUM FLASHER T-205                                                                     |         |                          |                       | DRAWING NUMBER                   |
| FWEC CONT. 15-1591                                                                                               |         |                          | REQ'N NO 1591-1116A   |                                  |

REFERENCE DRAWINGS, REQUISITIONS, STANDARDS

OP-764-566



ORIENTATION PLAN



THIS DRAWING IS THE PROPERTY OF THE FOSTER WHEELER CORPORATION, 110 SOUTH ORANGE AVENUE, LIVINGSTON, NEW JERSEY, AND IS LOANED WITHOUT CONSIDERATION OTHER THAN THE BORROWER'S AGREEMENT THAT IT SHALL NOT BE LOANED OR DISPOSED OF DIRECTLY OR INDIRECTLY NOR USED FOR ANY PURPOSE OTHER THAN THAT FOR WHICH IT IS SPECIFICALLY FURNISHED. THE APPARATUS SHOWN IN THE DRAWING IS COVERED BY PATENTS.

## RELEASES

| DWG. REV. | DATE | ISSUED FOR                                                                                                                                                                                  |
|-----------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           |      | (A) PURCHASE SHELL AND HEAD MATERIAL, PREPARE BUT DO NOT SUBMIT SHOP DETAIL DRAWINGS.                                                                                                       |
|           |      | (B) ISSUE CHECKED FOSTER WHEELER DRAWING, PURCHASE ALL OTHER MATERIALS, FINALIZE AND SUBMIT CHECKED SHOP DETAIL DRAWING WITHIN ONE YEAR OF RELEASE DATE. PROCEED WITH COMPLETE FABRICATION. |
|           |      | (C) VENDOR'S DRAWING RETURNED                                                                                                                                                               |
|           |      | (D) FIELD CONSTRUCTION                                                                                                                                                                      |
|           |      | (E)                                                                                                                                                                                         |

## NOZZLE CHART

| CORR. NO. | SIZE | USAS. RATING | SERVICE            | NO. REQD. |
|-----------|------|--------------|--------------------|-----------|
| 1         | 18"  | 150# RF      | MANWAY "/DAVIT     | 1         |
| 2         | 4"   |              | GAS OUTLET         | 1         |
| 3         | 2"   |              | LIQUID OUTLET      | 1         |
| 4         | 6"   |              | VAPOR-LIQUID INLET | 1         |
| 5         | 3/4" | 6000# CPLG   | GAGE GLASS         | 2         |
| 6         | 3/4" |              | LC                 | 2         |

## VESSEL DATA

|    |                                      |                            |              |      |
|----|--------------------------------------|----------------------------|--------------|------|
| 1  | ITEM NO.:                            | D-202                      | NO. REQD.:   | ONE  |
| 2  | SERVICE:                             | 1" STAGE SWS REFLUX DRUM   |              |      |
| 3  |                                      |                            |              |      |
| 4  | DIAMETER:                            | 3'-6" 1.D.                 |              |      |
| 5  | TARGET LENGTH:                       | 7'-0"                      |              |      |
| 6  | OPER. PRESSURE:                      | NORM.:                     | 14           | PSIG |
| 7  | ABOVE LIQUID LEVEL, MAX.:            |                            | 17           | PSIG |
| 8  | DESIGN PRESSURE:                     | 52                         |              | PSIG |
| 9  | OPER. LIQUID HOLD-UP PRESS:          | 1.2                        |              | PBI  |
| 10 | OPER. PRESS. DROP THRU VESSEL:       | 0.5                        |              | PSIG |
| 11 | MAX. RELIEVING PRESS. @ TOP HD.:     | 50                         |              | PSIG |
| 12 | MAX. OPER. TEMPERATURE:              | 202° F                     |              |      |
| 13 | DESIGN TEMPERATURE:                  | 252° F                     |              |      |
| 14 | SPECIFIC GRAVITY (PROCESS FLUID):    | 1.0                        |              |      |
| 15 | CODE ASME SECTION:                   | VIII DIV. 1                | STAMPED:     | YES  |
| 16 | P.M.N.T. FOR CODE:                   | NO                         | FOR PROCESS: | NO   |
| 17 | RADIOGRAPHED:                        | SPOT                       |              |      |
| 18 | JOINT EFFICIENCY:                    | 85%                        |              |      |
| 19 | CORROSION ALLOWANCE SHELLS:          | 1/8"                       | HEADS:       | 1/8" |
| 20 | MATL. SHELL:                         | SA-285-C                   |              |      |
| 21 | MATL. HEADS:                         | SA-285-C                   |              |      |
| 22 | MATL. SUPPORTS:                      | SA-36                      |              |      |
| 23 | TYPE OF HEADS:                       | 2:1 ELLIP                  |              |      |
| 24 | EXTERNAL BOLTING:                    | SA-193-B7/SA-194-2H        |              |      |
| 25 | INTERNAL BOLTING:                    | SA-302-B                   |              |      |
| 26 | GASKETS:                             | 1/16" COMP. ASB            |              |      |
| 27 | BOLT HOLES:                          | STRADDLE VESSEL CENTERLINE |              |      |
| 28 | PAINT:                               | 1590-63A1                  |              |      |
| 29 | INSULATION:                          | YES (BY OTHERS)*           |              |      |
| 30 | SHIPMENT:                            | ONE PIECE                  |              |      |
| 31 | * SUPP. RINGS FOR INS. BY VESSEL FAB |                            |              |      |
| 32 | EMPTY WGT.:                          | 3400                       |              | LBS  |
| 33 | WATER WGT. (ONLY)                    | 4900                       |              | LBS  |
| 34 | TRAYS WGT.:                          |                            |              | LBS  |
| 35 | INSULATION WGT.:                     |                            |              | LBS  |
| 36 | GUMITE WGT.:                         |                            |              | LBS  |
| 37 | OPER. LIQUID WGT.:                   | 1850                       |              | LBS  |
| 38 |                                      |                            |              |      |
| 39 |                                      |                            |              |      |
| 40 |                                      |                            |              |      |
| 41 | HYDROTEST: SHOP:                     | FIELD:                     |              | PBI  |
| 42 | GAGE LOCATION:                       |                            |              |      |
| 43 | MAX. ALLOW. PRESS. (HEAT & COLD):    |                            |              | PBI  |

UNITED STATES  
ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION  
FOSSIL ENERGY

COAL GASIFICATION COMBINED CYCLE PILOT PLANT  
SIOUX FALLS, SOUTH DAKOTA  
CONTRACT NO. ERDA-FE 14-32-0001-1521

FOSTER WHEELER ENERGY CORP.  
110 SOUTH ORANGE AVENUE  
LIVINGSTON, NEW JERSEY

UNITED STATES  
ERDA

FOSSIL ENERGY

FW EDC NO. OP-764-562-A

DRAWN: RLK DATE: 3/1/76  
CHECKED: DATE: 3/1/76  
APPROVED: DATE: 3/1/76

REVIEWED: DATE: 3/1/76  
APPROVED: DATE: 3/1/76

DESIGN NUMBER

1ST STAGE SWS REFLUX DRUM D-202

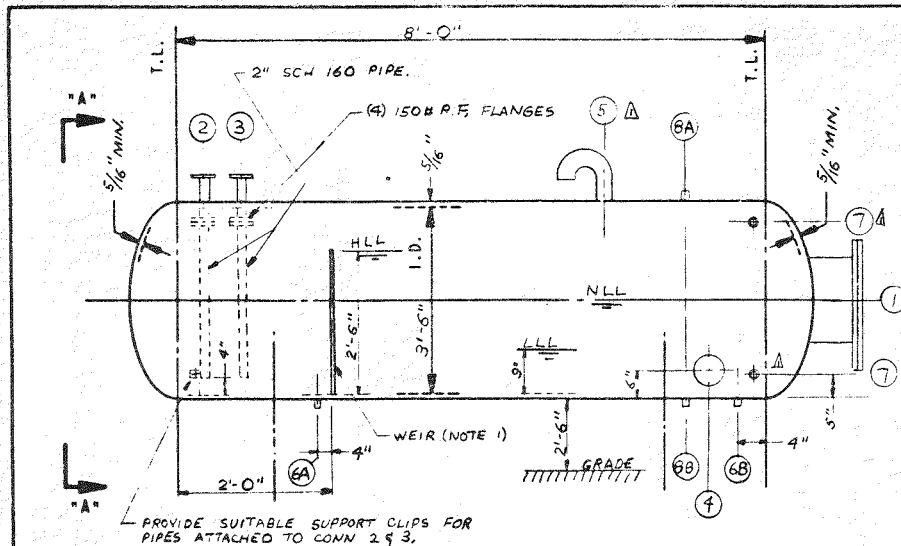
FWEC CONT. 15-1591

REQ. NO. 1591-1131G

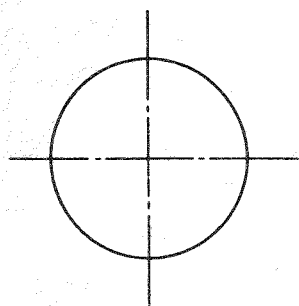
## REFERENCE DRAWINGS, REQUISITIONS, STANDARDS

1590-10A1 1590-83A1 10B141  
1590-100A 10B13.2  
1590-50A2 13B12.1  
1590-82A1

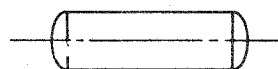




NOTES:  
1. WEIR CONSISTS OF 3/8" C.S. PLATE WELDED TO SHELL OF VESSEL.  
2. (2) SADDLES, MARK NO. 4, TO BE PROVIDED FOR VESSEL PER F.W. SPEC 13811.1



VIEW "A-A"

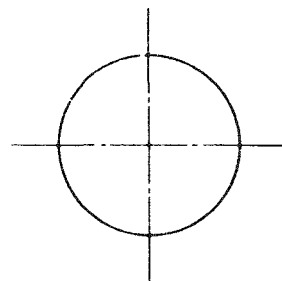
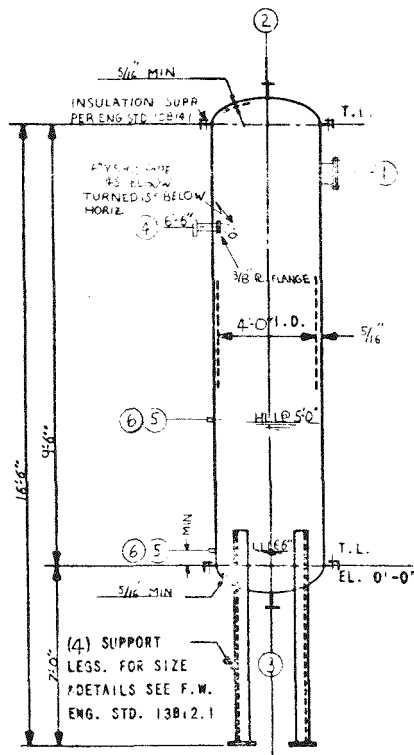


ORIENTATION PLAN



THIS DRAWING IS THE PROPERTY OF THE FOSTER WHEELER CORPORATION, 110 SOUTH ORANGE AVENUE, LIVINGSTON, NEW JERSEY, AND IS LENT WITHOUT CONSIDERATION OTHER THAN THE BORROWER'S AGREEMENT THAT IT SHALL NOT BE LENT OR DISPOSED OF DIRECTLY OR INDIRECTLY FOR ANY PURPOSE OTHER THAN THAT FOR WHICH IT IS SPECIFICALLY FURNISHED. THE APPARATUS SHOWN IN THE DRAWING IS COVERED BY PATENTS.

| RELEASES                                                                                                         |               |                                                                                                                                                                                             |                  |           | VESSEL DATA                              |                                              |
|------------------------------------------------------------------------------------------------------------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-----------|------------------------------------------|----------------------------------------------|
| DWG. REV.                                                                                                        | DATE          | ISSUED FOR                                                                                                                                                                                  |                  |           | 1                                        | ITEM NO.: D-208 NO. REQ'D: ONE               |
| OP                                                                                                               | DATE OF ORDER | (A) PURCHASE SHELL AND HEAD MATERIAL. PREPARE BUT DO NOT SUBMIT SHOP DETAIL DRAWINGS.                                                                                                       |                  |           | 2                                        | SERVICE: VACUUM CONDENSATE DRUM              |
|                                                                                                                  |               | (B) ISSUE CHECKED FOSTER WHEELER DRAWING. PURCHASE ALL OTHER MATERIALS. FINALIZE AND SUBMIT CHECKED SHOP DETAIL DRAWING WITHIN ONE WEEK OF RELEASE DATE. PROCEED WITH COMPLETE FABRICATION. |                  |           | 3                                        |                                              |
|                                                                                                                  |               | (C) VENDOR'S DRAWING RETURNED                                                                                                                                                               |                  |           | 4                                        | DIAMETER: 3'-6"                              |
|                                                                                                                  |               | (D) FIELD CONSTRUCTION                                                                                                                                                                      |                  |           | 5                                        | TANGENT LENGTH: 8'-0"                        |
|                                                                                                                  |               | (E)                                                                                                                                                                                         |                  |           | 6                                        | W.P. PRESSURE: NORM.: ATMOS PSI              |
| NOZZLE CHART                                                                                                     |               |                                                                                                                                                                                             |                  |           | 7                                        | W.P. LIQUID LEVEL, MAX.: ATMOS PSI           |
| COR. NO.                                                                                                         | SIZE          | USAS. RATING                                                                                                                                                                                | SERVICE          | NO. REQ'D | 8                                        | DESIGN PRESSURE: 27 PSIG                     |
| 1                                                                                                                | 18"           | 150# R.F.                                                                                                                                                                                   | MANWAY           | 1         | 9                                        | OPER. LIQUID HOLD-UP PRESS: 1.5 PSIG         |
| 2                                                                                                                | 2"            |                                                                                                                                                                                             | LIQUID INLET     | 1         | 10                                       | OPER. PRESS. DROP THRU VESSEL: PSI           |
| 3                                                                                                                | 2"            |                                                                                                                                                                                             | LIQUID INLET     | 1         | 11                                       | MAX. RELIEVING PRESS. @ TOP NO.: 25 PSIG     |
| 4                                                                                                                | 3"            |                                                                                                                                                                                             | LIQUID OUTLET    | 1         | 12                                       | MAX. OPER. TEMPERATURE: 145°F                |
| 5                                                                                                                | 3"            |                                                                                                                                                                                             | VENT (GOOSENECK) | 1         | 13                                       | DESIGN TEMPERATURE: 195°F                    |
| 6                                                                                                                | 1"            | 6000# C.P.G.                                                                                                                                                                                | DRAIN            | 2         | 14                                       | SPECIFIC GRAVITY (PROCESS FLUID): 1.0        |
| 7                                                                                                                | 1"            |                                                                                                                                                                                             | LEVEL CONTROL    | 2         | 15                                       | CODE: ASME SECT VIII DIV I STAMPED: YES      |
| 8                                                                                                                | 3/4"          |                                                                                                                                                                                             | LEVEL GAUGE      | 2         | 16                                       | P.W.M.T.: FOR CODE: NO FOR PROCESS: NO       |
|                                                                                                                  |               |                                                                                                                                                                                             |                  |           | 17                                       | RADIOGRAPHED: SPOT                           |
|                                                                                                                  |               |                                                                                                                                                                                             |                  |           | 18                                       | JOINT EFFICIENCY: 0.85                       |
|                                                                                                                  |               |                                                                                                                                                                                             |                  |           | 19                                       | CORROSION ALLOWANCE SHELLS: 1/8" HEADS: 1/8" |
|                                                                                                                  |               |                                                                                                                                                                                             |                  |           | 20                                       | MATL., SHELL: SA-285 GRC                     |
|                                                                                                                  |               |                                                                                                                                                                                             |                  |           | 21                                       | MATL., HEADS: SA-285 GRC                     |
|                                                                                                                  |               |                                                                                                                                                                                             |                  |           | 22                                       | MATL., SUPPORTS: SA-283 GRC                  |
|                                                                                                                  |               |                                                                                                                                                                                             |                  |           | 23                                       | TYPE OF HEADS: 2:1 ELLIPSOIDAL               |
|                                                                                                                  |               |                                                                                                                                                                                             |                  |           | 24                                       | EXTERNAL BOLTING: SA-193-B7/SA-194-2H        |
|                                                                                                                  |               |                                                                                                                                                                                             |                  |           | 25                                       | INTERNAL BOLTING:                            |
|                                                                                                                  |               |                                                                                                                                                                                             |                  |           | 26                                       | GASKETS: 1/8" COMPRESSED ASBESTOS            |
|                                                                                                                  |               |                                                                                                                                                                                             |                  |           | 27                                       | BOLT HOLES: STRADDLE VESSEL CENTERLINE       |
|                                                                                                                  |               |                                                                                                                                                                                             |                  |           | 28                                       | PAINT: AS PER SPEC. 1591-83A1                |
|                                                                                                                  |               |                                                                                                                                                                                             |                  |           | 29                                       | INSULATION: WINTERIZATION AS REQ'D           |
|                                                                                                                  |               |                                                                                                                                                                                             |                  |           | 30                                       | SHIPMENT: ONE PIECE                          |
|                                                                                                                  |               |                                                                                                                                                                                             |                  |           | 31                                       |                                              |
|                                                                                                                  |               |                                                                                                                                                                                             |                  |           | 32                                       | EMPTY WGT.: 3350 LBS                         |
|                                                                                                                  |               |                                                                                                                                                                                             |                  |           | 33                                       | WATER WGT.: 5830 LBS                         |
|                                                                                                                  |               |                                                                                                                                                                                             |                  |           | 34                                       | TRAYS WGT.: LBS                              |
|                                                                                                                  |               |                                                                                                                                                                                             |                  |           | 35                                       | INSULATION WGT.: LBS                         |
|                                                                                                                  |               |                                                                                                                                                                                             |                  |           | 36                                       | SUNITE WGT.: LBS                             |
|                                                                                                                  |               |                                                                                                                                                                                             |                  |           | 37                                       | OPER. LIQUID WGT.: 4380 LBS                  |
|                                                                                                                  |               |                                                                                                                                                                                             |                  |           | 38                                       |                                              |
|                                                                                                                  |               |                                                                                                                                                                                             |                  |           | 39                                       |                                              |
|                                                                                                                  |               |                                                                                                                                                                                             |                  |           | 40                                       |                                              |
|                                                                                                                  |               |                                                                                                                                                                                             |                  |           | 41                                       | HYDROTEST: SHOP: FIELD: PSI                  |
|                                                                                                                  |               |                                                                                                                                                                                             |                  |           | 42                                       | GAGE LOCATION:                               |
|                                                                                                                  |               |                                                                                                                                                                                             |                  |           | 43                                       | MAX. ALLOW. PRESS. (HEW & COLD): PSI         |
| UNITED STATES ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION FOSSIL ENERGY                                         |               |                                                                                                                                                                                             |                  |           |                                          |                                              |
| COAL GASIFICATION COMBINED CYCLE PILOT PLANT SIOUX FALLS, SOUTH DAKOTA CONTRACT NO. ERDA-FE 14-32-0001-1521      |               |                                                                                                                                                                                             |                  |           |                                          |                                              |
| FOSTER WHEELER ENERGY CORP. 110 SOUTH ORANGE AVENUE LIVINGSTON, NEW JERSEY                                       |               |                                                                                                                                                                                             |                  |           | UNITED STATES ERDA                       |                                              |
| FW Dwg. NO. OP-764-559-1                                                                                         |               |                                                                                                                                                                                             |                  |           | FOSSIL ENERGY                            |                                              |
| DRAWN: MS DATE: 3/23/66                                                                                          |               |                                                                                                                                                                                             |                  |           | REVIEWED: _____                          |                                              |
| CHECKED: _____ DATE: _____                                                                                       |               |                                                                                                                                                                                             |                  |           | APPROVED: _____                          |                                              |
| APPROVED: _____ DATE: _____                                                                                      |               |                                                                                                                                                                                             |                  |           | DRAWING NUMBER: _____                    |                                              |
| REFERENCE DRAWINGS, REQUISITIONS, STANDARDS F.W. SPECS 1590-10A1 50A2 1590-1003 52C4 1590-83A1 F.W. STDS 13811.1 |               |                                                                                                                                                                                             |                  |           | DRAW TITLE: VACUUM CONDENSATE DRUM D-208 |                                              |
|                                                                                                                  |               |                                                                                                                                                                                             |                  |           | FWEC CONT. 15-1591 REQ'N. N°1591-1131L   |                                              |



ORIENTATION PLAN



THIS DRAWING IS THE PROPERTY OF THE FOSTER WHEELER CORPORATION, 200 SOUTH ORANGE AVENUE, LIVINGSTON, NEW JERSEY, AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT THE WRITTEN PERMISSION OF THE FOSTER WHEELER CORPORATION. THIS DRAWING IS SPECIFICALLY FOR THE PROJECT AND IS NOT TO BE USED FOR ANY OTHER PROJECT.

## RELEASES

| DWG. REV. | DATE | ISSUED FOR                                                                                                                                                                                 |
|-----------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| OP        |      | (A) PURCHASE SHELL AND HEAD MATERIAL, PREPARE BUT NOT SUBMIT SHOP DETAIL DRAWINGS                                                                                                          |
|           |      | (B) ISSUE CHECKED FOSTER WHEELER DRAWING, PURCHASE ALL OTHER MATERIALS, FINALIZE AND SUBMIT CHECKED SHOP DETAIL DRAWING WITHIN ONE WEEK OF RELEASE DATE, PROCEED WITH COMPLETE FABRICATION |
|           |      | (C) VENDOR'S DRAWING RETURNED                                                                                                                                                              |
|           |      | (D) FIELD CONSTRUCTION                                                                                                                                                                     |
|           |      | (E)                                                                                                                                                                                        |

## NOZZLE CHART

| CON. NO. | SIZE | USAS RATING | SERVICE             | NO. REQD. |
|----------|------|-------------|---------------------|-----------|
| 1        | 8"   | 1500#       | MANWAY - 1/4" JAVIT | 1         |
| 2        | 4"   |             | GAS OUTLET          | 1         |
| 3        | 3"   |             | LIQUID OUTLET       | 1         |
| 4        | 6"   |             | INLET               | 1         |
| 5        | 3/4" | 1000#       | LC                  | 2         |
| 6        | 3/4" |             | GAGE GLASS          | 2         |

## VESSEL DATA

|    |                                   |                            |             |      |
|----|-----------------------------------|----------------------------|-------------|------|
| 1  | ITEM NO.                          | D-212                      | NO. REQ'D   | ONE  |
| 2  | SERVICE                           | 2ND STAGE SWS REFLUX DRUM  |             |      |
| 3  |                                   |                            |             |      |
| 4  | DIAMETER                          | 4.0" I.D.                  |             |      |
| 5  | HEIGHT                            | 9.6"                       |             |      |
| 6  | OPER. PRESSURE                    | NORM.: 1.4                 | PSIG        |      |
| 7  | DESIGN LIQUID LEVEL               | MAX.: 1.7                  | PSIG        |      |
| 8  | DESIGN PRESSURE                   | 53                         | PSIG        |      |
| 9  | OPER. LIQUID HOLD-UP PRESS.       | 2.2                        | PSI         |      |
| 10 | OPER. PRESS. DROP THRU VESSEL     | 0.5                        | PSIG        |      |
| 11 | MAX. RELIEVING PRESS. @ TOP I.D.  | 50                         | PSIG        |      |
| 12 | MAX. OPER. TEMPERATURE            | 200°F                      |             |      |
| 13 | DESIGN TEMPERATURE                | 250°F                      |             |      |
| 14 | SPECIFIC GRAVITY (PROCESS FLUID)  | 1.0                        |             |      |
| 15 | SEE ASME SECT. VIII DIV. 1        |                            | STAMPED     | YES  |
| 16 | P.W.M.T. FOR CODE                 | NO                         | FOR PROCESS | NO   |
| 17 | RADIOGRAPHED                      | SPOT                       |             |      |
| 18 | JOINT EFFICIENCY                  | 85%                        |             |      |
| 19 | CORROSION ALLOWANCE SHELLS        | 1/8"                       | HEADS       | 1/8" |
| 20 | MATL. SHELL                       | SA-285-C                   |             |      |
| 21 | MATL. HEADS                       | SA-285-C                   |             |      |
| 22 | T.L. SUPPORTS                     | SA-36                      |             |      |
| 23 | TYPE OF HEADS                     | 2:1 ELLIP                  |             |      |
| 24 | EXTERNAL BOLTING                  | SA-193 B7/SA-194-2H        |             |      |
| 25 | INTERNAL BOLTING                  |                            |             |      |
| 26 | GASKETS                           | 1/4" CNK COMP A5B          |             |      |
| 27 | BOLT HOLES                        | STRADDLE VESSEL CENTERLINE |             |      |
| 28 | PAINT                             | PER 15-10-83A1             |             |      |
| 29 | INSULATION                        | YES (BY OTHERS)*           |             |      |
| 30 | SHIPMENT                          | ONE PIECE                  |             |      |
| 31 | * INSULATION SUPP. BY VESSEL FAB. |                            |             |      |
| 32 | EMPTY WGT.                        | 4600                       | LBS         |      |
| 33 | WATER WGT. (ONLY)                 | 5203                       | LBS         |      |
| 34 | TRAYS WGT.                        |                            | LBS         |      |
| 35 | INSULATION WGT.                   |                            | LBS         |      |
| 36 | GRITE WGT.                        |                            | LBS         |      |
| 37 | OPER. LIQUID WGT.                 |                            | LBS         |      |
| 38 |                                   |                            |             |      |
| 39 |                                   |                            |             |      |
| 40 |                                   |                            |             |      |
| 41 | HYDROTEST: SHOP:                  | FIELD:                     | PSI         |      |
| 42 | GAGE LOCATION:                    |                            |             |      |
| 43 | MAX. ALLOW. PRESS. (HEAT & COLD): |                            | PSI         |      |

UNITED STATES  
ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION  
FOSSIL ENERGY

COAL GASIFICATION COMBINED CYCLE PILOT PLANT  
SIOUX FALLS, SOUTH DAKOTA  
CONTRACT NO. ERDA-FE 14-52-10001-51

FOSTER WHEELER ENERGY CORP.  
200 SOUTH ORANGE AVENUE  
LIVINGSTON, NEW JERSEY

UNITED STATES  
ERDA

FOSSIL ENERGY

PROJECT NO. OP-764-563-A

DRAWN BY: BLK DATE: 3/2/76

CHECKED BY: DATE: 3/2/76

APPROVED BY: DATE: 3/2/76

DESIGNED BY: D-212

2ND STAGE SWS REFLUX DRUM

FWEC CONT. 15-1591

REQ. N° 1591-1131-N

# MATERIAL REQUISITION



FOSTER WHEELER CORPORATION

PAGE 1 OF 5

FORM 135-20

|                                                               |                         |                           |                |
|---------------------------------------------------------------|-------------------------|---------------------------|----------------|
| FOR <u>ERDA-FE</u>                                            | F.W.REF. <u>15-1591</u> | REQUISITION NUMBER        | DATE           |
| SITE <u>SIOUX FALLS, SOUTH DAKOTA</u>                         |                         | <u>1591-1141-C</u>        | <u>3-22-76</u> |
| MATERIAL <u>SLURRY FILTRATION TANK/OIL SEPARATOR (TK-202)</u> |                         | SUPERSEDED BY CHANGE NO.: |                |
| <u>ENERGY RESEARCH &amp; DEVELOPMENT ADMINISTRATION</u>       | C1                      | C4                        |                |
| <u>FOSSIL ENERGY - LOCATION - NSP LAWRENCE STATION</u>        | C2                      | C5                        |                |
| <u>SIOUX FALLS, S.D.</u>                                      | C3                      | C6                        |                |

INDEX

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| I   | SCOPE                            |
| II  | GENERAL                          |
| III | BASIS OF DESIGN                  |
| IV  | MECHANICAL SPECIFICATIONS        |
| V   | SITE CONDITIONS                  |
| VI  | UTILITIES AVAILABLE              |
| VII | STANDARDS AND JOB SPECIFICATIONS |

|     |         |           |
|-----|---------|-----------|
| BY: | P.O.NO. | SUPPLIER: |
|-----|---------|-----------|

## I. SCOPE

This requisition covers the design, fabrication and supply of a unit for the continuous separation of a filtered waste stream containing water, oil, and tar particles. The unit will conform to standard construction as far as possible, but with certain modifications as may be necessary to fulfill all the requirements outlined below.

## II. GENERAL

- A. The design of all equipment of vendors supply will comply with all regulations applicable to the proposed location i.e. Sioux Falls, S.D. All materials to be of United States origin. Equipment shall be furnished in accordance with the Standards noted in Part VII of this specification as well as the applicable provisions of the latest revisions of the following codes, specifications, etc., which may be revised to adjust classification and addition made as necessary to assume good practice.

1. Electrical - NEC - Class 1 - Group D, Division - 2  
Class II- Group F, Division - 2
2. Safety - Federal Register (OSHA)
3. Other - State and Local Requirements.

- B. The following is required by ERDA-FE:

No subcontract shall be on a cost-plus-a-percentage-basis.

"This contract or purchase order pertains to the performance of ERDA-FE contract no. 14-32-0001-1521 between the United States and Foster Wheeler Energy Corporation and the sub contractor agrees that the Contracting Officer, ERDA-Fossil Energy or his authorized representative may inspect the plant and audit the books and records of the subcontractor with respect to work done or supplies, material and equipment furnished under this contract or purchase order."

Such requirements shall not apply to competitively advertised procurements, or standard "off the shelf" purchases of equipment or the subcontract or purchase order which is \$10,000 or less.

III. BASIS OF DESIGN

- A. Normal Water Thruput = 36 GPM  
Maximum Water Thruput= 150 GPM
- B. The water to be treated can contain up to 600#/hr of oil having an estimated SP GR of 0.97 @ 60°F. In addition the influent can on occasion contain up to 400 lbs/hr of tar having an estimated specific gravity of 1.12 at 60°F.

This tar would collect as a sludge in the tank and would be cleaned out periodically.

The influent can also contain 100-200 PPM of fine solids remaining from the preceeding vacuum filtration operation.

- C. The effluent water shall contain less than 30 ppmw oil.

IV. MECHANICAL SPECIFICATIONS

- A. Inlet water temperature 153°F
- B. Material of construction - Vendor to specify.
- C. The Vendor shall furnish an oil pump, controlled by a float control arrangement. The Vendor shall quote the extra cost for providing a pump of sufficient capacity (i.e. approx. 30 PSIG discharge pressure) to allow direct piping of the collected oil to a remote slop tank.
- D. The tank will be located at Grade. The Vendor shall provide a 4" connection on the outlet water chamber (at a suitable height to be determined later) for direct connection to the Purchasers Process Water Pump. (Sketch Page 5)
- E. The Vendor shall furnish suitable connections on the settling tank for the installation of a continuous level controller by the Purchaser of the process water level. The Vendor shall provide a 3 minutes hold up at maximum flow rate and approximately 10 minutes at normal flow rate. Hold-up in this instance is defined as the capacity between minimum and maximum liquid levels.
- F. The Vendor shall provide a 3" connection suitably located for occasional addition of clean make-up water to the effluent chamber.

V. SITE CONDITIONS

|                               |   |            |
|-------------------------------|---|------------|
| 1. Altitude (above sea level) | - | 1315 ft    |
| 2. Atmospheric Pressure       | - | 14.0 PSIA  |
| 3. Design Temp. Summer        | - | 93°F       |
| Winter                        | - | -25°F      |
| 4. Location                   | - | Outdoors   |
| 5. Type of Operation          | - | Continuous |
| 6. Earthquake Zone            | - | I          |
| 7. Wind Loading               |   |            |
| 0 - 29 ft                     | - | 20 PSF     |
| 30 - 49 ft                    | - | 25 PSF     |
| 50 - 99 ft                    | - | 30 PSF     |
| 100 - 499 ft                  | - | 40 PSF     |

VI. UTILITIES AVAILABLE

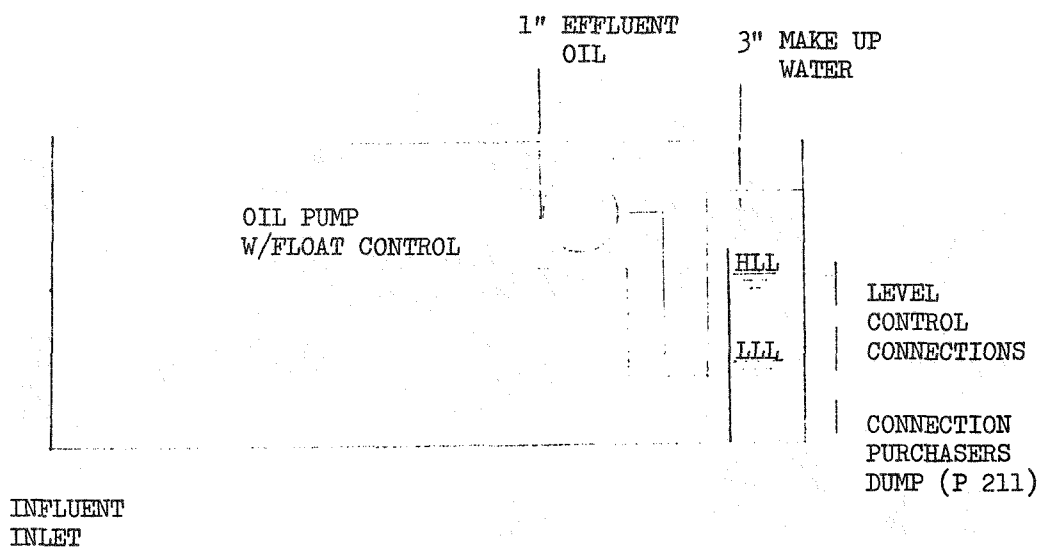
1. Power - Motors
  - 1/2 HP & below - 115 V, 1Ø 60 HZ
  - 3/4 HP to 150 HP - 460 V, 3 Ø 60 HZ
2. Steam for winterization available at 65 PSIG

VII. STANDARDS AND JOB SPECIFICATIONS

- A. The following documents shall be considered as an integral part of this requisition.

|    |            |                          |
|----|------------|--------------------------|
| 1. | 1590-10A1  | Vessel Specification     |
| 2. | 1590-1300A | General Notes            |
| 3. | 1590-31A   | Centrifugal Pumps        |
| 4. | 1590-38A1  | Induction Motors         |
| 5. | 1590-50A2  | Gaskets and Surfaces     |
| 6. | 1590-50A4  | Gaskets and Surfaces     |
| 7. | 1590-83A   | Painting                 |
| 8. | 1590-92A1  | Preparation for Shipment |
| 9. | 1590-1900  | General Notes            |

SCHEMATIC ARRANGEMENT OF PROCESS EQUIPMENT





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THIS DRAWING IS THE PROPERTY OF THE FOSTER WHEELER CORPORATION, 110 SOUTH ORANGE AVENUE, LIVINGSTON NEW JERSEY, AND IS LOENT WITHOUT CONSIDERATION OTHER THAN THE BORROWER'S AGREEMENT THAT IT SHALL NOT BE LENT OR DISPOSED OF DIRECTLY OR INDIRECTLY NOR USED FOR ANY PURPOSE OTHER THAN THAT FOR WHICH IT IS SPECIFICALLY FURNISHED. THE APPARATUS SHOWN IN THE DRAWING IS COVERED BY PATENTS.

50 FORM 1135 50A



## MATERIAL REQUISITION

FOSTER WHEELER ENERGY CORPORATION

110 SOUTH ORANGE AVENUE, LIVINGSTON, N. J.

SHELL & TUBE  
EXCHANGERS

PAGE 1 OF 1

|                                                                                                                                                      |                        |                                    |                               |                  |                   |
|------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|------------------------------------|-------------------------------|------------------|-------------------|
| CONTRACT NO. 15-1591                                                                                                                                 |                        | REQ'N. NO. 1591-1211-Q             |                               | DATE 3-10-76     |                   |
| CUSTOMER'S NAME UNITED STATES E.R.D.A. - FOSSIL ENERGY                                                                                               |                        | LOCATION SIOUX FALLS, SOUTH DAKOTA |                               |                  |                   |
| SUPERSEDED BY                                                                                                                                        |                        |                                    |                               |                  |                   |
| CHANGE NO.                                                                                                                                           | C-1                    | C-2                                | C-3                           | C-4              | C-5               |
| DATE                                                                                                                                                 | 4-5-76                 |                                    |                               |                  |                   |
| SERVICE OF UNIT STRIPPED WATER COOLER                                                                                                                |                        | ITEM NO. E-207                     |                               |                  |                   |
| SIZE 17-240                                                                                                                                          | TYPE BEM               |                                    | CONNECTED IN -                |                  |                   |
| SQ. FT. SURF./UNIT (EFF) 753                                                                                                                         | SHELLS/UNIT ONE        |                                    | SQ. FT. SURF./SHELL (EFF) 753 |                  |                   |
| PERFORMANCE OF ONE UNIT                                                                                                                              |                        |                                    |                               |                  |                   |
|                                                                                                                                                      | SHELL SIDE             |                                    | TUBE SIDE                     |                  |                   |
| FLUID CIRCULATED                                                                                                                                     | COOLING WATER          |                                    | STRIPPED WATER (3)            |                  |                   |
| TOTAL FLUID ENTERING                                                                                                                                 | 160,000                | LB/HR                              | 53,440                        | LB/HR            |                   |
| VAPOR                                                                                                                                                |                        | LB/HR                              |                               | LB/HR            |                   |
| LIQUID                                                                                                                                               | 160,000                | LB/HR                              | 53,440                        | LB/HR            |                   |
| STEAM                                                                                                                                                |                        | LB/HR                              |                               | LB/HR            |                   |
| NON-CONDENSABLES                                                                                                                                     |                        | LB/HR                              |                               | LB/HR            |                   |
| FLUID (VAPORIZED)(CONDENSED)                                                                                                                         |                        | LB/HR                              |                               | LB/HR            |                   |
| STEAM CONDENSED                                                                                                                                      |                        | LB/HR                              |                               | LB/HR            |                   |
| GRAVITY                                                                                                                                              | 0.96 (IN) : 0.95 (OUT) |                                    | 0.98 (AVG.)                   |                  |                   |
| VISCOSITY                                                                                                                                            | 0.48 (IN) : 0.22 (OUT) |                                    | 0.48 (AVG.)                   |                  |                   |
| MOLECULAR WEIGHT                                                                                                                                     | 18.0                   |                                    | 18.0                          |                  |                   |
| SPECIFIC HEAT                                                                                                                                        | 1.0                    | BTU/LB-°F                          | 1.0                           | BTU/LB-°F        |                   |
| THERMAL CONDUCTIVITY                                                                                                                                 | 0.35                   | BTU/HR-FT-°F                       |                               | BTU/HR-FT-°F     |                   |
| LATENT HEAT                                                                                                                                          |                        | BTU/LB                             |                               | BTU/LB           |                   |
| TEMPERATURE IN                                                                                                                                       | 85                     | °F                                 | 164                           | °F               |                   |
| TEMPERATURE OUT                                                                                                                                      | 105                    | °F                                 | 105                           | °F               |                   |
| OPERATING PRESSURE, INLET                                                                                                                            | 45                     | (PSIA) (PSIG)                      | 480                           | (PSIA) (PSIG)    |                   |
| NO. PASSES PER SHELL                                                                                                                                 | ONE                    |                                    | SIX                           |                  |                   |
| VELOCITY                                                                                                                                             |                        | FT/SEC                             | 4.3                           | FT/SEC           |                   |
| PRESSURE DROP - ALLOW. CALC'D.                                                                                                                       | 10                     | PSI                                | 10                            | PSI              |                   |
| FOULING RESISTANCE, MIN.                                                                                                                             | 0.002                  |                                    | 0.002                         |                  |                   |
| HEAT EXCHANGED - BTU/HR.                                                                                                                             | 3,185,000              |                                    | MTD CORRECTED-°F              | 29.1             |                   |
| TRANSFER RATE - SERVICE                                                                                                                              | 145                    |                                    | CLEAN                         |                  |                   |
| CONSTRUCTION OF ONE SHELL                                                                                                                            |                        |                                    |                               |                  |                   |
| DESIGN PRESSURE                                                                                                                                      | 100                    | PSIG                               | 640                           | PSIG             |                   |
| TEST PRESSURE                                                                                                                                        | PER CODE               | PSIG                               | PER CODE                      | PSIG             |                   |
| DESIGN TEMPERATURE                                                                                                                                   | 160                    | °F                                 | 275                           | °F               |                   |
| TUBES C.S.                                                                                                                                           | NO. 195                | O.D. 3/4"                          | BWG 14 (STR)                  | LENGTH 20' (STR) | PITCH 15/16" Δ    |
| SHELL C.S.                                                                                                                                           |                        | I.D. 17.25"                        | SHELL COVER (INTG)(REMOV)     |                  |                   |
| CHANNEL OR BONNET C.S.                                                                                                                               |                        |                                    | CHANNEL COVER                 |                  |                   |
| TUBESHEET - STATIONARY C.S.                                                                                                                          |                        |                                    | TUBESHEET - FLOATING          |                  |                   |
| BAFFLES - CROSS C.S.                                                                                                                                 | TYPE SEGM.             |                                    | FLOATING HEAD COVER           |                  |                   |
| BAFFLES - LONG                                                                                                                                       | TYPE                   |                                    | IMPINGMENT PROTECTION C.S.    |                  |                   |
| TUBE SUPPORTS                                                                                                                                        |                        |                                    |                               |                  |                   |
| TUBE TO TUBESHEET JOINT                                                                                                                              |                        |                                    |                               |                  |                   |
| GASKETS                                                                                                                                              |                        |                                    |                               |                  |                   |
| CONNECTIONS - SHELL SIDE                                                                                                                             | IN                     | 6"                                 | OUT                           | 6"               | RATING 150 LBS RF |
| CONNECTIONS - TUBE SIDE                                                                                                                              | IN                     | 4"                                 | OUT                           | 4"               | RATING 300 LBS RF |
| CORROSION ALLOWANCE - SHELL SIDE                                                                                                                     | 1/8                    | IN.                                | TUBE SIDE                     | 1/8              | IN.               |
| CODE REQUIREMENTS ASME VIII                                                                                                                          |                        |                                    | TEMA CLASS R                  |                  |                   |
| REMARKS: (1) NOZZLE & SUPPORT LOCATION TO BE AS NOTED ON F.W. STD. 21B11.1                                                                           |                        |                                    |                               |                  |                   |
| (2) FOR GENERAL NOTES REFER TO REQ'N. 1590-1200A WHICH IS AN INTEGRAL PART OF THIS REQ'N                                                             |                        |                                    |                               |                  |                   |
| (3) CONTAINS DISSOLVED GASES : (MAX. WT. PPM) 150 NH <sub>3</sub> , 110 CO <sub>2</sub> , 60 H <sub>2</sub> S. (4) PROVIDE EXPANSION JOINT ON SHELL. |                        |                                    |                               |                  |                   |

## MATERIAL REQUISITION

FESTER WHEELER ENERGY CORPORATION

SHELL & TUBE  
EXCHANGERS

110 SOUTH ORANGE AVENUE, LIVINGSTON, N. J.

PAGE 1 OF 1

|                                                                                                                                                                                                                                                               |                            |                                    |                          |                                 |     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|------------------------------------|--------------------------|---------------------------------|-----|
| CONTRACT NO. 15-1591                                                                                                                                                                                                                                          |                            | REQ'N. NO. 1591-1211-R             |                          | DATE 3-10-76                    |     |
| CUSTOMER'S NAME UNITED STATES E.R.D.A. - FOSSIL ENERGY                                                                                                                                                                                                        |                            | LOCATION SIOUX FALLS, SOUTH DAKOTA |                          |                                 |     |
| SUPERSEDED BY                                                                                                                                                                                                                                                 |                            |                                    |                          |                                 |     |
| CHANGE NO.                                                                                                                                                                                                                                                    | C-1                        | C-2                                | C-3                      | C-4                             | C-5 |
| DATE                                                                                                                                                                                                                                                          | 4-5-76                     |                                    |                          |                                 |     |
| SERVICE OF UNIT SOUR WATER STRIPPER EXCHANGER                                                                                                                                                                                                                 |                            |                                    | ITEM NO. E-208           |                                 |     |
| SIZE 23-240                                                                                                                                                                                                                                                   | TYPE BFU                   |                                    | (HORIZ) CONNECTED IN -   |                                 |     |
| SQ. FT. SURF./UNIT 1740                                                                                                                                                                                                                                       | SHELLS/UNIT ONE            |                                    | SQ. FT. SURF./SHELL 1740 |                                 |     |
| PERFORMANCE OF ONE UNIT                                                                                                                                                                                                                                       |                            |                                    |                          |                                 |     |
|                                                                                                                                                                                                                                                               | SHELL SIDE                 |                                    | TUBE SIDE                |                                 |     |
| FLUID CIRCULATED                                                                                                                                                                                                                                              | SOUR WATER (3)             |                                    | STRIPPED WATER (4)       |                                 |     |
| TOTAL FLUID ENTERING                                                                                                                                                                                                                                          | 51,870                     | LB/HR                              | 53,440                   | LB/HR                           |     |
| VAPOR                                                                                                                                                                                                                                                         |                            | LB/HR                              |                          | LB/HR                           |     |
| LIQUID                                                                                                                                                                                                                                                        | 51,870                     | LB/HR                              | 53,440                   | LB/HR                           |     |
| STEAM                                                                                                                                                                                                                                                         |                            | LB/HR                              |                          | LB/HR                           |     |
| NON-CONDENSABLES                                                                                                                                                                                                                                              |                            | LB/HR                              |                          | LB/HR                           |     |
| FLUID (VAPORIZED)(CONDENSED)                                                                                                                                                                                                                                  |                            | LB/HR                              |                          | LB/HR                           |     |
| STEAM CONDENSED                                                                                                                                                                                                                                               |                            | LB/HR                              |                          | LB/HR                           |     |
| GRAVITY                                                                                                                                                                                                                                                       | 0.96 (IN) ; 0.95 (OUT)     |                                    | 0.94 (IN) ; 0.98         |                                 |     |
| VISCOSITY Cps                                                                                                                                                                                                                                                 | 0.48 (IN) ; 0.22 (OUT)     |                                    | 0.18 (IN) ; 0.38         |                                 |     |
| MOLECULAR WEIGHT                                                                                                                                                                                                                                              |                            |                                    |                          |                                 |     |
| SPECIFIC HEAT                                                                                                                                                                                                                                                 | BTU/LB-°F                  |                                    | 1.0 BTU/LB-°F            |                                 |     |
| THERMAL CONDUCTIVITY                                                                                                                                                                                                                                          | BTU/HR-FT-°F               |                                    | BTU/HR-FT-°F             |                                 |     |
| LATENT HEAT                                                                                                                                                                                                                                                   | BTU/LB                     |                                    | BTU/LB                   |                                 |     |
| TEMPERATURE IN                                                                                                                                                                                                                                                | 133                        | °F                                 | 256                      | °F                              |     |
| TEMPERATURE OUT                                                                                                                                                                                                                                               | 231                        | °F                                 | 164                      | °F                              |     |
| OPERATING PRESSURE, INLET                                                                                                                                                                                                                                     | 50                         | (PSIG)                             | 494                      | (PSIG)                          |     |
| NO. PASSES PER SHELL                                                                                                                                                                                                                                          | Two                        |                                    | Two                      |                                 |     |
| VELOCITY                                                                                                                                                                                                                                                      | FT/SEC                     |                                    | 0.7 FT/SEC               |                                 |     |
| PRESSURE DROP - ALLOW. CALC'D.                                                                                                                                                                                                                                | 10                         | PSI                                | 10                       | PSI                             |     |
| FOULING RESISTANCE, MIN.                                                                                                                                                                                                                                      | 0.002                      |                                    | 0.002                    |                                 |     |
| HEAT EXCHANGED - BTU/HR.                                                                                                                                                                                                                                      | 4,920,000                  |                                    | MTD CORRECTED-°F 27.9    |                                 |     |
| TRANSFER RATE - SERVICE                                                                                                                                                                                                                                       | 101                        |                                    | CLEAN                    |                                 |     |
| CONSTRUCTION OF ONE SHELL                                                                                                                                                                                                                                     |                            |                                    |                          |                                 |     |
| DESIGN PRESSURE                                                                                                                                                                                                                                               | 100                        | PSIG                               | 640                      | PSIG                            |     |
| TEST PRESSURE                                                                                                                                                                                                                                                 | PER CODE                   | PSIG                               | PER CODE                 | PSIG                            |     |
| DESIGN TEMPERATURE                                                                                                                                                                                                                                            | 300                        | °F                                 | 320                      | °F                              |     |
| TUBES C.S.                                                                                                                                                                                                                                                    | NO. 218 "U"                | O.D. 3/4"                          | BWG 14                   | LENGTH 20'(STR.) PITCH 15/16" Δ |     |
| SHELL C.S.                                                                                                                                                                                                                                                    | I.D. 23.25"                | SHELL COVER (INTG)(REMOV)          |                          |                                 |     |
| CHANNEL OR BONNET C.S.                                                                                                                                                                                                                                        | CHANNEL COVER              |                                    |                          |                                 |     |
| TUBESHEET - STATIONARY C.S.                                                                                                                                                                                                                                   | TUBESHEET - FLOATING       |                                    |                          |                                 |     |
| BAFFLES - CROSS C.S. TYPE SEGM.                                                                                                                                                                                                                               | FLOATING HEAD COVER        |                                    |                          |                                 |     |
| BAFFLES - LONG C.S. TYPE                                                                                                                                                                                                                                      | IMPINGMENT PROTECTION C.S. |                                    |                          |                                 |     |
| TUBE SUPPORTS                                                                                                                                                                                                                                                 |                            |                                    |                          |                                 |     |
| TUBE TO TUBESHEET JOINT                                                                                                                                                                                                                                       |                            |                                    |                          |                                 |     |
| GASKETS                                                                                                                                                                                                                                                       |                            |                                    |                          |                                 |     |
| CONNECTIONS - SHELL SIDE                                                                                                                                                                                                                                      | IN 4"                      | OUT 4"                             | RATING 150 LBS RF        |                                 |     |
| CONNECTIONS - TUBE SIDE                                                                                                                                                                                                                                       | IN 4"                      | OUT 4"                             | RATING 300 LBS RF        |                                 |     |
| CORROSION ALLOWANCE - SHELL SIDE                                                                                                                                                                                                                              | 1/8 IN.                    | TUBE SIDE                          | 1/8 IN.                  |                                 |     |
| CODE REQUIREMENTS ASME VIII                                                                                                                                                                                                                                   |                            |                                    | TEMA CLASS R             |                                 |     |
| REMARKS: (1) NOZZLE & SUPPORT LOCATION TO BE AS NOTED ON F.W. STD. 21B11.1                                                                                                                                                                                    |                            |                                    |                          |                                 |     |
| (2) FOR GENERAL NOTES REFER TO REQ'N. 1590-1200A WHICH IS AN INTEGRAL PART OF THIS REQ'N                                                                                                                                                                      |                            |                                    |                          |                                 |     |
| (3) CONTAINS DISSOLVED GASES (WT.%): 1.02 NH <sub>3</sub> , 2.32 CO <sub>2</sub> , 0.17 H <sub>2</sub> S. (4) CONTAINS DISSOLVED GASES (MAX. WT. PPM): 150 NH <sub>3</sub> , 110 CO <sub>2</sub> , 60 H <sub>2</sub> S. (5) PROVIDE EXPANSION JOINT ON SHELL. |                            |                                    |                          |                                 |     |

## MATERIAL REQUISITION

FOSTER WHEELER ENERGY CORPORATION

110 SOUTH ORANGE AVENUE, LIVINGSTON, N. J.

SHELL & TUBE  
EXCHANGERS

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|                                                                                                                                                                                                                                                                               |            |                                                  |                               |                       |                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|--------------------------------------------------|-------------------------------|-----------------------|----------------|
| CONTRACT NO. 15-1591                                                                                                                                                                                                                                                          |            | REQ'N. NO. 1591-1211-T                           |                               | DATE 3-10-76          |                |
| CUSTOMER'S NAME UNITED STATES ERDA - FOSSIL ENERGY                                                                                                                                                                                                                            |            | LOCATION SIOUX FALLS, SOUTH DAKOTA               |                               |                       |                |
| SUPERSEDED BY                                                                                                                                                                                                                                                                 |            |                                                  |                               |                       |                |
| CHANGE NO.                                                                                                                                                                                                                                                                    | C-1        | C-2                                              | C-3                           | C-4                   | C-5            |
| DATE                                                                                                                                                                                                                                                                          | 4-5-76     |                                                  |                               |                       |                |
| SERVICE OF UNIT FIRST STAGE SWS OVHD CONDENSER                                                                                                                                                                                                                                |            |                                                  | ITEM NO. E-210                |                       |                |
| SIZE 17-144                                                                                                                                                                                                                                                                   | TYPE BEM   |                                                  | CONNECTED IN -                |                       |                |
| SQ. FT. SURF./UNIT (EFF)                                                                                                                                                                                                                                                      | 478        | SHELLS/UNIT ONE                                  | SQ. FT. SURF./SHELL (EFF) 478 |                       |                |
| PERFORMANCE OF ONE UNIT                                                                                                                                                                                                                                                       |            |                                                  |                               |                       |                |
|                                                                                                                                                                                                                                                                               |            | SHELL SIDE                                       |                               | TUBE SIDE             |                |
| FLUID CIRCULATED                                                                                                                                                                                                                                                              |            | SWS OVHD VAPOR                                   |                               | COOLING WATER         |                |
| TOTAL FLUID ENTERING                                                                                                                                                                                                                                                          |            | 10,700 (3) LB/HR                                 |                               | 322,400 LB/HR         |                |
| VAPOR                                                                                                                                                                                                                                                                         |            | 3,250 LB/HR                                      |                               |                       |                |
| LIQUID                                                                                                                                                                                                                                                                        |            |                                                  |                               | 322,400 LB/HR         |                |
| STEAM                                                                                                                                                                                                                                                                         |            | 5,660 LB/HR                                      |                               |                       |                |
| NON-CONDENSABLES                                                                                                                                                                                                                                                              |            | 1,790 LB/HR                                      |                               |                       |                |
| FLUID (VAPORIZED)(CONDENSED)                                                                                                                                                                                                                                                  |            | 3,245 (4) LB/HR                                  |                               |                       |                |
| STEAM CONDENSED                                                                                                                                                                                                                                                               |            | 5,305 (4) LB/HR                                  |                               |                       |                |
| GRAVITY DENSITY (LB./FT <sup>3</sup> )                                                                                                                                                                                                                                        |            | 0.094(VAP. IN); 62.4(LIQ. OUT); 0.128(VAP. OUT)  |                               | 62.2 (IN); 61.8 (OUT) |                |
| VISCOSITY CPS                                                                                                                                                                                                                                                                 |            | 0.014(VAP. IN); 0.15(LIQ. OUT); 0.015(VAP. OUT)  |                               | 0.82 (IN); 0.62 (OUT) |                |
| MOLECULAR WEIGHT                                                                                                                                                                                                                                                              |            | 22.06(VAP. IN); 20.39(LIQ. OUT); 32.37(VAP. OUT) |                               | 18.016                |                |
| SPECIFIC HEAT                                                                                                                                                                                                                                                                 |            | BTU/LB-°F                                        |                               | 1.0 BTU/LB-°F         |                |
| THERMAL CONDUCTIVITY                                                                                                                                                                                                                                                          |            | BTU/HR-FT-°F                                     |                               | 0.35 BTU/HR-FT-°F     |                |
| LATENT HEAT                                                                                                                                                                                                                                                                   |            | BTU/LB                                           |                               | BTU/LB                |                |
| TEMPERATURE IN                                                                                                                                                                                                                                                                |            | 231 °F                                           |                               | 85 °F                 |                |
| TEMPERATURE OUT                                                                                                                                                                                                                                                               |            | 202 °F                                           |                               | 110 °F                |                |
| OPERATING PRESSURE INLET                                                                                                                                                                                                                                                      |            | 17 (PSIG)                                        |                               | 45 (PSIG)             |                |
| NO. PASSES PER SHELL                                                                                                                                                                                                                                                          |            | ONE                                              |                               | TWO                   |                |
| VELOCITY                                                                                                                                                                                                                                                                      |            | FT/SEC                                           |                               | 8.11 FT/SEC           |                |
| PRESSURE DROP - ALLOW. CALC'D.                                                                                                                                                                                                                                                |            | 2.5 PSI                                          |                               | 10 PSI                |                |
| FOULING RESISTANCE, MIN.                                                                                                                                                                                                                                                      |            | 0.002                                            |                               | 0.002                 |                |
| HEAT EXCHANGED - BTU/HR.                                                                                                                                                                                                                                                      |            | 8,060,000                                        |                               | MTD CORRECTED-°F 118  |                |
| TRANSFER RATE - SERVICE                                                                                                                                                                                                                                                       |            | 143                                              |                               | CLEAN                 |                |
| CONSTRUCTION OF ONE SHELL                                                                                                                                                                                                                                                     |            |                                                  |                               |                       |                |
| DESIGN PRESSURE                                                                                                                                                                                                                                                               |            | 75 PSIG                                          |                               | 100 PSIG              |                |
| TEST PRESSURE                                                                                                                                                                                                                                                                 |            | PER CODE PSIG                                    |                               | PER CODE PSIG         |                |
| DESIGN TEMPERATURE                                                                                                                                                                                                                                                            |            | 298 °F                                           |                               | 160 °F                |                |
| TUBES C.S.                                                                                                                                                                                                                                                                    | NO. 205    | O.D. 3/4"                                        | BWG 14                        | LENGTH 12'            | PITCH 15/16" Δ |
| SHELL C.S.                                                                                                                                                                                                                                                                    |            | I.D. 17.25"                                      | SHELL COVER (INTEG)(REMOV)    |                       |                |
| CHANNEL OR BONNET C.S.                                                                                                                                                                                                                                                        |            | CHANNEL COVER                                    |                               |                       |                |
| TUBESHEET - STATIONARY C.S.                                                                                                                                                                                                                                                   |            | TUBESHEET - FLOATING                             |                               |                       |                |
| BAFFLES - CROSS C.S.                                                                                                                                                                                                                                                          | TYPE SEGM. | FLOATING HEAD COVER                              |                               |                       |                |
| BAFFLES - LONG                                                                                                                                                                                                                                                                | TYPE       | IMPINGMENT PROTECTION C.S.                       |                               |                       |                |
| TUBE SUPPORTS                                                                                                                                                                                                                                                                 |            |                                                  |                               |                       |                |
| TUBE TO TUBESHEET JOINT                                                                                                                                                                                                                                                       |            |                                                  |                               |                       |                |
| GASKETS                                                                                                                                                                                                                                                                       |            |                                                  |                               |                       |                |
| CONNECTIONS - SHELL SIDE                                                                                                                                                                                                                                                      |            | IN 8"                                            | OUT 6"                        | RATING 150 LBS RF     |                |
| CONNECTIONS - TUBE SIDE                                                                                                                                                                                                                                                       |            | IN 6"                                            | OUT 6"                        | RATING 150 LBS RF     |                |
| CORROSION ALLOWANCE - SHELL SIDE                                                                                                                                                                                                                                              |            | 1/8 IN.                                          | TUBE SIDE                     | 1/8 IN.               |                |
| CODE REQUIREMENTS ASME VIII                                                                                                                                                                                                                                                   |            |                                                  | TEMA CLASS R                  |                       |                |
| REMARKS: (1) NOZZLE & SUPPORT LOCATION TO BE AS NOTED ON F.W. STD. 21B11.1                                                                                                                                                                                                    |            |                                                  |                               |                       |                |
| (2) FOR GENERAL NOTES REFER TO REQ'N. 1590-1200 A WHICH IS AN INTEGRAL PART OF THIS REQ'N                                                                                                                                                                                     |            |                                                  |                               |                       |                |
| (3) VAPOR IN (MOLE %): 13.61 NH <sub>3</sub> , 28.61 CO <sub>2</sub> , 4.86 H <sub>2</sub> S, 52.91 H <sub>2</sub> O. (4) LIQUID OUT (MOLE %): 18.3 NH <sub>3</sub> , 7.8 CO <sub>2</sub> , 3.5 H <sub>2</sub> S, 70.4 H <sub>2</sub> O. (5) PROVIDE EXPANSION JOINT ON SHELL |            |                                                  |                               |                       |                |

## MATERIAL REQUISITION

EASTERN WILCOCK ENERGY CORPORATION

110 SOUTH ORANGE AVENUE, LIVINGSTON, N. J.

SHELL & TUBE  
EXCHANGERS

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|                                                                                                                                                                                                                                                                                                                                                  |        |                                    |                |                               |     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------------------------------------|----------------|-------------------------------|-----|
| CONTRACT NO. 15-1591                                                                                                                                                                                                                                                                                                                             |        | REQ'N. NO. 1591-1211-U             |                | DATE 3-10-76                  |     |
| CUSTOMER NAME UNITED STATES ERDA - FOSSIL ENERGY                                                                                                                                                                                                                                                                                                 |        | LOCATION SIOUX FALLS, SOUTH DAKOTA |                |                               |     |
| SUPERSEDED BY                                                                                                                                                                                                                                                                                                                                    |        |                                    |                |                               |     |
| CHANGE NO.                                                                                                                                                                                                                                                                                                                                       | C-1    | C-2                                | C-3            | C-4                           | C-5 |
| DATE                                                                                                                                                                                                                                                                                                                                             | 4-5-76 |                                    |                |                               |     |
| SERVICE OF UNIT FIRST SOUR WATER STRIPPER REBOILER                                                                                                                                                                                                                                                                                               |        |                                    | ITEM NO. E-211 |                               |     |
| SIZE 17-144                                                                                                                                                                                                                                                                                                                                      |        | TYPE BEL-THERMOSYPHON (VERT)       |                | CONNECTED IN -                |     |
| SQ. FT. SURF./UNIT (EFF) 569                                                                                                                                                                                                                                                                                                                     |        | SHELLS/UNIT ONE                    |                | SQ. FT. SURF./SHELL (EFF) 569 |     |
| PERFORMANCE OF ONE UNIT                                                                                                                                                                                                                                                                                                                          |        |                                    |                |                               |     |
| FLUID CIRCULATED                                                                                                                                                                                                                                                                                                                                 |        | SHELL SIDE                         |                | TUBE SIDE                     |     |
| TOTAL FLUID ENTERING                                                                                                                                                                                                                                                                                                                             |        | LOW PRESSURE STEAM                 |                | STRIPPED SOUR WATER (3)       |     |
| VAPOR                                                                                                                                                                                                                                                                                                                                            |        | 5200 LB/HR                         |                | 75,900 LB/HR                  |     |
| LIQUID                                                                                                                                                                                                                                                                                                                                           |        | LB/HR                              |                | LB/HR                         |     |
| STEAM                                                                                                                                                                                                                                                                                                                                            |        | 5200 LB/HR                         |                | 75,900 LB/HR                  |     |
| NON-CONDENSABLES                                                                                                                                                                                                                                                                                                                                 |        | LB/HR                              |                | LB/HR                         |     |
| FLUID (VAPORIZED) (EFF)                                                                                                                                                                                                                                                                                                                          |        | LB/HR                              |                | 3,700 LB/HR                   |     |
| STEAM CONDENSED                                                                                                                                                                                                                                                                                                                                  |        | 5200 LB/HR                         |                | LB/HR                         |     |
| GRAVITY (DENSITY) LBS/FT <sup>3</sup>                                                                                                                                                                                                                                                                                                            |        |                                    |                | LIQ = 59.02 ; VAP = 0.08      |     |
| VISCOSITY CPS                                                                                                                                                                                                                                                                                                                                    |        |                                    |                | LIQ = 0.19 ; VAP = 0.012      |     |
| MOLECULAR WEIGHT                                                                                                                                                                                                                                                                                                                                 |        | 18.02                              |                | LIQ = 18.01 ; VAP = 24.04     |     |
| SPECIFIC HEAT                                                                                                                                                                                                                                                                                                                                    |        | BTU/LB-°F                          |                | BTU/LB-°F                     |     |
| THERMAL CONDUCTIVITY                                                                                                                                                                                                                                                                                                                             |        | BTU/HR-FT-°F                       |                | BTU/HR-FT-°F                  |     |
| LATENT HEAT                                                                                                                                                                                                                                                                                                                                      |        | 901.7 BTU/LB                       |                | 947.5 (STEAM) BTU/LB          |     |
| TEMPERATURE IN                                                                                                                                                                                                                                                                                                                                   |        | 307 °F                             |                | 243 °F                        |     |
| TEMPERATURE OUT                                                                                                                                                                                                                                                                                                                                  |        | 307 °F                             |                | 248 °F                        |     |
| OPERATING PRESSURE, INLET                                                                                                                                                                                                                                                                                                                        |        | 60 (EFF) (PSIG)                    |                | 18.2 (EFF) (PSIG)             |     |
| NO. PASSES PER SHELL                                                                                                                                                                                                                                                                                                                             |        | ONE                                |                | ONE                           |     |
| VELOCITY                                                                                                                                                                                                                                                                                                                                         |        | FT/SEC                             |                | 15 (AVG.) FT/SEC              |     |
| PRESSURE DROP - ALLOW. CALC'D.                                                                                                                                                                                                                                                                                                                   |        | 2.0 PSI                            |                | TSE (4) PSI                   |     |
| FOULING RESISTANCE, MIN.                                                                                                                                                                                                                                                                                                                         |        | 0.001                              |                | 0.002                         |     |
| HEAT EXCHANGED - BTU/HR.                                                                                                                                                                                                                                                                                                                         |        | 4,300,000                          |                | MTD CORRECTED-°F 61.5         |     |
| TRANSFER RATE - SERVICE                                                                                                                                                                                                                                                                                                                          |        | 123                                |                | CLEAN                         |     |
| CONSTRUCTION OF ONE SHELL                                                                                                                                                                                                                                                                                                                        |        |                                    |                |                               |     |
| DESIGN PRESSURE                                                                                                                                                                                                                                                                                                                                  |        | 90 PSIG                            |                | 75 PSIG                       |     |
| TEST PRESSURE                                                                                                                                                                                                                                                                                                                                    |        | PER CODE PSIG                      |                | PER CODE PSIG                 |     |
| DESIGN TEMPERATURE                                                                                                                                                                                                                                                                                                                               |        | 375 °F                             |                | 310 °F                        |     |
| TUBES 1 C.S. NO. 245 O.D. 3/4" BWG 14 {MIN} LENGTH 12' PITCH 15/16" Δ                                                                                                                                                                                                                                                                            |        |                                    |                |                               |     |
| SHELL C.S. I.D. 17.25" SHELL COVER (INTG) (REMOV)                                                                                                                                                                                                                                                                                                |        |                                    |                |                               |     |
| CHANNEL OR BONNET C.S. CHANNEL COVER C.S.                                                                                                                                                                                                                                                                                                        |        |                                    |                |                               |     |
| TUBESHEET - STATIONARY C.S. TUBESHEET - FLOATING                                                                                                                                                                                                                                                                                                 |        |                                    |                |                               |     |
| BAFFLES - CROSS TYPE FLOATING HEAD COVER                                                                                                                                                                                                                                                                                                         |        |                                    |                |                               |     |
| BAFFLES - LONG TYPE IMPINGMENT PROTECTION C.S.                                                                                                                                                                                                                                                                                                   |        |                                    |                |                               |     |
| TUBE SUPPORTS C.S.                                                                                                                                                                                                                                                                                                                               |        |                                    |                |                               |     |
| TUBE TO TUBESHEET JOINT                                                                                                                                                                                                                                                                                                                          |        |                                    |                |                               |     |
| GASKETS                                                                                                                                                                                                                                                                                                                                          |        |                                    |                |                               |     |
| CONNECTIONS - SHELL SIDE IN 6" OUT 2" RATING 150 LBS RF                                                                                                                                                                                                                                                                                          |        |                                    |                |                               |     |
| CONNECTIONS - TUBE SIDE IN 6" OUT 10" RATING 150 LBS RF                                                                                                                                                                                                                                                                                          |        |                                    |                |                               |     |
| CORROSION ALLOWANCE - SHELL SIDE 1/8 IN. TUBE SIDE 1/8 IN.                                                                                                                                                                                                                                                                                       |        |                                    |                |                               |     |
| CODE REQUIREMENTS ASME VIII                                                                                                                                                                                                                                                                                                                      |        | TEMA CLASS R                       |                |                               |     |
| REMARKS: (1) NOZZLE & SUPPORT LOCATION TO BE AS NOTED ON F.W. STD. 21B11.1                                                                                                                                                                                                                                                                       |        |                                    |                |                               |     |
| (2) FOR GENERAL NOTES REFER TO REQ'N. 1590-1200A WHICH IS AN INTEGRAL PART OF THIS REQ'N                                                                                                                                                                                                                                                         |        |                                    |                |                               |     |
| (3) WATER CONTAINS (WT. PPM): 12,800 NH <sub>3</sub> , 2,895 CO <sub>2</sub> , 2,597 H <sub>2</sub> S. (4) THERMOSYPHON EFFECT - ONCE THRU TYPE; AT THE SPECIFIED FLOW CONDITION ΔP WILL BE APPROXIMATELY 1.6 PSI. (5) PROVIDE CONNECTIONS ON SHELL FOR LEVEL GAGE AND LEVEL CONTROL FOR STEAM CONDENSATE. (6) PROVIDE EXPANSION JOINT ON SHELL. |        |                                    |                |                               |     |

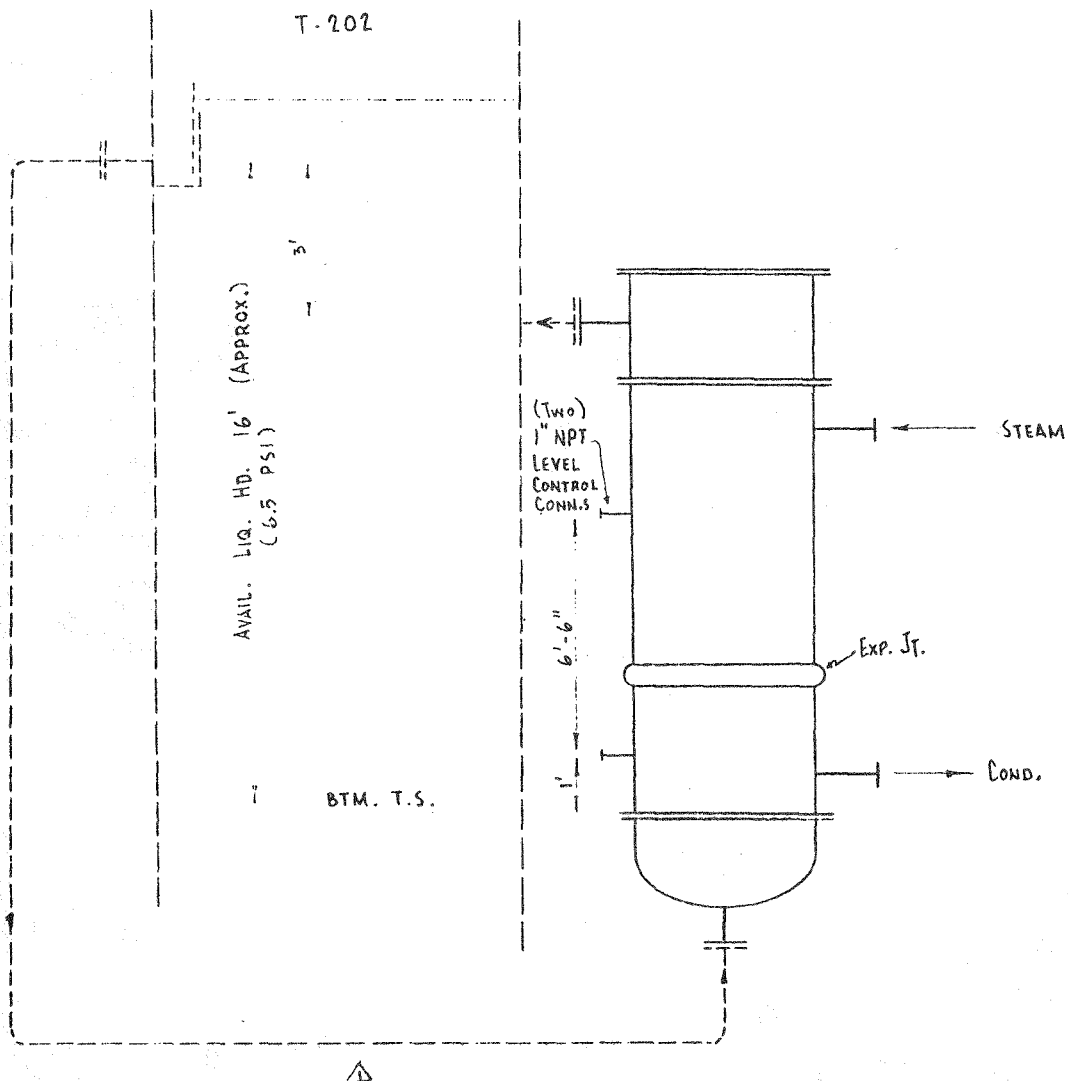
# MATERIAL REQUISITION

## FOSTER WHEELER CORPORATION

110 SOUTH ORANGE AVENUE, LIVINGSTON, N. J.

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| CONTRACT NO. 15-1591                                |        |     | REQ'N. NO. 1591-1211-U |     |     | DATE 3-10 6 |  |
| CUSTOMERS NAME UNITED STATES - ERDA - FOSSIL ENERGY |        |     | ITEM NO. E-211         |     |     |             |  |
| CHANGE NO.                                          | C-1    | C-2 | C-3                    | C-4 | C-5 | C-6         |  |
| DATE                                                | 4-5-76 |     |                        |     |     |             |  |



REMARKS:

## MATERIAL REQUISITION

SHELL & TUBE  
EXCHANGERSF. W. WHEELER COMPANY  
110 SOUTH ORANGE AVENUE, LIVINGSTON, N. J.

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|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|------------------------------------|--------------------------------------|----------------|----------------|
| CONTRACT NO. 15-1591                                                                                                                                                                                                                                                                                                |                                  | REQ'N. NO. 1591-1211-V             |                                      | DATE 3-10-76   |                |
| CUSTOMER'S NAME UNITED STATES - ERDA - FOSSIL ENERGY                                                                                                                                                                                                                                                                |                                  | LOCATION SIOUX FALLS, SOUTH DAKOTA |                                      |                |                |
| SUPERSEDED BY                                                                                                                                                                                                                                                                                                       |                                  |                                    |                                      |                |                |
| CHANGE NO.                                                                                                                                                                                                                                                                                                          | C-1                              | C-2                                | C-3                                  | C-4            | C-5            |
| DATE                                                                                                                                                                                                                                                                                                                | 4-5-76                           |                                    |                                      |                |                |
| SERVICE OF UNIT SECOND SOUR WATER STRIPPER REBOILER                                                                                                                                                                                                                                                                 |                                  |                                    |                                      | ITEM NO. E-212 |                |
| SIZES 31-192                                                                                                                                                                                                                                                                                                        | TYPE BEL-THERMOSYPHON (VERT)     |                                    | CONNECTED IN -                       |                |                |
| SQ. FT. SURF./UNIT (EFF) 2720                                                                                                                                                                                                                                                                                       | SHELLS/UNIT ONE                  |                                    | SQ. FT. SURF./SHELL (EFF) 2720       |                |                |
| PERFORMANCE OF ONE UNIT                                                                                                                                                                                                                                                                                             |                                  |                                    |                                      |                |                |
| FLUID CIRCULATED                                                                                                                                                                                                                                                                                                    | SHELL SIDE<br>LOW PRESSURE STEAM |                                    | TUBE SIDE<br>STRIPPED SOUR WATER (3) |                |                |
| TOTAL FLUID ENTERING                                                                                                                                                                                                                                                                                                | 19,500                           | LB/HR                              | 89,600                               | LB/HR          |                |
| VAPOR                                                                                                                                                                                                                                                                                                               |                                  | LB/HR                              |                                      | LB/HR          |                |
| LIQUID                                                                                                                                                                                                                                                                                                              |                                  | LB/HR                              | 89,600                               | LB/HR          |                |
| STEAM                                                                                                                                                                                                                                                                                                               | 19,500                           | LB/HR                              |                                      | LB/HR          |                |
| NON-CONDENSABLES                                                                                                                                                                                                                                                                                                    |                                  | LB/HR                              |                                      | LB/HR          |                |
| FLUID (VAPORIZED) (EFF)                                                                                                                                                                                                                                                                                             |                                  | LB/HR                              | 18,500                               | LB/HR          |                |
| STEAM CONDENSED                                                                                                                                                                                                                                                                                                     | 19,500                           | LB/HR                              |                                      | LB/HR          |                |
| GRAVITY (DENSITY) LBS/FT <sup>3</sup>                                                                                                                                                                                                                                                                               |                                  |                                    | LIQ = 55.67 ; VAP = 0.077            |                |                |
| VISCOSITY Cps                                                                                                                                                                                                                                                                                                       |                                  |                                    | LIQ = 0.18 ; VAP = 0.011             |                |                |
| MOLECULAR WEIGHT                                                                                                                                                                                                                                                                                                    | 18.02                            |                                    | 18.02                                |                |                |
| SPECIFIC HEAT                                                                                                                                                                                                                                                                                                       |                                  | BTU/LB-°F                          |                                      | BTU/LB-°F      |                |
| THERMAL CONDUCTIVITY                                                                                                                                                                                                                                                                                                |                                  | BTU/HR-FT-°F                       |                                      | BTU/HR-FT-°F   |                |
| LATENT HEAT                                                                                                                                                                                                                                                                                                         | 901.7                            | BTU/LB                             | 942.0                                | BTU/LB         |                |
| TEMPERATURE IN                                                                                                                                                                                                                                                                                                      | 307                              | °F                                 | 255                                  | °F             |                |
| TEMPERATURE OUT                                                                                                                                                                                                                                                                                                     | 307                              | °F                                 | 256                                  | °F             |                |
| OPERATING PRESSURE, INLET                                                                                                                                                                                                                                                                                           | 60                               | (PSIG)                             | 18.6                                 | (PSIG)         |                |
| NO. PASSES PER SHELL                                                                                                                                                                                                                                                                                                | ONE                              |                                    | ONE                                  |                |                |
| VELOCITY                                                                                                                                                                                                                                                                                                            |                                  | FT/SEC                             | 21 (MIXT-AVG)                        | FT/SEC         |                |
| PRESSURE DROP - ALLOW.   CALC'D.                                                                                                                                                                                                                                                                                    | 2.0                              | PSI                                | TSE (4)                              | PSI            |                |
| FOULING RESISTANCE, MIN.                                                                                                                                                                                                                                                                                            | 0.001                            |                                    | 0.002                                |                |                |
| HEAT EXCHANGED - BTU/HR.                                                                                                                                                                                                                                                                                            | 17,600,000                       |                                    | MTD CORRECTED-°F                     | 51.5           |                |
| TRANSFER RATE - SERVICE                                                                                                                                                                                                                                                                                             | 125.6                            |                                    | CLEAN                                |                |                |
| CONSTRUCTION OF ONE SHELL                                                                                                                                                                                                                                                                                           |                                  |                                    |                                      |                |                |
| DESIGN PRESSURE                                                                                                                                                                                                                                                                                                     | 90                               | PSIG                               | 75                                   | PSIG           |                |
| TEST PRESSURE                                                                                                                                                                                                                                                                                                       | PER CODE                         | PSIG                               | PER CODE                             | PSIG           |                |
| DESIGN TEMPERATURE                                                                                                                                                                                                                                                                                                  | 375                              | °F                                 | 310                                  | °F             |                |
| TUBES C.S.                                                                                                                                                                                                                                                                                                          | NO. 881                          | O.D. 3/4"                          | BWG 14 {MIN}                         | LENGTH 16'     | PITCH 15/16" Δ |
| SHELL C.S.                                                                                                                                                                                                                                                                                                          |                                  | I.D. 31"                           | SHELL COVER                          | (INTG)(REMOV)  |                |
| CHANNEL OR BONNET C.S.                                                                                                                                                                                                                                                                                              |                                  |                                    | CHANNEL COVER                        | C.S.           |                |
| TUBESHEET - STATIONARY C.S.                                                                                                                                                                                                                                                                                         |                                  |                                    | TUBESHEET - FLOATING                 |                |                |
| BAFFLES - CROSS TYPE                                                                                                                                                                                                                                                                                                |                                  |                                    | FLOATING HEAD COVER                  |                |                |
| BAFFLES - LONG TYPE                                                                                                                                                                                                                                                                                                 |                                  |                                    | IMPINGMENT PROTECTION                | C.S.           |                |
| TUBE SUPPORTS C.S.                                                                                                                                                                                                                                                                                                  |                                  |                                    |                                      |                |                |
| TUBE TO TUBESHEET JOINT                                                                                                                                                                                                                                                                                             |                                  |                                    |                                      |                |                |
| GASKETS                                                                                                                                                                                                                                                                                                             |                                  |                                    |                                      |                |                |
| CONNECTIONS - SHELL SIDE                                                                                                                                                                                                                                                                                            | IN 8"                            | OUT 3"                             | RATING 150 LBS                       | RF             |                |
| CONNECTIONS - TUBE SIDE                                                                                                                                                                                                                                                                                             | IN 8"                            | OUT 18"                            | RATING 150 LBS                       | RF             |                |
| CORROSION ALLOWANCE - SHELL SIDE                                                                                                                                                                                                                                                                                    | 1/8 IN.                          | TUBE SIDE                          | 1/8 IN.                              |                |                |
| CODE REQUIREMENTS ASME VIII                                                                                                                                                                                                                                                                                         |                                  |                                    | TEMA CLASS R                         |                |                |
| REMARKS: (1) NOZZLE & SUPPORT LOCATION TO BE AS NOTED ON F.W. STD. 21B11.1                                                                                                                                                                                                                                          |                                  |                                    |                                      |                |                |
| (2) FOR GENERAL NOTES REFER TO REQ'N. 1590-1200A WHICH IS AN INTEGRAL PART OF THIS REQ'N                                                                                                                                                                                                                            |                                  |                                    |                                      |                |                |
| (3) WATER CONTAINS (WT. PPM): 473 NH <sub>3</sub> , 173 H <sub>2</sub> S. (4) THERMOSYPHON EFFECT - ONCE THRU TYPE; AT THE SPECIFIED FLOW CONDITION ΔP WILL BE APPROXIMATELY 1.0 PSI. (5) PROVIDE CONNECTIONS ON SHELL FOR LEVEL GAGE AND LEVEL CONTROL FOR STEAM CONDENSATE. (6) PROVIDE EXPANSION JOINT ON SHELL. |                                  |                                    |                                      |                |                |

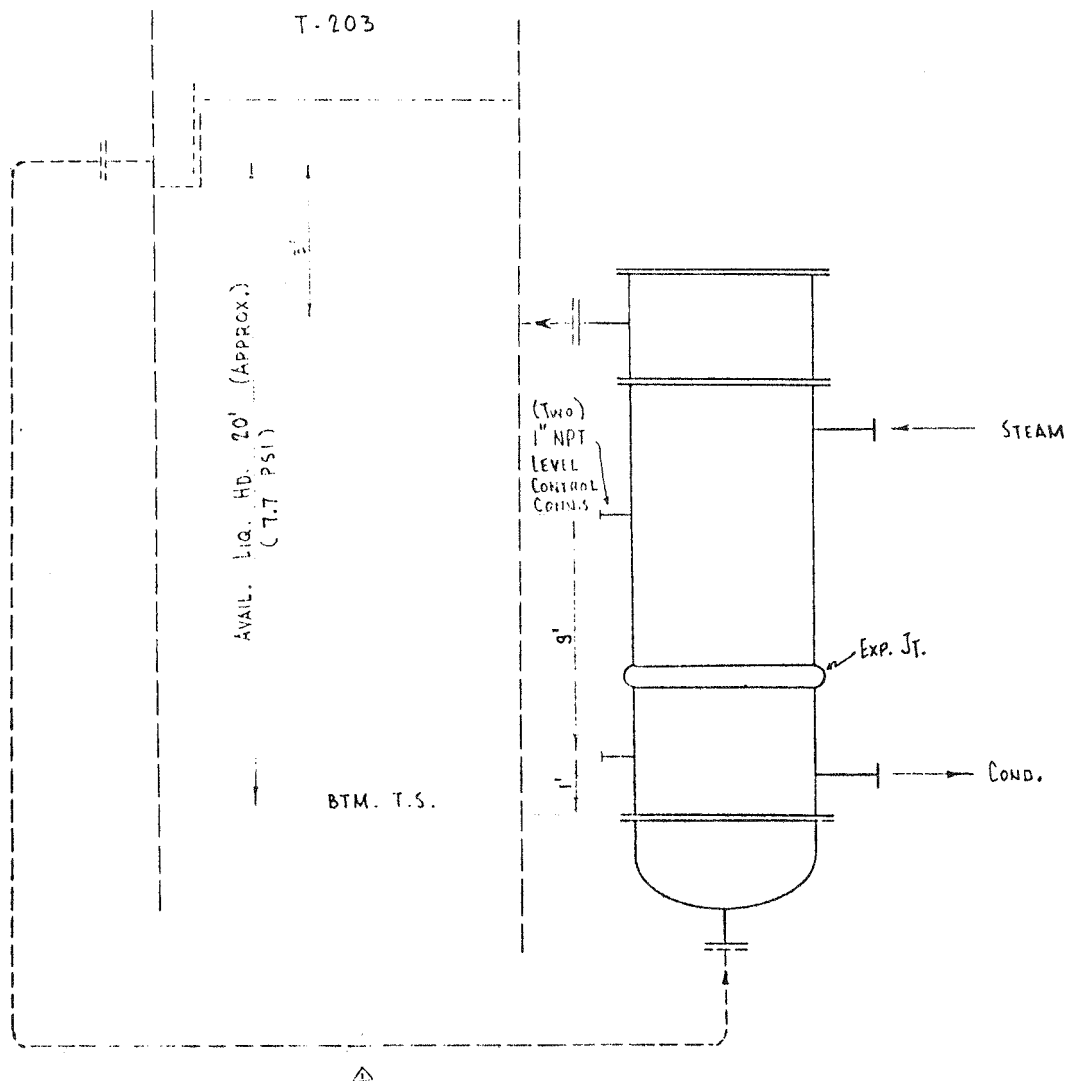
## MATERIAL REQUISITION

FOSTER WHEELER CORPORATION

110 SOUTH ORANGE AVENUE, LIVINGSTON, N. J.

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|                                                     |        |                        |     |              |     |
|-----------------------------------------------------|--------|------------------------|-----|--------------|-----|
| CONTRACT NO. 15-1591                                |        | REQ'N. NO. 1591-1211-V |     | DATE 3-10-76 |     |
| CUSTOMERS NAME UNITED STATES - ERDA - FOSSIL ENERGY |        | ITEM NO. E-212         |     |              |     |
| CHANGE NO.                                          | C-1    | C-2                    | C-3 | C-4          | C-5 |
| DATE                                                | 4-5-76 |                        |     |              |     |



REMARKS:

## MATERIAL REQUISITION

SHELL & TUBE  
EXCHANGERSFEDERAL WATERWORKS & HEAT EXCHANGER CO.  
110 SOUTH ORANGE AVENUE, LIVINGSTON, N. J.

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|                                                                                          |                   |                                    |                            |                           |                  |
|------------------------------------------------------------------------------------------|-------------------|------------------------------------|----------------------------|---------------------------|------------------|
| CONTRACT NO. 15-1591                                                                     |                   | REQ'N. NO. 1591-1211-W             |                            | DATE 3-11-76              |                  |
| CUSTOMER'S NAME UNITED STATES - ERDA - FOSSIL ENERGY                                     |                   | LOCATION SIOUX FALLS, SOUTH DAKOTA |                            |                           |                  |
| SUPERSEDED BY                                                                            |                   |                                    |                            |                           |                  |
| CHANGE NO.                                                                               | C-1               | C-2                                | C-3                        | C-4                       | C-5              |
| DATE                                                                                     | 4-5-76            |                                    |                            |                           |                  |
| SERVICE OF UNIT WATER WASH INTERCOOLER                                                   |                   | ITEM NO. E-214                     |                            |                           |                  |
| SIZE 32-240                                                                              | TYPE BEM          | (HORIZ)                            | CONNECTED IN SERIES        |                           |                  |
| SQ. FT. SURF./UNIT (EFF)                                                                 | 6735              | SHELLS/UNIT                        | Two                        | SQ. FT. SURF./SHELL (EFF) | 3368             |
| PERFORMANCE OF ONE UNIT                                                                  |                   |                                    |                            |                           |                  |
| FLUID CIRCULATED                                                                         |                   | SHELL SIDE                         |                            | TUBE SIDE                 |                  |
| TOTAL FLUID ENTERING                                                                     |                   | COOLING WATER                      |                            | CIRCULATING WATER         |                  |
| VAPOR                                                                                    |                   | 1,072,000 LB/HR                    |                            | 326,000 LB/HR             |                  |
| LIQUID                                                                                   |                   | 1,072,000 LB/HR                    |                            | 326,000 LB/HR             |                  |
| STEAM                                                                                    |                   | LB/HR                              |                            | LB/HR                     |                  |
| NON-CONDENSABLES                                                                         |                   | LB/HR                              |                            | LB/HR                     |                  |
| FLUID (VAPORIZED)(CONDENSED)                                                             |                   | LB/HR                              |                            | LB/HR                     |                  |
| STEAM CONDENSED                                                                          |                   | LB/HR                              |                            | LB/HR                     |                  |
| GRAVITY                                                                                  |                   | 1.0                                |                            | 0.97                      |                  |
| VISCOSITY Cps                                                                            |                   | 0.7                                |                            | 0.35                      |                  |
| MOLECULAR WEIGHT                                                                         |                   |                                    |                            |                           |                  |
| SPECIFIC HEAT                                                                            |                   | BTU/LB-°F                          |                            | BTU/LB-°F                 |                  |
| THERMAL CONDUCTIVITY                                                                     |                   | BTU/HR-FT-°F                       |                            | BTU/HR-FT-°F              |                  |
| LATENT HEAT                                                                              |                   | BTU/LB                             |                            | BTU/LB                    |                  |
| TEMPERATURE IN                                                                           |                   | 85 °F                              |                            | 180 °F                    |                  |
| TEMPERATURE OUT                                                                          |                   | 110 °F                             |                            | 98 °F                     |                  |
| OPERATING PRESSURE, INLET                                                                |                   | 45 (PSIG)                          |                            | 455 (PSIG)                |                  |
| NO. PASSES PER SHELL                                                                     |                   | ONE                                |                            | TWO                       |                  |
| VELOCITY                                                                                 |                   | FT/SEC                             |                            | 1.9 FT/SEC                |                  |
| PRESSURE DROP - ALLOW. CALC'D.                                                           |                   | 10 PSI                             |                            | 10 PSI                    |                  |
| FOULING RESISTANCE, MIN.                                                                 |                   | 0.002                              |                            | 0.002                     |                  |
| HEAT EXCHANGED - BTU/HR.                                                                 |                   | 26,800,000                         |                            | MTD CORRECTED-°F          |                  |
| TRANSFER RATE - SERVICE                                                                  |                   | 128                                |                            | CLEAN                     |                  |
| CONSTRUCTION OF ONE SHELL                                                                |                   |                                    |                            |                           |                  |
| DESIGN PRESSURE                                                                          |                   | 100 PSIG                           |                            | 500 PSIG                  |                  |
| TEST PRESSURE                                                                            |                   | PER CODE PSIG                      |                            | PER CODE PSIG             |                  |
| DESIGN TEMPERATURE                                                                       |                   | 160 °F                             |                            | 265 °F                    |                  |
| TUBES C.S.                                                                               | NO. 880           | O.D. 3/4"                          | BWG 14 (MTH)               | LENGTH 20'                | PITCH 15 1/16" Δ |
| SHELL C.S.                                                                               |                   | I.D. 32"                           | SHELL COVER (INTEG)(REMOV) |                           |                  |
| CHANNEL OR BONNET C.S.                                                                   |                   | CHANNEL COVER                      |                            |                           |                  |
| TUBESHEET - STATIONARY C.S.                                                              |                   | TUBESHEET - FLOATING               |                            |                           |                  |
| BAFFLES - CROSS C.S.                                                                     | TYPE DOUBLE SEGM. | FLOATING HEAD COVER                |                            |                           |                  |
| BAFFLES - LONG                                                                           | TYPE              | IMPINGMENT PROTECTION C.S.         |                            |                           |                  |
| TUBE SUPPORTS                                                                            |                   |                                    |                            |                           |                  |
| TUBE TO TUBESHEET JOINT                                                                  |                   |                                    |                            |                           |                  |
| GASKETS                                                                                  |                   |                                    |                            |                           |                  |
| CONNECTIONS - SHELL SIDE                                                                 |                   | IN 12"                             | OUT 12"                    | RATING 150 LBS RF         |                  |
| CONNECTIONS - TUBE SIDE                                                                  |                   | IN 8"                              | OUT 8"                     | RATING 300 LBS RF         |                  |
| CORROSION ALLOWANCE - SHELL SIDE                                                         |                   | 1/8 IN.                            | TUBE SIDE                  | 1/8 IN.                   |                  |
| CODE REQUIREMENTS ASME VIII                                                              |                   |                                    | TEMA CLASS R               |                           |                  |
| REMARKS: (1) NOZZLE & SUPPORT LOCATION TO BE AS NOTED ON F.W. STD. 21B11.1               |                   |                                    |                            |                           |                  |
| (2) FOR GENERAL NOTES REFER TO REQ'N. 1590-1200A WHICH IS AN INTEGRAL PART OF THIS REQ'N |                   |                                    |                            |                           |                  |
| (3) PROVIDE EXPANSION JOINT ON SHELL.                                                    |                   |                                    |                            |                           |                  |



# MATERIAL REQUISITION

FOSTER WHEELER ENERGY CORPORATION  
110 SOUTH ORANGE AVENUE, LIVINGSTON, N. J.

SHELL & TUBE  
EXCHANGERS

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|                                                                                                                                                                                                                                                                         |                                                     |                                    |                            |                           |                   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|------------------------------------|----------------------------|---------------------------|-------------------|
| CONTRACT NO. 15-1591                                                                                                                                                                                                                                                    |                                                     | REQ'N. NO. 1591-1211-Z             |                            | DATE 3-11-76              |                   |
| CUSTOMER'S NAME UNITED STATES - ERDA - Fossil Energy                                                                                                                                                                                                                    |                                                     | LOCATION SIOUX FALLS, SOUTH DAKOTA |                            |                           |                   |
| SUPERSEDED BY                                                                                                                                                                                                                                                           |                                                     |                                    |                            |                           |                   |
| CHANGE NO.                                                                                                                                                                                                                                                              | C-1                                                 | C-2                                | C-3                        | C-4                       | C-5               |
| DATE                                                                                                                                                                                                                                                                    | 4-5-76                                              |                                    |                            |                           |                   |
| SERVICE OF UNIT SECOND STAGE SWS OVHD CONDENSER                                                                                                                                                                                                                         |                                                     |                                    |                            | ITEM NO. E-217            |                   |
| SIZE 25-144                                                                                                                                                                                                                                                             | TYPE BEM                                            |                                    | (HORIZ) CONNECTED IN -     |                           |                   |
| SQ. FT. SURF./UNIT (EFF)                                                                                                                                                                                                                                                | 1150                                                | SHELLS/UNIT                        | ONE                        | SQ. FT. SURF./SHELL (EFF) | 1150              |
| PERFORMANCE OF ONE UNIT                                                                                                                                                                                                                                                 |                                                     |                                    |                            |                           |                   |
|                                                                                                                                                                                                                                                                         |                                                     | SHELL SIDE                         |                            | TUBE SIDE                 |                   |
|                                                                                                                                                                                                                                                                         |                                                     | SWS OVHD VAPOR                     |                            | COOLING WATER             |                   |
| FLUID CIRCULATED                                                                                                                                                                                                                                                        |                                                     |                                    |                            |                           |                   |
| TOTAL FLUID ENTERING                                                                                                                                                                                                                                                    | 19,935 (3)                                          |                                    | LB/HR                      | 691,200                   | LB/HR             |
| VAPOR                                                                                                                                                                                                                                                                   | 6,310                                               |                                    | LB/HR                      |                           | LB/HR             |
| LIQUID                                                                                                                                                                                                                                                                  |                                                     |                                    | LB/HR                      | 691,200                   | LB/HR             |
| STEAM                                                                                                                                                                                                                                                                   | 12,820                                              |                                    | LB/HR                      |                           | LB/HR             |
| NON-CONDENSABLES                                                                                                                                                                                                                                                        | 805                                                 |                                    | LB/HR                      |                           | LB/HR             |
| FLUID ( ) (CONDENSED)                                                                                                                                                                                                                                                   | 6,310 (4)                                           |                                    | LB/HR                      |                           | LB/HR             |
| STEAM CONDENSED                                                                                                                                                                                                                                                         | 12,550 (4)                                          |                                    | LB/HR                      |                           | LB/HR             |
| GRAVITY (DENSITY) LB/FT <sup>3</sup>                                                                                                                                                                                                                                    | 0.081 (VAP. IN), 0.076 (VAP. OUT), 56.8 (LIQ. OUT)  |                                    |                            | IN: 62.2 ; OUT: 61.8      |                   |
| VISCOSITY CPS                                                                                                                                                                                                                                                           | 0.013 (VAP. IN), 0.013 (VAP. OUT), 0.16 (LIQ. OUT)  |                                    |                            | IN: 0.82 ; OUT: 0.62      |                   |
| MOLECULAR WEIGHT                                                                                                                                                                                                                                                        | 19.40 (VAP. IN), 19.26 (VAP. OUT), 19.41 (LIQ. OUT) |                                    |                            | 18.016                    |                   |
| SPECIFIC HEAT                                                                                                                                                                                                                                                           |                                                     |                                    | BTU/LB-°F                  | 1.0                       | BTU/LB-°F         |
| THERMAL CONDUCTIVITY                                                                                                                                                                                                                                                    |                                                     |                                    | BTU/HR-FT-°F               | 0.35                      | BTU/HR-FT-°F      |
| LATENT HEAT                                                                                                                                                                                                                                                             |                                                     |                                    | BTU/LB                     |                           | BTU/LB            |
| TEMPERATURE IN                                                                                                                                                                                                                                                          | 234                                                 |                                    | °F                         | 85                        | °F                |
| TEMPERATURE OUT                                                                                                                                                                                                                                                         | 200                                                 |                                    | °F                         | 110                       | °F                |
| OPERATING PRESSURE, INLET                                                                                                                                                                                                                                               | 17 ( ) (PSIG)                                       |                                    |                            | 45 ( ) (PSIG)             |                   |
| NO. PASSES PER SHELL                                                                                                                                                                                                                                                    | ONE                                                 |                                    |                            | TWO                       |                   |
| VELOCITY                                                                                                                                                                                                                                                                |                                                     |                                    | FT/SEC                     | 7.2                       | FT/SEC            |
| PRESSURE DROP - ALLOW. CALC'D.                                                                                                                                                                                                                                          | 2.5                                                 | PSI                                | PSI                        | 10                        | PSI               |
| FOULING RESISTANCE, MIN.                                                                                                                                                                                                                                                | 0.002                                               |                                    |                            | 0.002                     |                   |
| HEAT EXCHANGED - BTU/HR.                                                                                                                                                                                                                                                | 17,280,000                                          |                                    | MTD CORRECTED-°F           | 118                       |                   |
| TRANSFER RATE - SERVICE                                                                                                                                                                                                                                                 | 127                                                 |                                    | CLEAN                      |                           |                   |
| CONSTRUCTION OF ONE SHELL                                                                                                                                                                                                                                               |                                                     |                                    |                            |                           |                   |
| DESIGN PRESSURE                                                                                                                                                                                                                                                         | 75                                                  |                                    | PSIG                       | 100                       | PSIG              |
| TEST PRESSURE                                                                                                                                                                                                                                                           | PER CODE                                            |                                    | PSIG                       | PER CODE                  | PSIG              |
| DESIGN TEMPERATURE                                                                                                                                                                                                                                                      | 298                                                 |                                    | °F                         | 160                       | °F                |
| TUBES C.S.                                                                                                                                                                                                                                                              | NO. 497                                             | O.D. 3/4"                          | BWG 14 ( ) ( )             | LENGTH 12'                | PITCH 15/16" Δ    |
| SHELL 4 C.S.                                                                                                                                                                                                                                                            | I.D. 25"                                            |                                    | SHELL COVER (INTEG)(REMOV) |                           |                   |
| CHANNEL OR BONNET C.S.                                                                                                                                                                                                                                                  |                                                     |                                    | CHANNEL COVER              |                           |                   |
| TUBESHEET - STATIONARY C.S.                                                                                                                                                                                                                                             |                                                     |                                    | TUBESHEET - FLOATING       |                           |                   |
| BAFFLES - CROSS C.S.                                                                                                                                                                                                                                                    | TYPE SEGM.                                          |                                    | FLOATING HEAD COVER        |                           |                   |
| BAFFLES - LONG                                                                                                                                                                                                                                                          | TYPE                                                |                                    | IMPINGMENT PROTECTION C.S. |                           |                   |
| TUBE SUPPORTS                                                                                                                                                                                                                                                           |                                                     |                                    |                            |                           |                   |
| TUBE TO TUBESHEET JOINT                                                                                                                                                                                                                                                 |                                                     |                                    |                            |                           |                   |
| GASKETS                                                                                                                                                                                                                                                                 |                                                     |                                    |                            |                           |                   |
| CONNECTIONS - SHELL SIDE                                                                                                                                                                                                                                                | IN                                                  | 10"                                | OUT                        | 6"                        | RATING 150 LBS RF |
| CONNECTIONS - TUBE SIDE                                                                                                                                                                                                                                                 | IN                                                  | 10"                                | OUT                        | 10"                       | RATING 150 LBS RF |
| CORROSION ALLOWANCE - SHELL SIDE                                                                                                                                                                                                                                        | 1/8 IN.                                             |                                    | TUBE SIDE                  | 1/8 IN.                   |                   |
| CODE REQUIREMENTS ASME VIII                                                                                                                                                                                                                                             |                                                     |                                    | TEMA CLASS R               |                           |                   |
| REMARKS: (1) NOZZLE & SUPPORT LOCATION TO BE AS NOTED ON F.W. STD. 21B11.1                                                                                                                                                                                              |                                                     |                                    |                            |                           |                   |
| (2) FOR GENERAL NOTES REFER TO REQ'N. 1590-1200 A WHICH IS AN INTEGRAL PART OF THIS REQ'N                                                                                                                                                                               |                                                     |                                    |                            |                           |                   |
| (3) VAPOR IN (MOL. %): 22.4 NH <sub>3</sub> , 3.1 CO <sub>2</sub> , 5.2 H <sub>2</sub> S, 69.3 H <sub>2</sub> O. (4) LIQ. OUT (MOL. %): 20.1 NH <sub>3</sub> , 3.1 CO <sub>2</sub> , 5.1 H <sub>2</sub> S, 71.7 H <sub>2</sub> O. (5) PROVIDE EXPANSION JOINT ON SHELL. |                                                     |                                    |                            |                           |                   |

|                                                             |  |                              |  |                          |               |
|-------------------------------------------------------------|--|------------------------------|--|--------------------------|---------------|
| FOR <u>ERDA-FE-14-32-0001-1521</u>                          |  | F.W. CONTRACT <u>15-1591</u> |  | REQUISITION NO.          | DATE          |
| SITE <u>NSP LAWRENCE STATION, SIOUX FALLS, SOUTH DAKOTA</u> |  |                              |  | <u>1591-1311-F</u>       | <u>2-6-76</u> |
| SERVICE <u>WATER WASH CIRCULATING PUMP</u>                  |  |                              |  | SUPERSEDED BY CHANGE NO. |               |
| NO. REQ'D <u>2</u> ITEM NOS. <u>P-201 A/B</u>               |  |                              |  | C1 <u>4-20-76</u> C3     | C5            |
|                                                             |  |                              |  | C2                       | C6            |

NO. OF MOTORS REQ'D. 2 : ITEM NOS. \_\_\_\_\_ SUPPLIED BY PUMP MFR MOUNTED BY PUMP MFR

NO. OF TURBINES REQ'D \_\_\_\_\_ : ITEM NOS. \_\_\_\_\_ SUPPLIED BY \_\_\_\_\_ MOUNTED BY \_\_\_\_\_

PUMP MFR. \_\_\_\_\_ SIZE &amp; MODEL \_\_\_\_\_

NO. STAGES \_\_\_\_\_

## OPERATING CONDITIONS, EACH PUMP:

LIQUID WATER (NOTE 1) U.S.GPM @ PT: MIN 310 NORM 615 RTD. 710  
 DISCH. PSIG \_\_\_\_\_ RTD. 456  
 P.T. °F. (MAX 265) 180 SUCT. PSIG (MAX. 414) RTD. 374  
 SP. GR. AT PT 0.97 (21/24) DIFF. PSI 82  
 VAP. PSIA @ PT 7.5 TOTAL DIFF. HEAD, FT. 202  
 VIS. @ PT 0.36 cks NPSHA, FT. 30+  
 CORR./EROS. FROM FINES, NH<sub>3</sub>, CO<sub>2</sub>, H<sub>2</sub>S HYD HP. 35

## PERFORMANCE

PROPOSAL CURVE NO. \_\_\_\_\_  
 RPM \_\_\_\_\_ NPSHR (WATER), FT. \_\_\_\_\_  
 MIN. CONTINUOUS U.S.GPM \_\_\_\_\_  
 ROTATION, VIEWING FROM COUPLING \_\_\_\_\_  
 WITH RATED IMPELLER:  
 EFFICIENCY AT RATED POINT, % \_\_\_\_\_  
 IF EFF. IS VISCOUS, WATER EFF. = \_\_\_\_\_  
 BHP: RATED \_\_\_\_\_ NORM \_\_\_\_\_ MAX \_\_\_\_\_  
 IF HP IS VISC., RATED WATER BHP = \_\_\_\_\_  
 MAX. TOTAL HEAD, FT. \_\_\_\_\_  
 MAX. POSSIBLE DISCH. PRESS.: \_\_\_\_\_ PSIG  
 WITH RATED SUCT. PRESS. = \_\_\_\_\_  
 WITH MAX. SUCT. PRESS. = \_\_\_\_\_

## CONSTRUCTION

| NOZZLES   | SIZE | ANSI RATING | FACING    | LOCATION    |
|-----------|------|-------------|-----------|-------------|
| SUCTION   |      | <u>300</u>  | <u>RF</u> | <u>SIDE</u> |
| DISCHARGE |      | <u>300</u>  | <u>RF</u> | <u>SIDE</u> |

CASE-MOUNT ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☒ IN-LINE ☐-SPLIT: ☐ AXIAL ☒ RADIAL-VOLUTE: ☐ SINGLE ☒ DOUBLE ☐ DIFFUSER ☐

-DESIGN: \_\_\_\_\_ PSIG @ \_\_\_\_\_ °F. HYDRO TEST \_\_\_\_\_ PSIG

-AUX. CONNECTS: ☒ VENTS ☒ DRAINS ☐ GAGES ☐

IMPELLER: DIA.: RATED \_\_\_\_\_, MAX. \_\_\_\_\_, MIN. \_\_\_\_\_ TYPE \_\_\_\_\_

MOUNTING ☐ BETWEEN BEARINGS ☐ OVERHUNG ☐WEAR RINGS: ☐ INLET ONLY ☐ BOTH SIDES ☐ CASE ONLY ☐ CASE & IMPELL.BEARINGS: TYPE: RADIAL BALL IN DRIVER, THRUST = BALL IN DRIVERLUBE: ☐ RING ☐ FLOOD ☐ FLINGER ☐ MIST ☐ PRESSURECOUPLING: MFR: \_\_\_\_\_ MODEL: RIGID SPACERDRIVER 1/2 MTD BY: ☐ PUMP MFR. ☐ DRIVER MFR. ☐ PURCH.

GUARD TYPE: \_\_\_\_\_

PACKING: MFR &amp; TYPE \_\_\_\_\_ SIZE \_\_\_\_\_ NO. RINGS \_\_\_\_\_

MECH. SEAL: MFR & MODEL \_\_\_\_\_ MFR'S CODE \_\_\_\_\_ API CODE BSTXL\*CRANE 2B OR EQUAL\* SEAL GASKET MTL: ETHYLENE PROPYLENE

## AUXILIARY PIPING:

C.W. PIPE PLAN C WITH ☐ C.S. ☒ S.S. ☒ TUBING ☐ PIPETOTAL C.W. REQ'D. \_\_\_\_\_ GPM. INCLUDE: ☐ FLOW INDIC. ☐ VALVE "C"

PACKING INJECTION: FLUID= \_\_\_\_\_ @ \_\_\_\_\_ °F. REQ'D= \_\_\_\_\_ GPM @ \_\_\_\_\_ PSIG

SEAL FLUSH PLAN 32 WITH ☐ C.S. ☒ S.S. ☒ TUBING ☐ PIPEEXT. FLUSH FLUID= WATER @ \_\_\_\_\_ °F. REQ'D= \_\_\_\_\_ GPM @ \_\_\_\_\_ PSIGAUX. SEAL PLAN \_\_\_\_\_ WITH ☐ C.S. ☐ S.S. ☐ TUBING ☐ PIPE

QUENCH FLUID= \_\_\_\_\_

## MOTOR DRIVERS:

HP \_\_\_\_\_, S.F. \_\_\_\_\_, RPM \_\_\_\_\_, FRAME \_\_\_\_\_, 460 V/3 PH/60 HZ

MFR. \_\_\_\_\_ BEARINGS \_\_\_\_\_ LUBE \_\_\_\_\_

TYPE \_\_\_\_\_ INSUL. CLASS B AMPS, FULL LOAD \_\_\_\_\_ENCL. XP RISE °C 80 AMPS, LOCKED ROTOR \_\_\_\_\_VERT. UNITS: ☐ VSS ☐ VHS THRUST CAP., LBS. \_\_\_\_\_ UP \_\_\_\_\_ DN. \_\_\_\_\_

## TURBINE DRIVERS:

☐ IF BY PUMP VENDOR SEE PAGE \_\_\_\_\_ ATTACHED☐ IF BY OTHERS: MFR. \_\_\_\_\_ MODEL \_\_\_\_\_ BHP \_\_\_\_\_

## SHOP TESTS:

PERFORMANCE YES NO

NPSHR \_\_\_\_\_

## DISMANTLE &amp; INSPECT

HYDROTEST CASE YES NO

HYDROTEST BOWLS \_\_\_\_\_

## MATERIALS:

☐ PUMP API CLASS A-8☐ \_\_\_\_\_

## BASE PLATE

## VERTICAL PUMPS

THRUST, LBS. \_\_\_\_\_ UP, \_\_\_\_\_ DOWN

OTHER DETAILS PER PAGE NO. \_\_\_\_\_

## APPROX. WEIGHTS

(LBS NET EACH)

PUMP ONLY \_\_\_\_\_ MOTOR \_\_\_\_\_

BASE \_\_\_\_\_ TURBINE \_\_\_\_\_

## SITE DATA

AMBIENT +93 °F MAX TO -25 °F MIN.INSTALLED ☒ OUTDOORS ☐ INDOORS☒ CL II - GRF - DIV 2. ☐ NON-HAZARDOUS

COOLING WATER: TYPE \_\_\_\_\_

°F &amp; PSIG IN, °F MAX &amp; PSIG OUT

APPLICABLE DOCUMENTS: 1590-1300A, 1590-38A1, 1590-50A2, 1590-50A4, 1590-92A1, 1590-31ANOTES: ① PUMPAGE MAY CONTAIN UP TO 2 LB/HR OF ABRASIVE SOLID FINES AND SMALL AMOUNTS OF DISSOLVED NH<sub>3</sub>, CO<sub>2</sub>, & H<sub>2</sub>S

FOR 15-80

|                                                             |                              |                                    |                    |
|-------------------------------------------------------------|------------------------------|------------------------------------|--------------------|
| FOR <u>FERA-FE-14-36-0001-1521</u>                          | F.W. CONTRACT <u>15-1591</u> | REQUISITION NO. <u>1591-1311-H</u> | DATE <u>2-6-76</u> |
| SITE <u>VSP-LAWRENCE STATION, SIOUX FALLS, SOUTH DAKOTA</u> |                              | SUPERSEDED BY CHANGE NO.           |                    |
| SERVICE <u>STRIPPED WATER PUMP</u>                          |                              | C1 <u>3-3-76</u>                   | C3 <u>C5</u>       |
| NO. REQ'D <u>2</u> ITEM NOS. <u>P-203A/B</u>                |                              | C2 <u>4-20-76</u>                  | C4 <u>C6</u>       |

NO. OF MOTORS REQ'D 2 : ITEM NOS. \_\_\_\_\_ SUPPLIED BY PUMP MFR MOUNTED BY PUMP MFR

NO. OF TURBINES REQ'D \_\_\_\_\_ : ITEM NOS. \_\_\_\_\_ SUPPLIED BY \_\_\_\_\_ MOUNTED BY \_\_\_\_\_

PUMP MFR. SUNNSTRAND SIZE & MODEL LMV-311 NO. STAGES ONEOPERATING CONDITIONS, EACH PUMP: NOTE (1)

LIQUID WATER U.S.GPM @ PT: MIN 32 NORM 114 RTD. 140  
 DISCH. PSIG \_\_\_\_\_ RPM 504  
 P.T. °F. (MAX 265) 256 SUCT. PSIG (MAX. 59) RTD. 24  
 SP.GR. AT PT 0.94 DIFF. PSI 480  
 VAP. PSIA @ PT 33.0 TOTAL DIFF. HEAD, FT. 1180  
 VIS. @ PT 0.2 cks NPSHA, FT. 10  
 CORR./EROS. FROM \_\_\_\_\_ HYD HP. 39

## PERFORMANCE

PROPOSAL CURVE NO. \_\_\_\_\_  
 MIN. CONTINUOUS U.S.GPM \_\_\_\_\_  
 ROTATION, VIEWING FROM COUPLING \_\_\_\_\_

## WITH RATED IMPELLER:

EFFICIENCY AT RATED POINT, % \_\_\_\_\_  
 IF EFF. IS VISCOUS, WATER EFF. = \_\_\_\_\_  
 BHP: RATED \_\_\_\_\_ NORM \_\_\_\_\_ MAX \_\_\_\_\_  
 IF HP IS VISC., RATED WATER BHP = \_\_\_\_\_  
 MAX. TOTAL HEAD, FT. \_\_\_\_\_  
 MAX. POSSIBLE DISCH. PRESS.: \_\_\_\_\_ PSIG  
 WITH RATED SUCT. PRESS. = \_\_\_\_\_  
 WITH MAX. SUCT. PRESS. = \_\_\_\_\_

## CONSTRUCTION

| NOZZLES   | SIZE | ANSI RATING | FACING    | LOCATION    |
|-----------|------|-------------|-----------|-------------|
| SUCTION   |      | <u>300</u>  | <u>TF</u> | <u>SIDE</u> |
| DISCHARGE |      | <u>300</u>  | <u>TF</u> | <u>SIDE</u> |

CASE-MOUNT ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☒ IN-LINE ☐-SPLIT: ☐ AXIAL ☒ RADIAL-VOLUTE: ☐ SINGLE ☐ DOUBLE ☒ DIFFUSER ☐

-DESIGN: \_\_\_\_\_ PSIG @ \_\_\_\_\_ °F. HYDRO TEST \_\_\_\_\_ PSIG

-AUX. CONNECTS: ☐ VENTS ☐ DRAINS ☐ GAGES ☐

IMPELLER: DIA.: RATED \_\_\_\_\_, MAX. \_\_\_\_\_, MIN. \_\_\_\_\_ TYPE \_\_\_\_\_

MOUNTING ☐ BETWEEN BEARINGS ☐ OVERHUNG ☐WEAR RINGS: ☐ INLET ONLY ☐ BOTH SIDES ☐ CASE ONLY ☐ CASE & IMPELL.BEARINGS: TYPE: RADIAL = SLEEVE THRUST = WASHERLUBE: ☐ RING ☐ FLOOD ☐ FLINGER ☐ MIST ☐ PRESSURE

COUPLING: MFR: \_\_\_\_\_ MODEL: \_\_\_\_\_

DRIVER 1/2 MTD BY: ☒ PUMP MFR. ☐ DRIVER MFR. ☐ PURCH.

GUARD TYPE: \_\_\_\_\_

PACKING: MFR &amp; TYPE \_\_\_\_\_ SIZE \_\_\_\_\_ NO. RINGS \_\_\_\_\_

MECH. SEAL: MFR & MODEL \_\_\_\_\_ MFR'S CODE \_\_\_\_\_ API CODE BSPXL\*CRANE 9/3 OR EQUAL

## SHOP TESTS:

PERFORMANCE YES NO

NPSHR \_\_\_\_\_

## DISMANTLE &amp; INSPECT

HYDROTEST CASE YES NO

HYDROTEST BOWLS \_\_\_\_\_

## MATERIALS:

☒ PUMP API CLASS S-4☐\* SEAL GASKET MTL: ETHYLENE PROPYLENE

## AUXILIARY PIPING:

C.W. PIPE PLAN J, WITH ☒ C.S. ☐ S.S. ☒ TUBING ☐ PIPETOTAL C.W. REQ'D \_\_\_\_\_ GPM. INCLUDE: ☐ FLOW INDIC. ☐ VALVE "C"☒ PACKING INJECTION: FLUID= \_\_\_\_\_ @ \_\_\_\_\_ °F. REQ'D= \_\_\_\_\_ GPM @ \_\_\_\_\_ PSIGSEAL FLUSH PLAN 2-1, WITH ☒ C.S. ☐ S.S. ☒ TUBING ☐ PIPE

EXT. FLUSH FLUID= \_\_\_\_\_ @ \_\_\_\_\_ °F. REQ'D= \_\_\_\_\_ GPM @ \_\_\_\_\_ PSIG

AUX. SEAL PLAN \_\_\_\_\_, WITH ☐ C.S. ☐ S.S. ☐ TUBING ☐ PIPE

QUENCH FLUID= \_\_\_\_\_

## MOTOR DRIVERS:

HP \_\_\_\_\_, S.F. \_\_\_\_\_, RPM \_\_\_\_\_, FRAME \_\_\_\_\_, 460V 13PH 60HZ

MFR. \_\_\_\_\_ BEARINGS \_\_\_\_\_ LUBE \_\_\_\_\_

TYPE \_\_\_\_\_ INSUL. CLASS B AMPS, FULL LOAD \_\_\_\_\_ENCL. XP RISE °C 80 AMPS, LOCKED ROTOR \_\_\_\_\_VERT. UNITS: ☐ VSS ☐ VHS THRUST CAP., LBS. \_\_\_\_\_ UP \_\_\_\_\_ DN. \_\_\_\_\_

## TURBINE DRIVERS:

☐ IF BY PUMP VENDOR SEE PAGE \_\_\_\_\_ ATTACHED☐ IF BY OTHERS: MFR. \_\_\_\_\_ MODEL \_\_\_\_\_ BHP \_\_\_\_\_APPLICABLE DOCUMENTS: 1520-1300A, 1590-38A1, 1590-50A2, 1590-50A4, 1590-92A11520-31A1NOTE: MAINTAIN 15 MIN. E-TESTED PERIOD OF MIN. LOW OPERATION

## APPROX. WEIGHTS

(LBS NET EACH)

PUMP ONLY \_\_\_\_\_ MOTOR \_\_\_\_\_

BASE \_\_\_\_\_ TURBINE \_\_\_\_\_

## SITE DATA

AMBIENT +23 °F MAX TO -25 °F MIN.INSTALLED ☒ OUTDOORS ☐ INDOORS☒ CL II - GRF-DIV 2. ☐ NON-HAZARDOUS

COOLING WATER: TYPE \_\_\_\_\_

°F &amp; PSIG IN, °F MAX &amp; PSIG OUT

## FOSTER WHEELER CORPORATION

## CENTRIFUGAL PUMPS

PAGE / OF /

FOR 5-80

FOR ERDA-WE-14-32-0001-1521 F.W. CONTRACT 15-1591

|                          |         |        |    |
|--------------------------|---------|--------|----|
| REQUISITION NO.          |         | DATE   |    |
| 1591-1311-J              |         | 2-6-76 |    |
| SUPERSEDED BY CHANGE NO. |         |        |    |
| C1                       | 3-3-76  | C3     | C5 |
| C2                       | 4-20-76 | C4     | C6 |

SITE MFR. LAWRENCE STATION, SIOUX FALLS, SOUTH DAKOTA

SERVICE FIRST STAGE SWS REFLUX PUMP

NO. REQ'D 2 ITEM NOS. P-204 A/B

NO. OF MOTORS REQ'D 2 : ITEM NOS. SUPPLIED BY PUMP MFR MOUNTED BY PUMP MFR

NO. OF TURBINES REQ'D : ITEM NOS. SUPPLIED BY MOUNTED BY

PUMP MFR. SUNDSTRAAND SIZE &amp; MODEL LMV-802 NO. STAGES ONE

## OPERATING CONDITIONS, EACH PUMP:

LIQUID WATER AND U.S.GPM @ PT: MIN 9 NORM 13 RTD. 18  
DISSOLVED GAS DISCH. PSIG RTD. 55  
 P.T. °F. (MAX 230) 202 SUCT. PSIG (MAX. 54) RTD. 16  
 SP. GR. AT PT 1.0 DIFF. PSI 39  
 VAP. PSIA @ PT 28 (MAX) TOTAL DIFF. HEAD, FT. 90  
 VIS. @ PT 0.15 NPSHA, FT. 5  
 CORR./EROS. FROM DISSOLVED NH<sub>3</sub>, CO<sub>2</sub>, H<sub>2</sub>S HYD HP. 0.41

## CONSTRUCTION

| NOZZLES   | SIZE | ANSI RATING | FACING    | LOCATION    |
|-----------|------|-------------|-----------|-------------|
| SUCTION   |      | <u>300</u>  | <u>RF</u> | <u>SIDE</u> |
| DISCHARGE |      | <u>300</u>  | <u>RF</u> | <u>SIDE</u> |

CASE-MOUNT ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☒ IN-LINE ☐-SPLIT: ☐ AXIAL ☒ RADIAL-VOLUTE: ☐ SINGLE ☐ DOUBLE ☒ DIFFUSER ☐

-DESIGN: PSIG @ °F. HYDRO TEST PSIG

-AUX. CONNECTS: ☒ VENTS ☒ DRAINS ☐ GAGES ☐

IMPELLER: DIA.: RATED , MAX. , MIN. TYPE

MOUNTING ☐ BETWEEN BEARINGS ☐ OVERHUNG ☐WEAR RINGS: ☐ INLET ONLY ☐ BOTH SIDES ☐ CASE ONLY ☐ CASE & IMPELL.

BEARINGS: TYPE: RADIAL - BALL IN IMPELL. THRUST = BALL IN MOTOR

LUBE: ☐ RING ☐ FLOOD ☐ FLINGER ☐ MIST ☐ PRESSURE

COUPLING: MFR: .MODEL:

DRIVER 1/2 MTD BY: ☐ PUMP MFR. ☐ DRIVER MFR. ☐ PURCH.

GUARD TYPE:

PACKING: MFR &amp; TYPE SIZE NO. RINGS

MECH. SEAL: MFR & MODEL MFR'S CODE API CODE USPXL\*CRANE 9 OR EQUAL

\* SEAL GASKET MTL: ETHYLENE PROPYLENE

## AUXILIARY PIPING:

C.W. PIPE PLAN J, WITH ☒ C.S. ☐ S.S. ☒ TUBING ☐ PIPETOTAL C.W. REQ'D GPM. INCLUDE: ☐ FLOW INDIC. ☐ VALVE "C"

PACKING INJECTION: FLUID= °F. REQ'D= GPM @ PSIG

SEAL FLUSH PLAN 21, WITH ☒ C.S. ☐ S.S. ☒ TUBING ☐ PIPE

EXT. FLUSH FLUID= °F. REQ'D= GPM @ PSIG

AUX. SEAL PLAN , WITH ☐ C.S. ☐ S.S. ☐ TUBING ☐ PIPE

QUENCH FLUID:

## MOTOR DRIVERS:

HP , S.F. , RPM , FRAME , 460 V/ 3 PH/ 60 HZ

MFR. .BEARINGS .LUBE

TYPE .INSUL. CLASS B

AMPS, FULL LOAD

ENCL. XP .RISE °C 80

AMPS, LOCKED ROTOR

VERT. UNITS: ☐ VSS ☐ VHS THRUST CAP., LBS. UP DN.

## TURBINE DRIVERS:

☐ IF BY PUMP VENDOR SEE PAGE ATTACHED☐ IF BY OTHERS: MFR. MODEL BHP

## PERFORMANCE

PROPOSAL CURVE NO.

RPM NPSHR (WATER), FT.

MIN. CONTINUOUS U.S.GPM

ROTATION, VIEWING FROM COUPLING

## WITH RATED IMPELLER:

EFFICIENCY AT RATED POINT, %

IF EFF. IS VISCOUS, WATER EFF. =

BHP: RATED NORM MAX

IF HP IS VISC., RATED WATER BHP =

MAX. TOTAL HEAD, FT.

MAX. POSSIBLE DISCH. PRESS.: PSIG

WITH RATED SUCT. PRESS. =

WITH MAX. SUCT. PRESS. =

## SHOP TESTS:

PERFORMANCE REQUIRED YES NO

NPSHR

## DISMANTLE &amp; INSPECT

HYDROTEST CASE YES NO

HYDROTEST BOWLS

## MATERIALS:

☐ PUMP API CLASS S-4☐

## BASE PLATE

## VERTICAL PUMPS

THRUST, LBS. UP, DOWN

OTHER DETAILS PER PAGE NO.

## APPROX. WEIGHTS

(LBS NET EACH)

PUMP ONLY MOTOR

BASE TURBINE

## SITE DATA

AMBIENT +25°F MAX TO -25°F MIN.

INSTALLED ☒ OUTDOORS ☐ INDOORS☒ CL II - GFE - DIV 2. ☐ NON-HAZARDOUS

COOLING WATER: TYPE

°F &amp; PSIG IN, °F MAX &amp; PSIG OUT

APPLICABLE DOCUMENTS: 1590-1300A, 1590-38A1, 1590-50A2, 1590-50A4, 1590-92A1, 1590-31A2

FOR 15-80

FOR ERDA-FE-14-32-0001-1521 F.W. CONTRACT 15-1591  
 SITE MSP-LAWRENCE STATION, SIOUX FALLS, SOUTH DAKOTA  
 SERVICE SECOND STAGE SWS FEED PUMP  
 NO. REQ'D 2 ITEM NOS. P-205 A/B

|                          |         |        |    |
|--------------------------|---------|--------|----|
| REQUISITION NO.          |         | DATE   |    |
| 1591-1311-K              |         | 2-3-76 |    |
| SUPERSEDED BY CHANGE NO. |         |        |    |
| C1                       | 4-20-76 | C3     | C5 |
| C2                       |         | C4     | C6 |

NO. OF MOTORS REQ'D 2 : ITEM NOS. SUPPLIED BY PUMP MFR MOUNTED BY PUMP MFR.  
 NO. OF TURBINES REQ'D : ITEM NOS. SUPPLIED BY MOUNTED BY

PUMP MFR. SIZE &amp; MODEL

NO. STAGES

## OPERATING CONDITIONS, EACH PUMP:

LIQUID WATER AND U.S.GPM @ PT: MIN 32 NORM 120 RTD. 145  
 DISOLVED GAS DISCH. PSIG RTD. 60  
 P.T. °F. (MAX 255) 248 SUCT. PSIG (MAX. 58) RTD. 23  
 SP. GR. AT PT 0.93 DIFF. PSI 37  
 VAP. PSIA @ PT 32.7 (VAP. P. 32.7) TOTAL DIFF. HEAD, FT. 95  
 VIS. @ PT 0.2 NPSHA, FT. 10  
 CORR. / EROS. FROM DISSOLVED NH<sub>3</sub>, CO<sub>2</sub>, H<sub>2</sub>S HYD HP. 3.2

## PERFORMANCE

PROPOSAL CURVE NO. \_\_\_\_\_  
 RPM \_\_\_\_\_ NPSHR (WATER), FT. \_\_\_\_\_  
 MIN. CONTINUOUS U.S.GPM \_\_\_\_\_  
 ROTATION, VIEWING FROM COUPLING \_\_\_\_\_

## CONSTRUCTION SIMILAR TO PENDING ANSI STANDARD

| NOZZLES   | SIZE | ANSI RATING | FACING | LOCATION |
|-----------|------|-------------|--------|----------|
| SUCTION   |      | 300         | RF     | SIDE     |
| DISCHARGE |      | 300         | RF     | SIDE     |

## WITH RATED IMPELLER:

EFFICIENCY AT RATED POINT, % \_\_\_\_\_  
 IF EFF. IS VISCOUS, WATER EFF. = \_\_\_\_\_  
 BHP: RATED \_\_\_\_\_ NORM \_\_\_\_\_ MAX \_\_\_\_\_  
 IF HP IS VISC., RATED WATER BHP = \_\_\_\_\_  
 MAX. TOTAL HEAD, FT. \_\_\_\_\_  
 MAX. POSSIBLE DISCH. PRESS.: PSIG \_\_\_\_\_  
 WITH RATED SUCT. PRESS. = \_\_\_\_\_  
 WITH MAX. SUCT. PRESS. = \_\_\_\_\_

CASE-MOUNT ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☒ IN-LINE ☐-SPLIT: ☐ AXIAL ☒ RADIAL-VOLUTE: ☒ SINGLE ☐ DOUBLE ☐ DIFFUSER ☐

-DESIGN: PSIG @ °F. HYDRO TEST PSIG

-AUX. CONNECTS: ☒ VENTS ☒ DRAINS ☐ GAGES ☐

IMPELLER: DIA.: RATED \_\_\_\_\_, MAX. \_\_\_\_\_, MIN. \_\_\_\_\_ TYPE \_\_\_\_\_

MOUNTING ☐ BETWEEN BEARINGS ☐ OVERHUNG ☐WEAR RINGS: ☐ INLET ONLY ☐ BOTH SIDES ☐ CASE ONLY ☐ CASE & IMPELL.

BEARINGS: TYPE: RADIAL - BALL IN IMPELL. THRUST = BALL IN DRIVER

LUBE: ☐ RING ☐ FLOOD ☐ FLINGER ☐ MIST ☐ PRESSURE

COUPLING: MFR: \_\_\_\_\_ MODEL: RIGID SPACER

DRIVER 1/2 MTD BY: ☒ PUMP MFR. ☐ DRIVER MFR. ☐ PURCH.

GUARD TYPE: \_\_\_\_\_

PACKING: MFR &amp; TYPE \_\_\_\_\_ SIZE \_\_\_\_\_ NO. RINGS \_\_\_\_\_

MECH. SEAL: MFR & MODEL \_\_\_\_\_ MFR'S CODE \_\_\_\_\_ API CODE 45PXL \*  
CRANE 9 OR EQUAL

## SHOP TESTS:

|                     | REQUIRED | WITNESSED |
|---------------------|----------|-----------|
| PERFORMANCE         | YES      | NO        |
| NPSHR               |          |           |
| DISMANTLE & INSPECT |          |           |
| HYDROTEST CASE      | YES      | NO        |
| HYDROTEST BOWLS     |          |           |

## MATERIALS:

☐ PUMP API CLASS 5-4  
☐

\* SEAL GASKET MTL: ETHYLENE PROPYLENE

## AUXILIARY PIPING:

C.W. PIPE PLAN J, WITH ☒ C.S. ☐ S.S. ☒ TUBING ☐ PIPETOTAL C.W. REQ'D \_\_\_\_\_ GPM. INCLUDE: ☐ FLOW INDIC. ☐ VALVE "C"

PACKING INJECTION: FLUID= \_\_\_\_\_ °F. REQ'D= \_\_\_\_\_ GPM @ \_\_\_\_\_ PSIG

SEAL FLUSH PLAN 21, WITH ☒ C.S. ☐ S.S. ☒ TUBING ☐ PIPE

EXT. FLUSH FLUID= \_\_\_\_\_ °F. REQ'D= \_\_\_\_\_ GPM @ \_\_\_\_\_ PSIG

AUX. SEAL PLAN \_\_\_\_\_, WITH ☐ C.S. ☐ S.S. ☐ TUBING ☐ PIPE

QUENCH FLUID= \_\_\_\_\_

## MOTOR DRIVERS:

HP \_\_\_\_\_, S.F. \_\_\_\_\_, RPM \_\_\_\_\_, FRAME \_\_\_\_\_, 460 V/3 PH/60 HZ

MFR. \_\_\_\_\_, BEARINGS \_\_\_\_\_, LUBE \_\_\_\_\_

TYPE \_\_\_\_\_, INSUL. CLASS B

ENCL. XP, RISE °C 80

VERT. UNITS: ☐ VSS ☐ VHS THRUST CAP., LBS. UP DN.

## TURBINE DRIVERS:

☐ IF BY PUMP VENDOR SEE PAGE \_\_\_\_\_ ATTACHED☐ IF BY OTHERS: MFR. \_\_\_\_\_ MODEL \_\_\_\_\_ BHP \_\_\_\_\_

## APPROX. WEIGHTS

(LBS NET EACH)  
 PUMP ONLY \_\_\_\_\_ MOTOR \_\_\_\_\_  
 BASE \_\_\_\_\_ TURBINE \_\_\_\_\_

## SITE DATA

AMBIENT +23 °F OF MAX TO -25 °F OF MIN.  
 INSTALLED ☒ OUTDOORS ☐ INDOORS  
☒ CL II - GRF - DIV 2. ☐ NON-HAZARDOUS  
 COOLING WATER: TYPE \_\_\_\_\_  
 °F & PSIG IN, °F MAX & PSIG OUT

APPLICABLE DOCUMENTS: 1590-1300-A, 1590-38A1, 1590-50A2, 1590-50A4, 1590-92A1  
 1590-31A2

FOR 15-80

|                                                           |                              |                                    |                    |
|-----------------------------------------------------------|------------------------------|------------------------------------|--------------------|
| FOR <u>FE-14-32-001 1521</u>                              | F.W. CONTRACT <u>15-1591</u> | REQUISITION NO. <u>1521-1311-N</u> | DATE <u>4-5-76</u> |
| SITE <u>MT. LAKE MINING CO. SIOUX FALLS, SOUTH DAKOTA</u> |                              | SUPERSEDED BY CHANGE NO.           |                    |
| SERVICE <u>SLURRY OIL MILLING PUMPS</u>                   |                              | C1 <u>4-20-76</u>                  | C3                 |
| NO. REQ'D <u>2</u>                                        | ITEM NOS. <u>P-208 A/B</u>   | C2                                 | C4                 |

NO. OF MOTORS REQ'D. 2 : ITEM NOS. \_\_\_\_\_ SUPPLIED BY PUMP MFR MOUNTED BY PUMP MFR.  
 NO. OF TURBINES REQ'D \_\_\_\_\_ : ITEM NOS. \_\_\_\_\_ SUPPLIED BY \_\_\_\_\_ MOUNTED BY \_\_\_\_\_

PUMP MFR. \_\_\_\_\_ SIZE & MODEL \_\_\_\_\_ NO. STAGES \_\_\_\_\_

OPERATING CONDITIONS, EACH PUMP: (SEE PAGE 2)

LIQUID \_\_\_\_\_ U.S.GPM @ PT: MIN \_\_\_\_\_ NORM \_\_\_\_\_ RTD. \_\_\_\_\_  
 DISCH. PSIG \_\_\_\_\_ RTD. \_\_\_\_\_  
 P.T. °F. (MAX \_\_\_\_\_) SUCT. PSIG (MAX. \_\_\_\_\_) RTD. \_\_\_\_\_  
 SP.GR. AT PT \_\_\_\_\_ DIFF. PSI \_\_\_\_\_  
 VAP. PSIA @ PT \_\_\_\_\_ TOTAL DIFF. HEAD, FT. \_\_\_\_\_  
 VIS. @ PT \_\_\_\_\_ NPSHA, FT. \_\_\_\_\_  
 CORR./EROS. FROM \_\_\_\_\_ HYD HP. \_\_\_\_\_

## CONSTRUCTION

| NOZZLES   | SIZE | ANSI RATING | FACING    | LOCATION   |
|-----------|------|-------------|-----------|------------|
| SUCTION   |      |             | <u>RF</u> | <u>END</u> |
| DISCHARGE |      |             | <u>RF</u> | <u>TOP</u> |

CASE-MOUNT ☒ CENTERLINE ☐ FOOT ☐ BRACKET ☐ IN-LINE ☐-SPLIT: ☐ AXIAL ☒ RADIAL-VOLUTE: ☒ SINGLE ☐ DOUBLE ☐ DIFFUSER ☐

-DESIGN: \_\_\_\_\_ PSIG @ \_\_\_\_\_ °F. HYDRO TEST \_\_\_\_\_ PSIG

-AUX. CONNECTS: ☒ VENTS ☒ DRAINS ☐ GAGES ☐

IMPELLER: DIA.: RATED \_\_\_\_\_, MAX. \_\_\_\_\_, MIN. \_\_\_\_\_ TYPE \_\_\_\_\_

MOUNTING ☐ BETWEEN BEARINGS ☒ OVERHUNG ☐WEAR RINGS: ☐ INLET ONLY ☐ BOTH SIDES ☐ CASE ONLY ☐ CASE & IMPELL.BEARINGS: TYPE: RADIAL = FALL, THRUST = FALLLUBE: ☐ RING ☐ FLOOD ☐ FLINGER ☐ MIST ☐ PRESSURE

COUPLING: MFR: \_\_\_\_\_ MODEL: \_\_\_\_\_

DRIVER 1/2 MTD BY: ☒ PUMP MFR. ☐ DRIVER MFR. ☐ PURCH.

GUARD TYPE: \_\_\_\_\_

PACKING: MFR &amp; TYPE \_\_\_\_\_ SIZE \_\_\_\_\_ NO. RINGS \_\_\_\_\_

MECH. SEAL: MFR & MODEL \_\_\_\_\_ MFR'S CODE \_\_\_\_\_ API CODE 45PXL\*C PANE 9 OR EQUAL\* SEAL GASKET MFR: ETHYLENE PROPYLENE

## AUXILIARY PIPING:

C.W. PIPE PLAN C, WITH ☐ C.S. ☒ S.S. ☒ TUBING ☐ PIPETOTAL C.W. REQ'D \_\_\_\_\_ GPM. INCLUDE: ☐ FLOW INDIC. ☐ VALVE "C"

PACKING INJECTION: FLUID= \_\_\_\_\_ @ \_\_\_\_\_ °F. REQ'D= \_\_\_\_\_ GPM @ \_\_\_\_\_ PSIG

SEAL FLUSH PLAN 32, WITH ☐ C.S. ☒ S.S. ☒ TUBING ☐ PIPE

EXT. FLUSH FLUID= \_\_\_\_\_ @ \_\_\_\_\_ °F. REQ'D= \_\_\_\_\_ GPM @ \_\_\_\_\_ PSIG

AUX. SEAL PLAN \_\_\_\_\_, WITH ☐ C.S. ☐ S.S. ☐ TUBING ☐ PIPE

QUENCH FLUID= \_\_\_\_\_

## MOTOR DRIVERS:

HP \_\_\_\_\_, S.F. \_\_\_\_\_, RPM \_\_\_\_\_, FRAME \_\_\_\_\_, 450 V 1/3 PH 160 HZ

MFR. \_\_\_\_\_ BEARINGS \_\_\_\_\_ LUBE \_\_\_\_\_

TYPE \_\_\_\_\_ INSUL. CLASS B

AMPS, FULL LOAD \_\_\_\_\_

ENCL. XP RISE °C 80

AMPS, LOCKED ROTOR \_\_\_\_\_

VERT. UNITS: ☐ VSS ☐ VHS THRUST CAP., LBS. \_\_\_\_\_ UP \_\_\_\_\_ DN. \_\_\_\_\_

## TURBINE DRIVERS:

☐ IF BY PUMP VENDOR SEE PAGE \_\_\_\_\_ ATTACHED☐ IF BY OTHERS: MFR. \_\_\_\_\_ MODEL \_\_\_\_\_ BHP \_\_\_\_\_APPLICABLE DOCUMENTS: 1520-1300A, 1520-38A1, 1520-50A2, 1520-50A4, 1520-92A1,1520-31A1

## PERFORMANCE

PROPOSAL CURVE NO. \_\_\_\_\_

RPM 1750 MAX NPSHR (WATER), FT. \_\_\_\_\_

MIN. CONTINUOUS U.S.GPM \_\_\_\_\_

ROTATION, VIEWING FROM COUPLING \_\_\_\_\_

## WITH RATED IMPELLER:

EFFICIENCY AT RATED POINT, % \_\_\_\_\_

IF EFF. IS VISCOUS, WATER EFF. = \_\_\_\_\_

BHP: RATED \_\_\_\_\_ NORM \_\_\_\_\_ MAX \_\_\_\_\_

IF HP IS VISC. RATED WATER BHP = \_\_\_\_\_

MAX. TOTAL HEAD, FT. \_\_\_\_\_

MAX. POSSIBLE DISCH. PRESS.: \_\_\_\_\_ PSIG

WITH RATED SUCT. PRESS. = \_\_\_\_\_

WITH MAX. SUCT. PRESS. = \_\_\_\_\_

## SHOP TESTS:

PERFORMANCE REQUIRED WITNESSEDNPSHR YES NO

## DISMANTLE &amp; INSPECT

HYDROTEST CASE YES NO

HYDROTEST BOWLS \_\_\_\_\_

## MATERIALS:

☒ PUMP API CLASS C-6☐ \_\_\_\_\_

## BASE PLATE

## VERTICAL PUMPS

THRUST, LBS. \_\_\_\_\_ UP, \_\_\_\_\_ DOWN

OTHER DETAILS PER PAGE NO. \_\_\_\_\_

## APPROX. WEIGHTS

(LBS NET EACH)

PUMP ONLY \_\_\_\_\_ MOTOR \_\_\_\_\_

BASE \_\_\_\_\_ TURBINE \_\_\_\_\_

## SITE DATA

AMBIENT 93 °F MAX TO -25 °F MIN.INSTALLED ☒ OUTDOORS ☐ INDOORS☒ CL II - GR F - DIV 2 ☐ NON-HAZARDOUS

COOLING WATER: TYPE \_\_\_\_\_

°F &amp; PSIG IN, °F MAX &amp; PSIG OUT

## FOSTER WHEELER ENERGY CORPORATION

PAGE 2 OF 2

FORM NO. 135-68

|                                                              |  |                           |    |                    |      |
|--------------------------------------------------------------|--|---------------------------|----|--------------------|------|
| FOR ERDA-FE-14-32-0001-1521                                  |  | F.W. CONTRACT 15-1521     |    | REQUISITION NUMBER | DATE |
| SITE <u>ALSO LAWRENCE STATION, SIOUX FALLS, SOUTH DAKOTA</u> |  | <u>1521-1311-N</u>        |    | <u>4-5-76</u>      |      |
| ITEM NOS. <u>P-208 A/B</u>                                   |  | SUPERSEDED BY CHANGE NO.: |    |                    |      |
|                                                              |  | C1 <u>4-20-76</u>         | C3 | C5                 |      |
|                                                              |  | C2                        | C4 | C6                 |      |

## OPERATING CONDITIONS, EACH PUMP:

|                                                                                        |                       |                 |                 |                                   |  |
|----------------------------------------------------------------------------------------|-----------------------|-----------------|-----------------|-----------------------------------|--|
| OPER. CASE <u>START-UP (CHAR DENSITY 20<sup>lb</sup>/FT<sup>3</sup>)</u>               |                       |                 |                 | EFFICIENCY AT RATED POINT, %      |  |
| LIQUID <u>WATER AND</u>                                                                | U.S. GPM @ PT: MIN    | NORM <u>258</u> | RTD <u>300</u>  | IF EFF. IS VISCOUS, WATER EFF. =  |  |
| <u>COAL CHAR SLURRY</u>                                                                | DISCH. PSIG           |                 | RTD <u>38</u>   | BHP: RATED NORM MAX               |  |
| P.T. °F. (MAX <u>270</u> ) <u>260</u>                                                  | SUCT. PSIG (MAX. )    |                 | RTD <u>26.5</u> | IF HP IS VISC., RTD. WATER BHP =  |  |
| SP. GR. AT PT <u>0.74</u>                                                              | DIFF. PSI             |                 | <u>11.5</u>     | MAX. POSSIBLE TOTAL HEAD, FT.     |  |
| VAP. PSIA @ PT <u>36.6</u>                                                             | TOTAL DIFF. HEAD, FT. |                 | <u>36</u>       | MAX. POSSIBLE DISCH. PRESS.: PSIG |  |
| VIS. @ PT <u>0.78 cKs</u>                                                              | NPSHA, FT.            |                 | <u>10</u>       | WITH RATED SUCT. PRESS. =         |  |
| CORR./EROS. FROM <u>CO<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, CHAR PARTICLES</u> |                       |                 |                 | WITH MAX. SUCT. PRESS. =          |  |
|                                                                                        |                       |                 |                 | NPSHR (WATER), FT. =              |  |
|                                                                                        |                       |                 |                 |                                   |  |
| OPER. CASE <u>START-UP (CHAR DENSITY 73.5<sup>lb</sup>/FT<sup>3</sup>)</u>             |                       |                 |                 | EFFICIENCY AT RATED POINT, %      |  |
| LIQUID <u>WATER AND</u>                                                                | U.S. GPM @ PT: MIN    | NORM <u>197</u> | RTD <u>225</u>  | IF EFF. IS VISCOUS, WATER EFF. =  |  |
| <u>COAL CHAR SLURRY</u>                                                                | DISCH. PSIG           |                 | RTD <u>47</u>   | BHP: RATED NORM MAX               |  |
| P.T. °F. (MAX <u>270</u> ) <u>260</u>                                                  | SUCT. PSIG (MAX. )    |                 | RTD <u>28</u>   | IF HP IS VISC., RTD. WATER BHP =  |  |
| SP. GR. AT PT <u>0.97</u>                                                              | DIFF. PSI             |                 | <u>19</u>       | MAX. POSSIBLE TOTAL HEAD, FT.     |  |
| VAP. PSIA @ PT <u>36.6</u>                                                             | TOTAL DIFF. HEAD, FT. |                 | <u>45</u>       | MAX. POSSIBLE DISCH. PRESS.: PSIG |  |
| VIS. @ PT <u>0.23 cKs</u>                                                              | NPSHA, FT.            |                 | <u>10</u>       | WITH RATED SUCT. PRESS. =         |  |
| CORR./EROS. FROM <u>CO<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, CHAR PARTICLES</u> |                       |                 |                 | WITH MAX. SUCT. PRESS. =          |  |
|                                                                                        |                       |                 |                 | NPSHR (WATER), FT. =              |  |
|                                                                                        |                       |                 |                 |                                   |  |
| OPER. CASE <u>NORMAL OPERATING</u>                                                     |                       |                 |                 | EFFICIENCY AT RATED POINT, %      |  |
| LIQUID <u>WATER AND</u>                                                                | U.S. GPM @ PT: MIN    | NORM <u>117</u> | RTD <u>117</u>  | IF EFF. IS VISCOUS, WATER EFF. =  |  |
| <u>COAL CHAR SLURRY</u>                                                                | DISCH. PSIG           |                 | RTD <u>52</u>   | BHP: RATED NORM MAX               |  |
| P.T. °F. (MAX <u>270</u> ) <u>260</u>                                                  | SUCT. PSIG (MAX. )    |                 | RTD <u>28.5</u> | IF HP IS VISC., RTD. WATER BHP =  |  |
| SP. GR. AT PT <u>0.94</u>                                                              | DIFF. PSI             |                 | <u>23.5</u>     | MAX. POSSIBLE TOTAL HEAD, FT.     |  |
| VAP. PSIA @ PT <u>36.6</u>                                                             | TOTAL DIFF. HEAD, FT. |                 | <u>58</u>       | MAX. POSSIBLE DISCH. PRESS.: PSIG |  |
| VIS. @ PT <u>0.2 cKs</u>                                                               | NPSHA, FT.            |                 | <u>10</u>       | WITH RATED SUCT. PRESS. =         |  |
| CORR./EROS. FROM <u>CO<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, CHAR PARTICLES</u> |                       |                 |                 | WITH MAX. SUCT. PRESS. =          |  |
|                                                                                        |                       |                 |                 | NPSHR (WATER), FT. =              |  |
|                                                                                        |                       |                 |                 |                                   |  |
| OPER. CASE                                                                             |                       |                 |                 | EFFICIENCY AT RATED POINT, %      |  |
| LIQUID                                                                                 | U.S. GPM @ PT: MIN    | NORM            | RTD             | IF EFF. IS VISCOUS, WATER EFF. =  |  |
|                                                                                        | DISCH. PSIG           |                 | RTD             | BHP: RATED NORM MAX               |  |
| P.T. °F. (MAX )                                                                        | SUCT. PSIG (MAX. )    |                 | RTD             | IF HP IS VISC., RTD. WATER BHP =  |  |
| SP. GR. AT PT                                                                          | DIFF. PSI             |                 |                 | MAX. POSSIBLE TOTAL HEAD, FT.     |  |
| VAP. PSIA @ PT                                                                         | TOTAL DIFF. HEAD, FT. |                 |                 | MAX. POSSIBLE DISCH. PRESS.: PSIG |  |
| VIS. @ PT                                                                              | NPSHA, FT.            |                 |                 | WITH RATED SUCT. PRESS. =         |  |
| CORR./EROS. FROM                                                                       |                       |                 |                 | WITH MAX. SUCT. PRESS. =          |  |

NOTE (1) SLURRIES MAY CONTAIN UP TO 16% WEIGHT OF CHAR PARTICLES



FOR 15-80

FOR ERDA-FE-14-32-0001-1521 F.W. CONTRACT 15-1591

SITE NSR LAWRENCE STATION, SIOUX FALLS, SOUTH DAKOTASERVICE VACUUM CONDENSATE WATER PUMPNO. REQ'D 2 ITEM NOS. P-209 A/B

|                          |         |         |    |
|--------------------------|---------|---------|----|
| REQUISITION NO.          |         | DATE    |    |
| 1521-1311-P              |         | 2-17-76 |    |
| SUPERSEDED BY CHANGE NO. |         |         |    |
| C1                       | 4-20-76 | C3      | C5 |
| C2                       |         | C4      | C6 |

NO. OF MOTORS REQ'D. 2 : ITEM NOS. \_\_\_\_\_SUPPLIED BY PUMP MFR MOUNTED BY PUMP MFR

NO. OF TURBINES REQ'D \_\_\_\_\_ : ITEM NOS. \_\_\_\_\_

SUPPLIED BY \_\_\_\_\_ MOUNTED BY \_\_\_\_\_

PUMP MFR.

SIZE &amp; MODEL

NO. STAGES

## OPERATING CONDITIONS, EACH PUMP:

LIQUID SOUP WATER U.S.GPM @ PT: MIN 12 NORM 39 RTD. 45  
 DISCH. PSIG \_\_\_\_\_ RTD. 67  
 P.T. °F. (MAX) 175 145 SUCT. PSIG (MAX. \_\_\_\_\_) RTD. 0  
 SP.GR. AT PT 0.985 DIFF. PSI 67  
 VAP. PSIA @ PT 3.5 TOTAL DIFF. HEAD, FT. 157  
 VIS. @ PT 0.5 CPS NPSHA, FT. 25  
 CORR./EROS. FROM H<sub>2</sub>S, CO<sub>2</sub>, NH<sub>3</sub> HYD HP. 1.8

## PERFORMANCE

PROPOSAL CURVE NO. \_\_\_\_\_  
 RPM \_\_\_\_\_ NPSHR (WATER), FT. \_\_\_\_\_  
 MIN. CONTINUOUS U.S.GPM \_\_\_\_\_  
 ROTATION, VIEWING FROM COUPLING \_\_\_\_\_

## WITH RATED IMPELLER:

EFFICIENCY AT RATED POINT, % \_\_\_\_\_  
 IF EFF. IS VISCOUS, WATER EFF. = \_\_\_\_\_  
 BHP: RATED \_\_\_\_\_ NORM \_\_\_\_\_ MAX \_\_\_\_\_  
 IF HP IS VISC., RATED WATER BHP = \_\_\_\_\_  
 MAX. TOTAL HEAD, FT. \_\_\_\_\_  
 MAX. POSSIBLE DISCH. PRESS.: \_\_\_\_\_ PSIG  
 WITH RATED SUCT. PRESS. = \_\_\_\_\_  
 WITH MAX. SUCT. PRESS. = \_\_\_\_\_

CONSTRUCTION SIMILAR TO PENDING ANSI STANDARD

| NOZZLES   | SIZE | ANSI RATING | FACING    | LOCATION    |
|-----------|------|-------------|-----------|-------------|
| SUCTION   |      | <u>300</u>  | <u>RF</u> | <u>SIDE</u> |
| DISCHARGE |      | <u>300</u>  | <u>RF</u> | <u>SIDE</u> |

CASE-MOUNT ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☒ IN-LINE ☐-SPLIT: ☐ AXIAL ☒ RADIAL-VOLUTE: ☒ SINGLE ☐ DOUBLE ☐ DIFFUSER ☐

-DESIGN: \_\_\_\_\_ PSIG @ \_\_\_\_\_ °F. HYDRO TEST \_\_\_\_\_ PSIG

-AUX. CONNECTS: ☒ VENTS ☒ DRAINS ☐ GAGES ☐

IMPELLER: DIA.: RATED \_\_\_\_\_, MAX. \_\_\_\_\_, MIN. \_\_\_\_\_ TYPE \_\_\_\_\_

MOUNTING ☐ BETWEEN BEARINGS ☐ OVERHUNG ☐WEAR RINGS: ☐ INLET ONLY ☐ BOTH SIDES ☐ CASE ONLY ☐ CASE & IMPELL.BEARINGS: TYPE: RADIAL FULL INLET THRUST = FULL INLETLUBE: ☐ RING ☐ FLOOD ☐ FLINGER ☐ MIST ☐ PRESSURECOUPLING: MFR: \_\_\_\_\_ MODEL: RIGID SPACERDRIVER 1/2 MTD BY: ☒ PUMP MFR. ☐ DRIVER MFR. ☐ PURCH.

GUARD TYPE: \_\_\_\_\_

PACKING: MFR &amp; TYPE \_\_\_\_\_ SIZE \_\_\_\_\_ NO. RINGS \_\_\_\_\_

MECH. SEAL: MFR & MODEL \_\_\_\_\_ MFR'S CODE \_\_\_\_\_ API CODE USPXL\*CLINE 2 WREN\* SEAL GASKET MTL: ETHYLENE PROPYLENE

## AUXILIARY PIPING:

C.W. PIPE PLAN \_\_\_\_\_, WITH ☐ C.S. ☐ S.S. ☐ TUBING ☐ PIPETOTAL C.W. REQ'D. \_\_\_\_\_ GPM. INCLUDE: ☐ FLOW INDIC. ☐ VALVE "C"

PACKING INJECTION: FLUID= \_\_\_\_\_ °F. REQ'D= \_\_\_\_\_ GPM @ \_\_\_\_\_ PSIG

SEAL FLUSH PLAN //, WITH ☒ C.S. ☐ S.S. ☒ TUBING ☐ PIPE

EXT. FLUSH FLUID= \_\_\_\_\_ °F. REQ'D= \_\_\_\_\_ GPM @ \_\_\_\_\_ PSIG

AUX. SEAL PLAN \_\_\_\_\_, WITH ☐ C.S. ☐ S.S. ☐ TUBING ☐ PIPE

QUENCH FLUID= \_\_\_\_\_

## MOTOR DRIVERS:

HP \_\_\_\_\_, S.F. \_\_\_\_\_, RPM \_\_\_\_\_, FRAME \_\_\_\_\_, 460 V 3 PH 60 HZ

MFR. \_\_\_\_\_ BEARINGS \_\_\_\_\_, LUBE \_\_\_\_\_

TYPE \_\_\_\_\_ INSUL. CLASS B AMPS, FULL LOAD \_\_\_\_\_ENCL. XP RISE °C 80 AMPS, LOCKED ROTOR \_\_\_\_\_VERT. UNITS: ☐ VSS ☐ VHS THRUST CAP., LBS. \_\_\_\_\_ UP \_\_\_\_\_ DN. \_\_\_\_\_

## TURBINE DRIVERS:

☐ IF BY PUMP VENDOR SEE PAGE \_\_\_\_\_ ATTACHED☐ IF BY OTHERS: MFR. \_\_\_\_\_ MODEL \_\_\_\_\_ BHP \_\_\_\_\_APPLICABLE DOCUMENTS: 1590-13-2A, 1590-38A1, 1590-50A2, 1590-50A4, 1590-92A1,1590-31A2

## SHOP TESTS:

PERFORMANCE REQUIRED WITNESSEDNPSHR YES NO

## DISMANTLE &amp; INSPECT

HYDROTEST CASE YES NO

HYDROTEST BOWLS \_\_\_\_\_

## MATERIALS:

☐ PUMP API CLASS 5-4☐ \_\_\_\_\_

## BASE PLATE

## VERTICAL PUMPS

THRUST, LBS. \_\_\_\_\_ UP, \_\_\_\_\_ DOWN

OTHER DETAILS PER PAGE NO. \_\_\_\_\_

## APPROX. WEIGHTS

(LBS NET EACH)

PUMP ONLY \_\_\_\_\_ MOTOR \_\_\_\_\_

BASE \_\_\_\_\_ TURBINE \_\_\_\_\_

## SITE DATA

AMBIENT 93 °F MAX TO 25 °F MIN.INSTALLED ☐ OUTDOORS ☐ INDOORS☒ CL II -GR F-DIV 2 ☐ NON-HAZARDOUS

COOLING WATER: TYPE \_\_\_\_\_

°F &amp; PSIG IN, °F MAX &amp; PSIG OUT



FOR 5-80

|                                                              |                              |                                    |                    |
|--------------------------------------------------------------|------------------------------|------------------------------------|--------------------|
| FOR <u>EPDA-FE-14-32-0001-1521</u>                           | F.W. CONTRACT <u>15-1591</u> | REQUISITION NO. <u>1591-1311-G</u> | DATE <u>4-5-76</u> |
| SITE <u>NPS LIVESTOCK STATION, CLOUX FALLS, SOUTH DAKOTA</u> |                              | SUPERSEDED BY CHANGE NO.           |                    |
| SERVICE <u>SLURRY FILTRATION FEED PUMPS</u>                  |                              | C1 <u>4-20-76</u>                  | C3 <u></u>         |
| NO. REQ'D <u>2</u>                                           | ITEM NOS. <u>P-210 A/B</u>   | C2 <u></u>                         | C4 <u></u>         |

NO. OF MOTORS REQ'D. 2 : ITEM NOS. \_\_\_\_\_ SUPPLIED BY PUMP MFR MOUNTED BY PUMP MFR

NO. OF TURBINES REQ'D \_\_\_\_\_ : ITEM NOS. \_\_\_\_\_ SUPPLIED BY \_\_\_\_\_ MOUNTED BY \_\_\_\_\_

PUMP MFR. \_\_\_\_\_ SIZE &amp; MODEL \_\_\_\_\_

NO. STAGES \_\_\_\_\_

OPERATING CONDITIONS, EACH PUMP: (SEE PAGE 2)

|                        |                                                |                                       |
|------------------------|------------------------------------------------|---------------------------------------|
| LIQUID _____           | U.S. GPM @ PT: MIN _____ NORM _____ RTD. _____ | PROPOSAL CURVE NO. _____              |
| P.T. °F. (MAX _____)   | DISCH. PSIG _____                              | RTD. _____                            |
| SP. GR. AT PT _____    | SUCT. PSIG (MAX. _____)                        | RTD. _____                            |
| VAP. PSIA @ PT _____   | DIFF. PSI _____                                | MIN. CONTINUOUS U.S. GPM _____        |
| VIS. @ PT _____        | TOTAL DIFF. HEAD, FT. _____                    | ROTATION, VIEWING FROM COUPLING _____ |
| CORR./EROS. FROM _____ | NPSHA, FT. _____                               |                                       |
|                        | HYD HP _____                                   |                                       |

## CONSTRUCTION

| NOZZLES   | SIZE | ANSI RATING | FACING    | LOCATION   |
|-----------|------|-------------|-----------|------------|
| SUCTION   |      |             | <u>RF</u> | <u>END</u> |
| DISCHARGE |      |             | <u>RF</u> | <u>TOP</u> |

CASE-MOUNT ☒ CENTERLINE ☐ FOOT ☐ BRACKET ☐ IN-LINE ☐-SPLIT: ☐ AXIAL ☒ RADIAL-VOLUTE: ☒ SINGLE ☐ DOUBLE ☐ DIFFUSER ☐

-DESIGN: \_\_\_\_\_ PSIG @ \_\_\_\_\_ °F. HYDRO TEST \_\_\_\_\_ PSIG

-AUX. CONNECTS: ☒ VENTS ☒ DRAINS ☐ GAGES ☐

IMPELLER: DIA.: RATED \_\_\_\_\_, MAX. \_\_\_\_\_, MIN. \_\_\_\_\_ TYPE \_\_\_\_\_

MOUNTING ☐ BETWEEN BEARINGS ☒ OVERHUNG ☐WEAR RINGS: ☐ INLET ONLY ☐ BOTH SIDES ☐ CASE ONLY ☐ CASE & IMPELL.BEARINGS: TYPE: RADIAL = CR1, THRUST = CR1LUBE: ☐ RING ☐ FLOOD ☐ FLINGER ☐ MIST ☐ PRESSURE

COUPLING: MFR: \_\_\_\_\_ MODEL: \_\_\_\_\_

DRIVER 1/2 MTD BY: ☒ PUMP MFR. ☐ DRIVER MFR. ☐ PURCH.

GUARD TYPE: \_\_\_\_\_

PACKING: MFR &amp; TYPE \_\_\_\_\_ SIZE \_\_\_\_\_ NO. RINGS \_\_\_\_\_

MECH. SEAL: MFR & MODEL \_\_\_\_\_ MFR'S CODE \_\_\_\_\_ API CODE UCPXL\*CRANE 2 OR EQUAL

\* SEAL GASKET MTL: ETHYLENE PROPYLENE

## AUXILIARY PIPING:

C.W. PIPE PLAN C, WITH ☐ C.S. ☒ S.S. ☐ TUBING ☐ PIPETOTAL C.W. REQ'D. \_\_\_\_\_ GPM. INCLUDE: ☐ FLOW INDIC. ☐ VALVE "C"

PACKING INJECTION: FLUID= \_\_\_\_\_ @ \_\_\_\_\_ °F. REQ'D= \_\_\_\_\_ GPM @ \_\_\_\_\_ PSIG

SEAL FLUSH PLAN 32, WITH ☐ C.S. ☒ S.S. ☐ TUBING ☐ PIPE

EXT. FLUSH FLUID= \_\_\_\_\_ @ \_\_\_\_\_ °F. REQ'D= \_\_\_\_\_ GPM @ \_\_\_\_\_ PSIG

AUX. SEAL PLAN \_\_\_\_\_, WITH ☐ C.S. ☐ S.S. ☐ TUBING ☐ PIPE

QUENCH FLUID= \_\_\_\_\_

## MOTOR DRIVERS:

HP \_\_\_\_\_, S.F. \_\_\_\_\_, RPM \_\_\_\_\_, FRAME \_\_\_\_\_, 460 V/ 3 PH/ 60 HZ

MFR. \_\_\_\_\_, BEARINGS \_\_\_\_\_, LUBE \_\_\_\_\_

TYPE \_\_\_\_\_, INSUL. CLASS B AMPS, FULL LOAD \_\_\_\_\_ENCL. XP, RISE °C 80 AMPS, LOCKED ROTOR \_\_\_\_\_VERT. UNITS: ☐ VSS ☐ VHS THRUST CAP., LBS. \_\_\_\_\_ UP \_\_\_\_\_ DN. \_\_\_\_\_

## TURBINE DRIVERS:

☐ IF BY PUMP VENDOR SEE PAGE \_\_\_\_\_ ATTACHED☐ IF BY OTHERS: MFR. \_\_\_\_\_ MODEL \_\_\_\_\_ BHP \_\_\_\_\_APPLICABLE DOCUMENTS: 1520-1300A, 1520-38A1, 1520-50A2, 1520-50A4, 1520-92A11520-31A1

## WITH RATED IMPELLER:

EFFICIENCY AT RATED POINT, % \_\_\_\_\_

IF EFF. IS VISCOUS, WATER EFF. = \_\_\_\_\_

BHP: RATED \_\_\_\_\_ NORM \_\_\_\_\_ MAX \_\_\_\_\_

IF HP IS VISC.: RATED WATER BHP = \_\_\_\_\_

MAX. TOTAL HEAD, FT. \_\_\_\_\_

MAX. POSSIBLE DISCH. PRESS.: \_\_\_\_\_ PSIG

WITH RATED SUCT. PRESS. = \_\_\_\_\_

WITH MAX. SUCT. PRESS. = \_\_\_\_\_

## SHOP TESTS:

PERFORMANCE REQUIRED YES WITNESSED NO

NPSHR \_\_\_\_\_

DISMANTLE &amp; INSPECT \_\_\_\_\_

HYDROTEST CASE YES NO

HYDROTEST BOWLS \_\_\_\_\_

## MATERIALS:

☐ PUMP API CLASS C-6☐ \_\_\_\_\_

## BASE PLATE

## VERTICAL PUMPS

THRUST, LBS. \_\_\_\_\_ UP, \_\_\_\_\_ DOWN

OTHER DETAILS PER PAGE NO. \_\_\_\_\_

## APPROX. WEIGHTS

(LBS NET EACH)

PUMP ONLY \_\_\_\_\_ MOTOR \_\_\_\_\_

BASE \_\_\_\_\_ TURBINE \_\_\_\_\_

## SITE DATA

AMBIENT 93 °F MAX TO 25 °F MIN.INSTALLED ☒ OUTDOORS ☐ INDOORS☒ CL II-GR E-DIV 2 ☐ NON-HAZARDOUS

COOLING WATER: TYPE \_\_\_\_\_

°F &amp; PSIG IN, °F MAX &amp; PSIG OUT \_\_\_\_\_

FORM NO. 135-68

|                                                       |                           |                                |
|-------------------------------------------------------|---------------------------|--------------------------------|
| FOR ERDA-FE-14-32-0001-1521                           | F.W. CONTRACT 15-1591     | REQUISITION NUMBER 1591-1311-G |
| SITE NISP LAWRENCE STATION, SIOUX FALLS, SOUTH DAKOTA | DATE 4-5-76               |                                |
| ITEM NOS. P-210 A/B                                   | SUPERSEDED BY CHANGE NO.: |                                |
|                                                       | C1 4-20-76                | C3                             |
|                                                       | C2                        | C4                             |
|                                                       |                           | C5                             |
|                                                       |                           | C6                             |

OPERATING CONDITIONS, EACH PUMP:OPER. CASE START-UP (CHAR DENSITY 20<sup>lb</sup>/FT<sup>3</sup>)

|                                        |                                                         |                                          |
|----------------------------------------|---------------------------------------------------------|------------------------------------------|
| LIQUID <u>WATER AND</u>                | U.S. GPM @ PT: MIN _____ NORM <u>222</u> RTD <u>255</u> | EFFICIENCY AT RATED POINT, % _____       |
| <u>COAL CHAR SLURRY</u>                | DISCH. PSIG _____ RTD <u>28</u>                         | IF EFF. IS VISCOUS, WATER EFF. = _____   |
| P.T. °F. (MAX <u>165</u> ) <u>153</u>  | SUCT. PSIG (MAX. <u>7</u> ) _____ RTD <u>0</u>          | BHP: RATED _____ NORM _____ MAX _____    |
| SP. GR. AT PT <u>0.73</u>              | DIFF. PSI _____ <u>28</u>                               | IF HP IS VISC., RTD. WATER BHP = _____   |
| VAP. PSIA @ PT <u>4</u>                | TOTAL DIFF. HEAD, FT. _____ <u>90</u>                   | MAX. POSSIBLE TOTAL HEAD, FT. _____      |
| VIS. @ PT <u>2.3</u> CFS               | NPSHA, FT. _____ <u>30</u>                              | MAX. POSSIBLE DISCH. PRESS.: <u>PSIG</u> |
| CORR./EROS. FROM <u>CHAR PARTICLES</u> |                                                         | WITH RATED SUCT. PRESS. = _____          |
|                                        |                                                         | WITH MAX. SUCT. PRESS. = _____           |

OPER. CASE START-UP (CHAR DENSITY 73.6<sup>lb</sup>/FT<sup>3</sup>)

|                                        |                                                         |                                          |
|----------------------------------------|---------------------------------------------------------|------------------------------------------|
| LIQUID <u>WATER AND</u>                | U.S. GPM @ PT: MIN _____ NORM <u>161</u> RTD <u>185</u> | EFFICIENCY AT RATED POINT, % _____       |
| <u>COAL CHAR SLURRY</u>                | DISCH. PSIG _____ RTD <u>28</u>                         | IF EFF. IS VISCOUS, WATER EFF. = _____   |
| P.T. °F. (MAX <u>165</u> ) <u>153</u>  | SUCT. PSIG (MAX. <u>7</u> ) _____ RTD <u>0</u>          | BHP: RATED _____ NORM _____ MAX _____    |
| SP. GR. AT PT <u>1.01</u>              | DIFF. PSI _____ <u>28</u>                               | IF HP IS VISC., RTD. WATER BHP = _____   |
| VAP. PSIA @ PT <u>4</u>                | TOTAL DIFF. HEAD, FT. _____ <u>64</u>                   | MAX. POSSIBLE TOTAL HEAD, FT. _____      |
| VIS. @ PT <u>1.1</u> CFS               | NPSHA, FT. _____ <u>21</u>                              | MAX. POSSIBLE DISCH. PRESS.: <u>PSIG</u> |
| CORR./EROS. FROM <u>CHAR PARTICLES</u> |                                                         | WITH RATED SUCT. PRESS. = _____          |
|                                        |                                                         | WITH MAX. SUCT. PRESS. = _____           |

OPER. CASE NORMAL OPERATING

|                                        |                                                       |                                          |
|----------------------------------------|-------------------------------------------------------|------------------------------------------|
| LIQUID <u>WATER AND</u>                | U.S. GPM @ PT: MIN _____ NORM <u>49</u> RTD <u>56</u> | EFFICIENCY AT RATED POINT, % _____       |
| <u>COAL CHAR SLURRY</u>                | DISCH. PSIG _____ RTD <u>28</u>                       | IF EFF. IS VISCOUS, WATER EFF. = _____   |
| P.T. °F. (MAX <u>165</u> ) <u>153</u>  | SUCT. PSIG (MAX. <u>7</u> ) _____ RTD <u>0</u>        | BHP: RATED _____ NORM _____ MAX _____    |
| SP. GR. AT PT <u>0.99</u>              | DIFF. PSI _____ <u>28</u>                             | IF HP IS VISC., RTD. WATER BHP = _____   |
| VAP. PSIA @ PT <u>4</u>                | TOTAL DIFF. HEAD, FT. _____ <u>65</u>                 | MAX. POSSIBLE TOTAL HEAD, FT. _____      |
| VIS. @ PT <u>0.6</u> CFS               | NPSHA, FT. _____ <u>21</u>                            | MAX. POSSIBLE DISCH. PRESS.: <u>PSIG</u> |
| CORR./EROS. FROM <u>CHAR PARTICLES</u> |                                                       | WITH RATED SUCT. PRESS. = _____          |
|                                        |                                                       | WITH MAX. SUCT. PRESS. = _____           |

## OPER. CASE \_\_\_\_\_

|                        |                                               |                                          |
|------------------------|-----------------------------------------------|------------------------------------------|
| LIQUID _____           | U.S. GPM @ PT: MIN _____ NORM _____ RTD _____ | EFFICIENCY AT RATED POINT, % _____       |
|                        | DISCH. PSIG _____ RTD _____                   | IF EFF. IS VISCOUS, WATER EFF. = _____   |
| P.T. °F. (MAX _____)   | SUCT. PSIG (MAX. _____) _____ RTD _____       | BHP: RATED _____ NORM _____ MAX _____    |
| SP. GR. AT PT _____    | DIFF. PSI _____                               | IF HP IS VISC., RTD. WATER BHP = _____   |
| VAP. PSIA @ PT _____   | TOTAL DIFF. HEAD, FT. _____                   | MAX. POSSIBLE TOTAL HEAD, FT. _____      |
| VIS. @ PT _____        | NPSHA, FT. _____                              | MAX. POSSIBLE DISCH. PRESS.: <u>PSIG</u> |
| CORR./EROS. FROM _____ |                                               | WITH RATED SUCT. PRESS. = _____          |
|                        |                                               | WITH MAX. SUCT. PRESS. = _____           |

NOTE: (1) SLURRIES MAY CONTAIN UP TO 16% WT OF CHAR

(2) VENDOR TO ADVISE IF MIN FLOW BY-PASS IS REQUIRED FOR NORMAL OPERATING CASE

## FOSTER WHEELER CORPORATION

## CENTRIFUGAL PUMPS

PAGE 1 OF 1

FOI 35-80

|                                                             |                              |                                    |                     |
|-------------------------------------------------------------|------------------------------|------------------------------------|---------------------|
| FOR <u>ERMA-FE-14-72-0001-1521</u>                          | F.W. CONTRACT <u>15-1591</u> | REQUISITION NO. <u>1591-1311-R</u> | DATE <u>2-17-76</u> |
| SITE <u>AND LAWRENCE STATION, SIOUX FALLS, SOUTH DAKOTA</u> |                              | SUPERSEDED BY CHANGE NO. <u>0</u>  |                     |
| SERVICE <u>SEMI-CLEAN WATER PUMPS</u>                       |                              | C1 <u>3-24-76</u>                  | C3 <u></u>          |
| NO. REQ'D <u>2</u>                                          | ITEM NOS. <u>P-211A/B</u>    | C2 <u>4-20-76</u>                  | C4 <u></u>          |

|                               |                             |                             |                            |
|-------------------------------|-----------------------------|-----------------------------|----------------------------|
| NO. OF MOTORS REQ'D <u>2</u>  | ITEM NOS. <u></u>           | SUPPLIED BY <u>PUMP MFR</u> | MOUNTED BY <u>PUMP MFR</u> |
| NO. OF TURBINES REQ'D <u></u> | ITEM NOS. <u></u>           | SUPPLIED BY <u></u>         | MOUNTED BY <u></u>         |
| PUMP MFR. <u>SUNDSTADT</u>    | SIZE & MODEL <u>LMV-311</u> | NO. STAGES <u>ONE</u>       |                            |

## OPERATING CONDITIONS, EACH PUMP:

LIQUID WATER U.S.GPM @ PT: MIN 20 NORM 147 RTD. 170

DISCH. PSIG  RTD. 480 RPM  NPSHR (WATER), FT.

P.T. °F. (MAX 165) 153 SUCT. PSIG (MAX. 4) RTD. 0

SP.GR. AT PT 0.98 DIFF. PSI 480

VAP. PSIA @ PT 4 TOTAL DIFF. HEAD, FT. 1131

VIS. @ PT 0.46 NPSHA, FT. 21

CORR./EROS. FROM DISCOVERED NH<sub>3</sub>, H<sub>2</sub>S, CO<sub>2</sub> HYD HP. 24

## PERFORMANCE

PROPOSAL CURVE NO.

IF EFF. IS VISCOUS, WATER EFF. =

BHP: RATED  NORM  MAX

IF HP IS VISC., RATED WATER BHP =

MAX. TOTAL HEAD, FT.

MAX. POSSIBLE DISCH. PRESS.:  PSIG

WITH RATED SUCT. PRESS. =

WITH MAX. SUCT. PRESS. =

## CONSTRUCTION

| NOZZLES   | SIZE       | ANSI RATING | FACING      | LOCATION |
|-----------|------------|-------------|-------------|----------|
| SUCTION   | <u>300</u> | <u>RF</u>   | <u>SIDE</u> |          |
| DISCHARGE | <u>300</u> | <u>RF</u>   | <u>SIDE</u> |          |

CASE-MOUNT ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☒ IN-LINE ☐

-SPLIT: ☐ AXIAL ☒ RADIAL

-VOLUTE: ☐ SINGLE ☒ DOUBLE ☒ DIFFUSER ☐

-DESIGN:  PSIG @  °F. HYDRO TEST  PSIG

-AUX. CONNECTS: ☒ VENTS ☒ DRAINS ☐ GAGES ☐

IMPELLER: DIA.: RATED , MAX. , MIN. . TYPE OPEN

MOUNTING ☐ BETWEEN BEARINGS ☐ OVERHUNG ☐

WEAR RINGS: ☐ INLET ONLY ☐ BOTH SIDES ☐ CASE ONLY ☐ CASE & IMPELL.

BEARINGS: TYPE: RADIAL SIDE, THRUST = WASHER

LUBE: ☐ RING ☐ FLOOD ☐ FLINGER ☐ MIST ☐ PRESSURE

COUPLING: MFR:  MODEL: SPLINE

DRIVER 1/2 MTD BY: ☒ PUMP MFR. ☐ DRIVER MFR. ☐ PURCH.

GUARD TYPE:

PACKING: MFR & TYPE  SIZE  NO. RINGS

MECH. SEAL: MFR & MODEL  MFR'S CODE  API CODE BSPXL\*

CLINE 9B OR EQUAL

\* SEAL GASKET MTL: ETHYLENE PROPYLENE

## AUXILIARY PIPING:

C.W. PIPE PLAN , WITH ☐ C.S. ☐ S.S. ☐ TUBING ☐ PIPE

TOTAL C.W. REQ'D.  GPM. INCLUDE: ☐ FLOW INDIC. ☐ VALVE "C"

PACKING INJECTION: FLUID=  @  °F. REQ'D=  GPM @  PSIG

SEAL FLUSH PLAN //, WITH ☒ C.S. ☐ S.S. ☒ TUBING ☐ PIPE

EXT. FLUSH FLUID=  @  °F. REQ'D=  GPM @  PSIG

AUX. SEAL PLAN , WITH ☐ C.S. ☐ S.S. ☐ TUBING ☐ PIPE

QUENCH FLUID=

## MOTOR DRIVERS:

HP , S.F. , RPM , FRAME , 460 V/3 PH/60 HZ

MFR.  BEARINGS  LUBE

TYPE  INSUL. CLASS B AMPS, FULL LOAD

ENCL. XP RISE °C 80 AMPS, LOCKED ROTOR

VERT. UNITS: ☐ VSS ☐ VHS THRUST CAP., LBS.  UP  DN.

## TURBINE DRIVERS:

☐ IF BY PUMP VENDOR SEE PAGE  ATTACHED

☐ IF BY OTHERS: MFR.  MODEL  BHP

APPLICABLE DOCUMENTS: 1590-1300A, 1590-38A1, 1590-50A2, 1590-50A4, 1590-92A1

1590-31A1

## SHOP TESTS:

|                     | REQUIRED   | WITNESSED |
|---------------------|------------|-----------|
| PERFORMANCE         | <u>YES</u> | <u>NO</u> |
| NPSHR               | <u></u>    | <u></u>   |
| DISMANTLE & INSPECT | <u></u>    | <u></u>   |
| HYDROTEST CASE      | <u>YES</u> | <u>NO</u> |
| HYDROTEST BOWLS     | <u></u>    | <u></u>   |

## MATERIALS:

☐ PUMP API CLASS

☒ CASE: STEEL

INTERNALS: 316

## BASE PLATE

## VERTICAL PUMPS

THRUST, LBS.  UP,  DOWN

OTHER DETAILS PER PAGE NO.

## APPROX. WEIGHTS

(LBS NET EACH)

PUMP ONLY  MOTOR

BASE  TURBINE

## SITE DATA

AMBIENT 83 °F MAX TO 25 °F MIN.

INSTALLED ☒ OUTDOORS ☐ INDOORS

☒ CL II-GRF-DIV 2 ☐ NON-HAZARDOUS

COOLING WATER: TYPE

°F & PSIG IN, °F MAX & PSIG OUT

FOR 5-80

FOR ERDA FE-14-32-0001-1521 F.W. CONTRACT 15-1591

REQUISITION NO.

DATE

1591-1311-S

2-6-76

SITE NEW LAWRENCE STATION, SIOUX FALLS, SOUTH DAKOTA

SUPERSEDED BY CHANGE NO.

SERVICE SECOND STAGE SWS REFLUX PUMP

C1 3-3-76 C3

NO. REQ'D 2 ITEM NOS. P-213 A/B

C2 4-20-76 C4 C5

NO. OF MOTORS REQ'D 2 : ITEM NOS. SUPPLIED BY PUMP MFR MOUNTED BY PUMP MFR.

NO. OF TURBINES REQ'D : ITEM NOS. SUPPLIED BY MOUNTED BY

PUMP MFR. SIZE &amp; MODEL

NO. STAGES

## OPERATING CONDITIONS, EACH PUMP:

LIQUID WATER AND U.S.GPM @ PT: MIN 25 NORM 32 RTD. 42  
DISSOLVED GAS DISCH. PSIG RTD. 63  
 P.T. °F. (MAX 225) 200 SUCT. PSIG (MAX. 55) RTD. 16  
 SP.GR. AT PT 0.91 1.0 DIFF. PSI RTD. 47  
 VAP. PSIA @ PT 28 (15.5) TOTAL DIFF. HEAD, FT. 120  
 VIS. @ PT 0.13 NPSHA, FT. 5  
 CORR./EROS. FROM DISSOLVED NH<sub>3</sub> CO<sub>2</sub> H<sub>2</sub>S HYD HP. 1.2

## PERFORMANCE

PROPOSAL CURVE NO. \_\_\_\_\_  
 RPM \_\_\_\_\_ NPSHR (WATER), FT. \_\_\_\_\_  
 MIN. CONTINUOUS U.S.GPM \_\_\_\_\_  
 ROTATION, VIEWING FROM COUPLING \_\_\_\_\_

CONSTRUCTION SIMILAR TO PENDING ANSI STANDARD

| NOZZLES   | SIZE | ANSI RATING | FACING | LOCATION |
|-----------|------|-------------|--------|----------|
| SUCTION   |      |             | RF     | SIDE     |
| DISCHARGE |      |             | RF     | SIDE     |

CASE-MOUNT ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☒ IN-LINE ☐-SPLIT: ☐ AXIAL ☒ RADIAL-VOLUTE: ☒ SINGLE ☐ DOUBLE ☐ DIFFUSER ☐

-DESIGN: \_\_\_\_\_ PSIG @ \_\_\_\_\_ °F. HYDRO TEST \_\_\_\_\_ PSIG

-AUX. CONNECTS: ☒ VENTS ☒ DRAINS ☐ GAGES ☐

IMPELLER: DIA.: RATED \_\_\_\_\_, MAX. \_\_\_\_\_, MIN. \_\_\_\_\_. TYPE \_\_\_\_\_

MOUNTING ☐ BETWEEN BEARINGS ☐ OVERHUNG ☐WEAR RINGS: ☐ INLET ONLY ☐ BOTH SIDES ☐ CASE ONLY ☐ CASE & IMPELL.BEARINGS: TYPE: RADIAL BALL IN DRIVER, THRUST = BALL IN DRIVERLUBE: ☐ RING ☐ FLOOD ☐ FLINGER ☐ MIST ☐ PRESSURECOUPLING: MFR: \_\_\_\_\_ MODEL: RIGID SPACERDRIVER 1/2 MTD BY: ☒ PUMP MFR. ☐ DRIVER MFR. ☐ PURCH.

GUARD TYPE: \_\_\_\_\_

PACKING: MFR &amp; TYPE \_\_\_\_\_ SIZE \_\_\_\_\_ NO. RINGS \_\_\_\_\_

MECH. SEAL: MFR & MODEL \_\_\_\_\_ MFR'S CODE \_\_\_\_\_ API CODE 452XL \*CRANE 9 OR EQUAL\* SEAL GASKET MTL: ETHYLENE PROPYLENE

## AUXILIARY PIPING:

C.W. PIPE PLAN J, WITH ☒ C.S. ☐ S.S. ☒ TUBING ☐ PIPETOTAL C.W. REQ'D \_\_\_\_\_ GPM. INCLUDE: ☐ FLOW INDIC. ☐ VALVE "C"

PACKING INJECTION: FLUID= \_\_\_\_\_ @ \_\_\_\_\_ °F. REQ'D= \_\_\_\_\_ GPM @ \_\_\_\_\_ PSIG

SEAL FLUSH PLAN 21, WITH ☒ C.S. ☐ S.S. ☒ TUBING ☐ PIPE

EXT. FLUSH FLUID= \_\_\_\_\_ @ \_\_\_\_\_ °F. REQ'D= \_\_\_\_\_ GPM @ \_\_\_\_\_ PSIG

AUX. SEAL PLAN \_\_\_\_\_, WITH ☐ C.S. ☐ S.S. ☐ TUBING ☐ PIPE

QUENCH FLUID= \_\_\_\_\_

## MOTOR DRIVERS:

HP \_\_\_\_\_, S.F. \_\_\_\_\_, RPM \_\_\_\_\_, FRAME \_\_\_\_\_, 460 V 3 PH 60 HZ

MFR. \_\_\_\_\_ BEARINGS \_\_\_\_\_ LUBE \_\_\_\_\_

TYPE \_\_\_\_\_ INSUL. CLASS B3 AMPS, FULL LOAD \_\_\_\_\_ENCL. XP RISE °C 80 AMPS, LOCKED ROTOR \_\_\_\_\_VERT. UNITS: ☐ VSS ☐ VHS THRUST CAP., LBS. \_\_\_\_\_ UP \_\_\_\_\_ DN. \_\_\_\_\_

## TURBINE DRIVERS:

☐ IF BY PUMP VENDOR SEE PAGE \_\_\_\_\_ ATTACHED☐ IF BY OTHERS: MFR. \_\_\_\_\_ MODEL \_\_\_\_\_ BHP \_\_\_\_\_APPLICABLE DOCUMENTS: 1590-1300A, 1590-38A1, 1590-50A2, 1590-50A4, 1590-92A1, 1590-31A2

## SHOP TESTS:

PERFORMANCE REQUIRED WITNESSEDNPSHR YES NO

## DISMANTLE &amp; INSPECT

HYDROTEST CASE YES NO

HYDROTEST BOWLS \_\_\_\_\_

## MATERIALS:

☐ PUMP API CLASS 5-4☐

## BASE PLATE

## VERTICAL PUMPS

THRUST, LBS. \_\_\_\_\_ UP, \_\_\_\_\_ DOWN

OTHER DETAILS PER PAGE NO. \_\_\_\_\_

## APPROX. WEIGHTS

(LBS NET EACH)

PUMP ONLY \_\_\_\_\_ MOTOR \_\_\_\_\_

BASE \_\_\_\_\_ TURBINE \_\_\_\_\_

## SITE DATA

AMBIENT 93 °F MAX TO 25 °F MIN.INSTALLED ☒ OUTDOORS ☐ INDOORS☒ CL II - GR F-DIV 2 ☐ NON-HAZARDOUS

COOLING WATER: TYPE \_\_\_\_\_

°F &amp; PSIG IN, °F MAX &amp; PSIG OUT

# MATERIAL REQUISITION

FOSTER WHEELER ENERGY CORPORATION

PAGE<sup>1</sup> OF 4

FORM 135-2

|                                                               |                         |                           |                |
|---------------------------------------------------------------|-------------------------|---------------------------|----------------|
| FOR <u>ERDA-FE</u>                                            | F.W.REF. <u>15-1592</u> | REQUISITION NUMBER        | DATE           |
| SITE <u>SIOUX FALLS, SOUTH DAKOTA</u>                         |                         | <u>1592-1349-A</u>        | <u>8/29/75</u> |
| MATERIAL <u>SLURRY FILTRATION PACKAGE</u>                     |                         | SUPERSEDED BY CHANGE NO.: |                |
| <u>ITEM A-202</u>                                             |                         | C1 <u>3-26-76</u>         | C4             |
| <u>ENERGY RESEARCH &amp; DEVELOPMENT ADMIN.-FOSSIL ENERGY</u> |                         | C2                        | C5             |
| CONTRACT NO. <u>ERDA-FE 11-32-0001-1521</u>                   |                         | C3                        | C6             |

## INDEX

- I. SCOPE
- II. GENERAL
- III. NORMAL OPERATION
- IV. START-UP OPERATION
- V. GENERAL OPERATING REQUIREMENTS
- VI. EQUIPMENT CONSIDERATION
- VII. SITE CONDITIONS
- VIII. UTILITIES AVAILABLE
- IX. REFERENCES

|     |         |           |
|-----|---------|-----------|
| BY: | P.O.NO. | SUPPLIER: |
|-----|---------|-----------|

I. SCOPE

This requisition covers the supply of a filtration package<sup>for</sup> separating the char-water slurry obtained from a coal gasification process. The type of filter shall be specified by the vendor. If more than one filtration unit is required, each shall be capable of operating independently. The filter or filters shall be capable of handling all operating conditions.

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II. GENERAL

The design of all equipment of vendors supply shall comply with all regulations applicable to the proposed location i.e. Sioux Falls, South Dakota. All materials to be of United States origin. Equipment shall be furnished in accordance with the applicable provisions of the latest revision of codes and specifications.

The design of this package should be based on the expected operating life of the pilot plant: 18 months.

The slurry during operation is mainly char particles, carbon dust and water plus dissolved gases consisting mainly of CO<sub>2</sub>, NH<sub>3</sub> and H<sub>2</sub>S. The slurry has been de-gassed in an upstream stripper operating at about 4 PSIA, hence, the filter shall be designed to operate somewhat above this pressure i.e. 15" to 20" Hg. Provide exhaust heads to vent any hot vapors.

C-1

III. NORMAL OPERATION

The slurry will be at 150-155°. In one case the char will have an apparent particle density of 20 lbs/ft<sup>3</sup> and in the second case 60 lbs/ft<sup>3</sup>. The loading and estimated particle size distributions are listed below:

|               |        |
|---------------|--------|
| Flow Rate     | LBS/HR |
| Water         | 16,425 |
| Char & Carbon | 780    |
| Total         | 17,205 |

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| <u>PARTICLE SIZE (MICRONS)</u> | <u>WEIGHT</u>                |                              |
|--------------------------------|------------------------------|------------------------------|
|                                | <u>20 LBS/FT<sup>3</sup></u> | <u>60 LBS/FT<sup>3</sup></u> |
| 0-0.01                         | 0.07                         | 0.07                         |
| 0.01-0.05                      | 11.48                        | 12.00                        |
| 0.05-0.10                      | 21.54                        | 22.54                        |
| 0.10-0.50                      | 11.03                        | 11.54                        |
| 0.50-1.79                      | 1.69                         | 1.77                         |
| 1.79-3.78                      | 4.48                         | 4.69                         |
| 3.78-9.77                      | 22.06                        | 23.08                        |
| 9.77-13.30                     | 27.65                        | 24.31                        |
|                                | <u>100.00</u>                | <u>100.00</u>                |

#### IV. START-UP OPERATION

This operation differs from normal mainly in char particle size distribution and in total quantities of char and water, also the slurry may contain small amounts of oil and tar. Here again the slurry has been vacuum stripped in upstream equipment at about 4 PSIA. Some residual H<sub>2</sub>S, NH<sub>3</sub> and CO<sub>2</sub> dissolved in the slurry feed to the filter may be expected.

Slurry at 150-160°F.

The char particles are represented by two cases at 20 lbs/ft<sup>3</sup> and 60 lbs/ft<sup>3</sup> as in normal operation, but will be of equal size distribution.

|               | <u>LBS/HR.</u> |
|---------------|----------------|
| Water         | 68,815         |
| Char & Carbon | 13,437         |
| Oil and Tar   | <u>1,000</u>   |
|               | 83,252         |

| <u>Particle Size Microns</u> | <u>Weight % (Estimated)</u> |
|------------------------------|-----------------------------|
| 0.05                         | 0.00                        |
| 0.05 - 1.79                  | 0.06                        |
| 1.79 - 3.78                  | 0.15                        |
| 3.78 - 9.77                  | 1.04                        |
| 9.77 - 13.28                 | 0.75                        |
| 13.28 - 32.02                | 5.00                        |
| 32.02 - 64.32                | 11.00                       |
| 64.32 - 100.00               | 12.00                       |
| 100.00 - 109.49              | 3.00                        |
| 109.49 - 186.00              | 19.50                       |
| 187.00 - 212.00              | 5.50                        |
| 212.00 - 276.00              | 11.00                       |
| 276.00 - 358.00              | 6.00                        |
| 358.00 - 416.00              | 3.00                        |
| 416.00 - 582.00              | 6.00                        |
| 582.00 - 2000.00             | <u>16.00</u>                |
|                              | 100.00                      |

#### V. GENERAL OPERATING REQUIREMENTS

The filter cake should be as dry as possible consistent with economical operation of the proposed system. Vendor should have provision for washing prior to final cake dewatering. The filtrate should be as clear as possible. Vendor to check economics and/or equipment limitations involved in obtaining a filtrate having a maximum solids contents of 100 and 50 and 25 parts per million by weight.

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Vendor to specify the means and degree of controlling through put.

Turndown capability of the filtration package should be based on a throughput of one-third (1/3) of the normal operation.

#### VI. EQUIPMENT CONSIDERATION

A rotary vacuum filter should be considered as the primary choice of equipment although a pressure filter, centrifuge or other equipment may be considered.

Should a rotary vacuum filter be furnished, included (but not necessarily limited to) should be; a) Vacuum Filter(s) with integral slurry tank, agitation and filter media. b) Precoat or filter aid facilitates as may be required, and for each filter supplied: filtrate pump and spare, chute for discharge of filter cake to a collection hopper at grade.

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#### VII. SITE CONDITIONS

- |                                |   |            |
|--------------------------------|---|------------|
| 1. Altitude (above sea level)  | - | 1315 ft.   |
| 2. Atmospheric Pressure        | - | 14.0 PSIA  |
| 3. Design Temperature - winter | - | (-) 25°F   |
| - summer                       | - | (+) 93°F   |
| 4. Location                    | - | Outdoors   |
| 5. Type of Operation           | - | Continuous |
| 6. Earthquake Zone             | - | I          |
| 7. Wind Loading                | - | 1590-40A1  |
| 8. Design Snow Loading         | - | 35 PSF     |

#### VIII. UTILITIES AVAILABLE

1. Power Motors:
 

|                    |   |                          |
|--------------------|---|--------------------------|
| 200 HP & Above     | - | 4000 V, 3 $\phi$ , 60 HZ |
| 3/4 HP thru 150 HP | - | 460 V, 3 $\phi$ , 60 HZ  |
| 1/2 HP & Below     | - | 115 V, 1 $\phi$ , 60 HZ  |
2. Cooling water for bearings and seals is available at 85°F and 40 PSIG at the equipment. The Vendor shall specify quantity required by the unit.

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#### IX. REFERENCES

- |            |   |                                    |
|------------|---|------------------------------------|
| 1590-31A3  | - | Centrifugal Pumps General Service  |
| 1590-38A1  | - | Induction Motors                   |
| 1590-40A1  | - | Wind, Snow, & Earthquake Loading   |
| 1590-50A2  | - | Gaskets & Surface                  |
| 1590-92A1  | - | Preparation for Shipment           |
| 1590-96A2  | - | Noise Specification                |
| 1590-1300B | - | General Notes Mechanical Equipment |



# MATERIAL REQUISITION

FOSTER WHEELER CORPORATION

PAGE 1 OF 5

FORM 135-20

|                                                      |                 |                           |         |
|------------------------------------------------------|-----------------|---------------------------|---------|
| FOR <u>ERDA-FE</u>                                   | F.W.REF.15-1591 | REQUISITION NUMBER        | DATE    |
| SITE <u>SIOUX FALLS, SOUTH DAKOTA</u>                |                 | 1591-1271-A               | 3-10-76 |
| MATERIAL <u>BAROMETRIC VACUUM SYSTEM</u>             |                 | SUPERSEDED BY CHANGE NO.: |         |
| ITEM <u>A-203</u>                                    |                 | C1 3-26-76                | C4      |
| ENERGY RESEARCH & DEVELOPMENT ADMIN. - FOSSIL ENERGY |                 | C2                        | C5      |
| CONTRACT NO. <u>ERDA-FE 14-32-0001-1521</u>          |                 | C3                        | C6      |

## INDEX

- I. SCOPE
- II. GENERAL
- III. BASIS OF DESIGN
- IV. MECHANICAL SPECIFICATIONS
- V. SITE CONDITIONS
- VI. STANDARDS AND SPECIFICATION

|     |         |           |
|-----|---------|-----------|
| BY: | P.O.NO. | SUPPLIER: |
|-----|---------|-----------|

I. SCOPE

C-1

This requisition is for the design, fabrication and supply of a package vacuum system for the evacuation of steam, air and process gases from a system operating at 3.75 PSIA and 153° F. These vapors, less any steam condensed in the vendor's equipment must be then boosted to a pressure of 3 1/4 PSIA. The required instrumentation shall be included as part of the package.

III. GENERAL

A. The design of all equipment of vendors supply will comply with all regulations applicable to the proposed location i.e. Sioux Falls, S.D. All materials to be of United States origin. Equipment shall be furnished in accordance with the Standards noted in Part VI of this specification as well as the applicable provisions of the latest revisions of the following codes, specifications, etc., which may be revised to adjust classification and addition made as necessary to assume good practice.

1. Electrical - NEC - Class 1 - Group D, Division - 2  
Class II- Group F, Division - 2
2. Safety - Federal Register (OSHA)
3. Other - State and Local Requirements

B. The following is required by ERDA-FE:

No subcontract shall be on a cost-plus-a-percentage-basis.

"This contract or purchase order pertains to the performance of ERDA-FE contract no. 14-32-0001-1521 between the United States and Foster Wheeler Energy Corporation and the sub contractor agrees that the Contracting Officer, ERDA-Fossil Energy or his authorized representative may inspect the plant and audit the books and records of the subcontractor with respect to work done or supplies, material and equipment furnished under this contract or purchase order."

Such requirements shall not apply to competitively advertised procurements, or standard "off the shelf" purchases of equipment or the subcontract or purchase order which is \$10,000 or less.

C. The design of the package should be based on the expected operating life of the pilot plant of 18 months.

All instruments and controls furnished as part of the requisition shall be identified as to make and model and be subject to purchase approval.

III. BASIS OF DESIGN

C-1

In the operating cases given below the term "start-up" does not mean short term evacuation but represents a true, continuously running condition and must be considered when evaluating economic alternatives. (see Sketch page 5)

Flow to E-215

|                  | <u>LBS/HR NORMAL</u> | <u>START-UP MAXIMUM</u> |
|------------------|----------------------|-------------------------|
| NH <sub>3</sub>  | 35.2                 | 59.3                    |
| CO <sub>2</sub>  | 32.1                 | 75.7                    |
| H <sub>2</sub> S | 7.8                  | 46.3                    |
| H <sub>2</sub> O | 5661.0               | 10210.0                 |
| AIR *            | 32.0                 | 33.0                    |
|                  | <u>5768.1</u>        | <u>10424.3</u>          |

\* The air loading is not an integral part of the system but represents mechanical leakage only which was estimated on the basis of the volume of the upstream (not vendor's) equipment using "Standards for Steam Jet Ejectors," by the Heat Exchange Institute. The vendor shall comment on the method of estimating air leakage and to account for additional leakage of air into his proposed equipment.

Precondenser E-215

Inlet pressure - 3.75 psia  
 Inlet temperature - 152°F

Second jet.

Discharge pressure - 34 psia  
 Discharge temperature - By Vendor

IV. MECHANICAL SPECIFICATIONS

C-1

- A. Approximately 9000 lbs/hr of process water will be available for direct use in the barometric condenser BC-201, with or without precooling in exchanger E-216. This water is available at 150°F and will contain approximately 400 ppm each of NH<sub>3</sub>, CO<sub>2</sub> and H<sub>2</sub>S.
- B. Steam - available at 150 PSIG with a 5-10°F superheat above saturation. Vendor shall state required quantity and pressure.
- C. Cooling water - available at 85°F for indirect use only. Vendor shall state quantity required.
- D. Materials of construction - Vendor to specify

C-1

V. SITE CONDITIONS

C-1

|                               |   |            |
|-------------------------------|---|------------|
| 1. Altitude (above sea level) | - | 1315 ft    |
| 2. Atmospheric pressure       | - | 14 psia    |
| 3. Design temp. summer        | - | (+) 93°F   |
| winter                        | - | (-) 25°F   |
| 4. Location                   | - | Outdoors   |
| 5. Type of operation          | - | Continuous |
| 6. Earthquake Zone            | - | I          |
| 7. Wind Loading               | - | 1590-40A1  |
| 8. Snow Loading               | - | 35 PSF     |

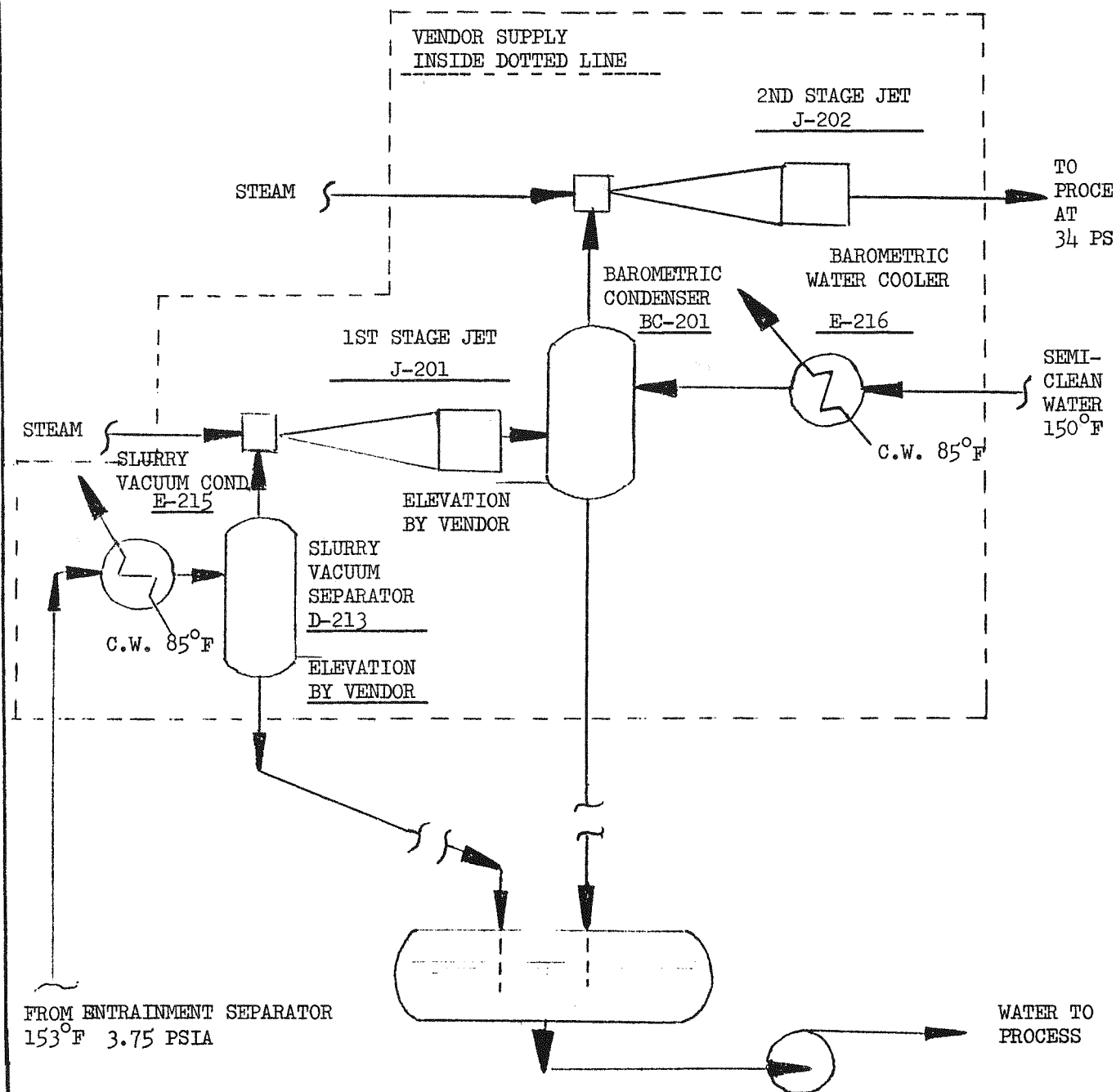
VI. STANDARDS AND JOB SPECIFICATIONS

C-1

A. The following documents shall be considered as a integral part of this Requisition:

1. 1590-10A1 Vessel Specification
2. 1590-40A1 Wind, Snow & Earthquake Loading
3. 1590-46A1 Structural Steel
4. 1590-46B19.1 & 2 Platforms
5. 1590-46B21.1 & 2 Ladders & Cages
6. 1590-50A2 Gaskets and Surface
7. 1590-83A1 Painting
8. 1590-92A1 Preparation for Shipment
9. 1590-96A2 Noise Specification
10. 1590-1100B General Notes
11. 1590-1200B General Notes
12. 1590-1900B General Notes

FLOW DIAGRAM



# MATERIAL REQUISITION

FOSTER WHEELER CORPORATION

PAGE 1 OF 7

FORM 135-20

|                                                         |                           |                    |                |
|---------------------------------------------------------|---------------------------|--------------------|----------------|
| FOR <u>ERDA-FE</u>                                      | F.W.REF. <u>15-1591</u>   | REQUISITION NUMBER | DATE           |
| SITE <u>SIOUX FALLS, SOUTH DAKOTA</u>                   |                           | <u>1591-1343-C</u> | <u>5/21/75</u> |
| MATERIAL <u>GAS SCRUBBER PACKAGE (A-204)</u>            | SUPERSEDED BY CHANGE NO.: |                    |                |
| <u>ENERGY RESEARCH &amp; DEVELOPMENT ADMINISTRATION</u> | C1                        | <u>6/17/75</u>     | C4             |
| <u>FOSSIL ENERGY LOCATION - NSP LAWRENCE STATION</u>    | C2                        | <u>6/30/75</u>     | C5             |
| <u>SIOUX FALLS, S.D.</u>                                | C3                        | <u>3/10/76</u>     | C6             |

## INDEX

- I SCOPE
- II GENERAL
- III BASIS OF DESIGN
- IV MECHANICAL SPECIFICATIONS
- V SITE CONDITIONS
- VI UTILITIES AVAILABLE
- VII STANDARDS AND JOB SPECIFICATIONS

|     |         |           |
|-----|---------|-----------|
| BY: | P.O.NO. | SUPPLIER: |
|-----|---------|-----------|

I. SCOPE

This requisition covers the design, fabrication and supply of a venturi-type scrubber system (including recirculating pump) to remove char particles and carbon dust from gasifier effluent gas. Vendor to confirm water requirements and advise on slurry concentration and blowdown rate. Package to include:

|           |                           |       |
|-----------|---------------------------|-------|
| S-202     | Gas Scrubber              | (c-3) |
| P-206 A/B | Gas Scrubber Pump & Spare | (c-3) |

II. GENERAL

- A. The design of all equipment of vendors supply will comply with all regulations applicable to the proposed location i.e. Sioux Falls, S.D. All materials to be of United States origin. Equipment shall be furnished in accordance with the standards noted in Part VII of this specification as well as the applicable provisions of the latest revisions of the following codes, specifications, etc., which may be revised to adjust classification and addition made as necessary to assume good practice.

1. Electrical - NEC- Class I - Group D, Division-2 (c-3)  
Class II - Group F, Division-2
2. Safety - Federal Register (OSHA)
3. Other - State & local requirements

- B. The following is required by ERDA-FE:

No subcontract shall be on a cost-plus-a-percentage-basis.

"This contract or purchase order pertains to the performance of ERDA-FE contract no. 14-32-0001-1521 between the United States and Foster Wheeler Energy Corporation and the subcontractor agrees that the Contracting Officer, ERDA-Fossil Energy or his authorized representative may inspect the plant and audit the books and records of the subcontractor with respect to work done or supplies, material and equipment furnished under this contract or purchase order."

<sup>1</sup> Such requirements shall not apply to competitively advertised procurements, or standard "off the shelf" purchases of equipment or the subcontract or purchase order which is \$10,000 or less.

III. BASIS OF DESIGN

## A. Gas Properties

1. Fluid Type: Effluent gas from coal gasification

2. Composition:

| <u>COMPONENTS</u> | <u>VOL %</u> |
|-------------------|--------------|
| CO <sub>2</sub>   | 8.49         |
| H <sub>2</sub> S  | 0.53         |
| COS               | .05          |
| CH <sub>4</sub>   | 3.57         |
| H <sub>2</sub>    | 12.44        |
| CO                | 17.56        |
| N <sub>2</sub>    | 47.58        |
| NH <sub>3</sub>   | 0.43         |
| H <sub>2</sub> O  | 9.35         |
| TOTAL             | 100.00       |

(c-3)



3. Pressure

a. Normal inlet pressure: 394 PSIG

b. Atmospheric Pressure: 14.0 PSIA

4. Temperature

a. Inlet temperature

Normal: 300°F (Gas Dew Point = 280°F)

(c-3)

b. Desired outlet temperature: 265°F

5. Flow

a. pounds / hour: 191,205

(c-3)

b. SCFM: 50,835 (@ 60°F, 14.7 PSIA)

(c-3)

6. Density: 1.24 lbs/ft<sup>3</sup> @ inlet conditions

(c-3)

7. Viscosity: 0.023 CPS @ inlet conditions



III. BASIS OF DESIGN (Cont'd)

A. Gas Properties (Cont'd)

8. Compressibility Factor = 1.00

B. Solids Properties

1. Densities - Two Cases

a. Case 1

Apparent particle density: 20 lbs/ft<sup>3</sup>

b. Case 2

Apparent particle density: 60 lbs/ft<sup>3</sup>

2. Design solids flowrates: (a) 1360 lb/hr @ Pp = 20 lb/ft<sup>3</sup>  
 (b) 1300 lb/hr @ Pp = 60 lb/ft<sup>3</sup>

3. Dust loading, grains/acf

a. At inlet : 20 lbs/ft<sup>3</sup> case = 62 GR/ACF 60 lb/ft<sup>3</sup> case = 59 GR/ACF

b. Required at outlet: less than 0.1 GR/ACF C-3

4. Particle Size Distribution

| SIZE RANGE<br>MICRONS | 20 LBS/FT <sup>3</sup> CASE<br>LBS/HR | 60 LBS/FT <sup>3</sup> CASE<br>LBS/HR |
|-----------------------|---------------------------------------|---------------------------------------|
| < 0.01                | 1                                     | 1                                     |
| 0.01 to 0.05          | 156                                   | 156                                   |
| 0.05 to 0.10          | 293                                   | 293                                   |
| 0.10 to 0.50          | 150                                   | 150                                   |
| 0.50 to 1.79          | 23                                    | 23                                    |
| 1.79 to 3.78          | 61                                    | 61                                    |
| 3.78 to 9.77          | 300                                   | 300                                   |
| 9.77 to 13.3          | 376                                   | 316                                   |
|                       | 1360                                  | 1300                                  |

C. Turndown: Scrubber will have turndown capability to 33 1/3%.

1. Inlet pressure at turndown: 122 PSIG

C-3

2. Gas flow at turndown

a. 66,395 lbs/hr

C-3

b. 16,945 SCFM (60°F, 14.7 PSIA)

C-3

3. Solids flow at turndown

a. 453 lbs/hr for 20 lbs/ft<sup>3</sup> case

b. 433 lbs/hr. for 60 lbs/ft<sup>3</sup> case

III. BASIS OF DESIGN

C. Turndown: Scrubber will have turndown capability to 33 1/3%.

4. Dust loading at turndown

- (a) 62 grains/ACF for 20 lbs/ft<sup>3</sup> case
- (b) 59 grains/ACF for 60 lbs/ft<sup>3</sup> case

IV. MECHANICAL SPECIFICATIONS

A. Design Conditions

- 1. Temperature = 400°F
- 2. Pressure = 470 psig

c-3

B. Maximum allowable pressure drop: 20 psi

c-3

C. Material of Construction - Vendor to specify.

D. Scrubber to be furnished with the following instrument connections as a minimum:

c-3

- Two (2) level control taps
- Two (2) level gauge taps
- One (1) thermocouple connection
- One (1) low level pump cut-off switch

V. SITE CONDITIONS

- |                               |   |            |
|-------------------------------|---|------------|
| 1. Altitude (above sea level) | - | 1315 ft    |
| 2. Atmospheric Pressure       | - | 14.0 psia  |
| 3. Design Temp. Summer        | - | 93°F       |
| Winter                        | - | -25°F      |
| 4. Location                   | - | Outdoors   |
| 5. Type of Operation          | - | Continuous |
| 6. Earthquake Zone            | - | I          |
| 7. Wind Loading               |   |            |
| 0-29 ft.                      | - | 20 psf     |
| 30-49 ft.                     | - | 25 psf     |
| 50-99 ft.                     | - | 30 psf     |
| 100-499 ft.                   | - | 40 psf     |

VI. UTILITIES AVAILABLE

- 1. Power - Motors
  - 1/2 hp & below - 115 v, 1Ø 60 hz
  - 3/4 hp to 150 hp - 460 v, 3 Ø 60 hz

VI. UTILITIES AVAILABLE (Cont'd)

2. Scrubbing Water

- a. Supply temperature: 180°F
- b. Supply pressure: 420 psig
- c. Contained Solids: 0.03 wt% suspended solids
- d. Dissolved gases: water at 180°F saturated with  $\text{NH}_3$ , COS,  $\text{H}_2\text{S}$  &  $\text{CO}_2$
- e. Flow rate: 14,089 lbs/hr

VII. STANDARDS AND JOB SPECIFICATIONS

- A. The following documents shall be considered as an integral part of this requisition:

(c-3)

- |                     |                                 |
|---------------------|---------------------------------|
| 1. 1590-10A1        | Vessel Specification            |
| 2. 1590-40A1        | Wind, Snow & Earthquake Loading |
| 3. 1590-46A1        | Structural Steel                |
| 4. 1590-46B19.1 & 2 | Platforms                       |
| 5. 1590-46B21.1 & 2 | Ladders & Cages                 |
| 6. 1590-50A2        | Gaskets and Surface             |
| 7. 1590-59B13.1     | RF Flanges                      |
| 8. 1590-83A1        | Painting                        |
| 9. 1590-92A1        | Preparation for shipment        |
| 10. 1590-96A2       | Noise Specification             |
| 11. 1590-1100B      | General Notes                   |
| 12. 1590-1900B      | General Notes                   |

FORM 45-80

|                                               |                              |                                    |                     |
|-----------------------------------------------|------------------------------|------------------------------------|---------------------|
| FOR <u>ERDA-FE</u>                            | F.W. CONTRACT <u>15-1591</u> | REQUISITION NO. <u>1591-1343 C</u> | DATE <u>6/12/75</u> |
| SITE <u>Sioux Falls, South Dakota</u>         |                              | SUPERSEDED BY CHANGE NO.           |                     |
| SERVICE <u>Gas Scrubber Pump</u>              |                              | C1                                 | C3                  |
| NO. REQ'D <u>2</u> ITEM NOS. <u>P-206 A/B</u> |                              | C2                                 | C4                  |
|                                               |                              | C5                                 | C6                  |

NO. OF MOTORS REQ'D. 2 : ITEM NOS. P-206A/B SUPPLIED BY \_\_\_\_\_ MOUNTED BY \_\_\_\_\_  
 NO. OF TURBINES REQ'D. \_\_\_\_\_ : ITEM NOS. \_\_\_\_\_ SUPPLIED BY \_\_\_\_\_ MOUNTED BY \_\_\_\_\_

PUMP MFR. \_\_\_\_\_ SIZE & MODEL \_\_\_\_\_ NO. STAGES \_\_\_\_\_

## OPERATING CONDITIONS, EACH PUMP:

LIQUID \_\_\_\_\_ U.S.GPM @ PT: MIN \_\_\_\_\_ NORM \_\_\_\_\_ RTD. \_\_\_\_\_  
 DISCH. PSIG \_\_\_\_\_ RTD. \_\_\_\_\_  
 P.T. °F. MAX \_\_\_\_\_ SUCT. PSIG (MAX. \_\_\_\_\_) RTD. \_\_\_\_\_  
 SP. GR. AT PT \_\_\_\_\_ DIFF. PSI \_\_\_\_\_  
 VAP. PSIA @ PT \_\_\_\_\_ TOTAL DIFF. HEAD, FT. \_\_\_\_\_  
 VIS. @ PT \_\_\_\_\_ NPSHA, FT. \_\_\_\_\_  
 CORR. EROS. FROM \_\_\_\_\_ HYD HP. \_\_\_\_\_

## CONSTRUCTION

NOZZLES \_\_\_\_\_ SIZE \_\_\_\_\_ ANSI RATING \_\_\_\_\_ FACING \_\_\_\_\_ LOCATION \_\_\_\_\_  
 SUCTION \_\_\_\_\_  
 DISCHARGE \_\_\_\_\_

CASE-MOUNT ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☐ IN-LINE ☐ \_\_\_\_\_

SPLIT: ☐ AXIAL ☐ RADIAL

VOLUTE: ☐ SINGLE ☐ DOUBLE ☐ DIFFUSER ☐ \_\_\_\_\_

DESIGN: \_\_\_\_\_ PSIG @ \_\_\_\_\_ °F. HYDRO TEST \_\_\_\_\_ PSIG

AUX. CONNECTS: ☐ VENTS ☐ DRAINS ☐ GAGES ☐ \_\_\_\_\_

IMPELLER: DIA.: RATED \_\_\_\_\_, MAX. \_\_\_\_\_, MIN. \_\_\_\_\_ TYPE \_\_\_\_\_

MOUNTING ☐ BETWEEN BEARINGS ☐ OVERHUNG ☐ \_\_\_\_\_

WEAR RINGS: ☐ INLET ONLY ☐ BOTH SIDES ☐ CASE ONLY ☐ CASE & IMPELL.

BEARINGS: TYPE: RADIAL = \_\_\_\_\_, THRUST = \_\_\_\_\_

LUBE: ☐ RING ☐ FLOOD ☐ FLINGER ☐ MIST ☐ PRESSURE

COUPLING: MFR: \_\_\_\_\_ MODEL: \_\_\_\_\_

DRIVER 1/2 MD BY: ☐ PUMP MFR. ☐ DRIVER MFR. ☐ PURCH.

GUARD TYPE: \_\_\_\_\_

PACKING: MFR & TYPE \_\_\_\_\_ SIZE \_\_\_\_\_ NO. RINGS \_\_\_\_\_

MECH. SEAL: MFR & MODEL \_\_\_\_\_ MFR'S CODE \_\_\_\_\_ API CODE \_\_\_\_\_

## AUXILIARY PIPING:

C.W. PIPE PLAN \_\_\_\_\_, WITH ☐ C.S. ☐ S.S. ☐ TUBING ☐ PIPE

TOTAL C.W. REQ'D. \_\_\_\_\_ GPM. INCLUDE: ☐ FLOW INDIC. ☐ VALVE "C"

PACKING INJECTION: FLUID= \_\_\_\_\_ @ \_\_\_\_\_ °F. REQ'D= \_\_\_\_\_ GPM @ \_\_\_\_\_ PSIG

SEAL FLUSH PLAN \_\_\_\_\_, WITH ☐ C.S. ☐ S.S. ☐ TUBING ☐ PIPE

EXT. FLUSH FLUID= \_\_\_\_\_ @ \_\_\_\_\_ °F. REQ'D= \_\_\_\_\_ GPM @ \_\_\_\_\_ PSIG

AUX. SEAL PLAN \_\_\_\_\_, WITH ☐ C.S. ☐ S.S. ☐ TUBING ☐ PIPE

QUENCH FLUID: \_\_\_\_\_

## MOTOR DRIVERS:

HP \_\_\_\_\_, S.F. \_\_\_\_\_, RPM \_\_\_\_\_, FRAME \_\_\_\_\_, 460 V/ 3 PH/ 60 HZ

MFR. \_\_\_\_\_, BEARINGS Ball LUBE Grease

TYPE Sq. Cage INSUL. CLASS B AMPS, FULL LOAD \_\_\_\_\_

ENCL. TEFC RISE °C \_\_\_\_\_ AMPS, LOCKED ROTOR \_\_\_\_\_

VERT. UNITS: ☐ VSS ☐ VHS THRUST CAP., LBS. \_\_\_\_\_ UP \_\_\_\_\_ DN. \_\_\_\_\_

## TURBINE DRIVERS:

☐ IF BY PUMP VENDOR SEE PAGE \_\_\_\_\_ ATTACHED

☐ IF BY OTHERS: MFR. \_\_\_\_\_ MODEL \_\_\_\_\_ BHP \_\_\_\_\_

APPLICABLE DOCUMENTS: 1590-31A3

1590-38A1

## PERFORMANCE

PROPOSAL CURVE NO. \_\_\_\_\_  
 RPM \_\_\_\_\_ NPSHR (WATER), FT. \_\_\_\_\_  
 MIN. CONTINUOUS U.S.GPM \_\_\_\_\_  
 ROTATION, VIEWING FROM COUPLING \_\_\_\_\_

## WITH RATED IMPELLER:

EFFICIENCY AT RATED POINT, % \_\_\_\_\_

IF EFF. IS VISCOUS, WATER EFF. = \_\_\_\_\_

BHP: RATED \_\_\_\_\_ NORM \_\_\_\_\_ MAX \_\_\_\_\_

IF HP IS VISC., RATED WATER BHP = \_\_\_\_\_

MAX. TOTAL HEAD, FT. \_\_\_\_\_

MAX. POSSIBLE DISCH. PRESS.: \_\_\_\_\_ PSIG

WITH RATED SUCT. PRESS. = \_\_\_\_\_

WITH MAX. SUCT. PRESS. = \_\_\_\_\_

## SHOP TESTS:

PERFORMANCE \_\_\_\_\_ REQUIRED \_\_\_\_\_ WITNESSED \_\_\_\_\_

NPSHR \_\_\_\_\_

## DISMANTLE &amp; INSPECT

HYDROTEST CASE \_\_\_\_\_

HYDROTEST BOWLS \_\_\_\_\_

## MATERIALS:

☐ PUMP API CLASS \_\_\_\_\_

☐ \_\_\_\_\_

## BASE PLATE

## VERTICAL PUMPS

THRUST, LBS. \_\_\_\_\_ UP, \_\_\_\_\_ DOWN

OTHER DETAILS PER PAGE NO. \_\_\_\_\_

## APPROX. WEIGHTS

(LBS NET EACH)

PUMP ONLY \_\_\_\_\_ MOTOR \_\_\_\_\_

BASE \_\_\_\_\_ TURBINE \_\_\_\_\_

## SITE DATA

AMBIENT 93 °F MAX TO 25 °F MIN. (c-3)

INSTALLED ☒ OUTDOORS ☐ INDOORS

☒ CL I-GRD-DIV 2 ☐ NON-HAZARDOUS

COOLING WATER: TYPE \_\_\_\_\_

°F & PSIG IN, °F MAX & PSIG OUT

## PAGE / OF /

70

# MATERIAL REQUISITION

FOSTER WHEELER CORPORATION

PAGE 1 OF 4

FORM 135-20

|                                                               |                 |                           |                |
|---------------------------------------------------------------|-----------------|---------------------------|----------------|
| FOR <u>ERDA-FE</u>                                            | F.W.REF.15-1591 | REQUISITION NUMBER        | DATE           |
| SITE <u>SIOUX FALLS, SOUTH DAKOTA</u>                         |                 | <u>1591-1342A</u>         | <u>3-22-76</u> |
| MATERIAL <u>SOLIDS STRIPPER ENTRAINMENT SEPARATOR (S-20L)</u> |                 | SUPERSEDED BY CHANGE NO.: |                |
| <u>ENERGY RESEARCH &amp; DEVELOPMENT ADMINISTRATION</u>       | <u>C1</u>       | <u>C4</u>                 |                |
| <u>FOSSIL ENERGY - LOCATION - NSP LAWRENCE STATION</u>        | <u>C2</u>       | <u>C5</u>                 |                |
| <u>SIOUX FALLS, S.D.</u>                                      | <u>C3</u>       | <u>C6</u>                 |                |

## INDEX

- I SCOPE
- II GENERAL
- III BASIS OF DESIGN
- IV MECHANICAL SPECIFICATIONS
- V SITE CONDITIONS
- VI STANDARDS AND JOB SPECIFICATIONS

|     |         |           |
|-----|---------|-----------|
| BY: | P.O.NO. | SUPPLIER: |
|-----|---------|-----------|

I. SCOPE

This specification covers the requirements for a scrubbing-type separator to remove char particles and carbon dust which may be entrained in the effluent vapor from a steam stripping tower. The scrubber shall consist of one or more stages of separating vanes with provision for contacting the gas with water via spray nozzles or other means.

II. GENERAL

A. The design of all equipment of vendors supply will comply with all regulations applicable to the proposed location i.e. Sioux Falls, S.D. All materials to be of United States origin. Equipment shall be furnished in accordance with the standards noted in Part VI of this specification as well as the applicable provisions of the latest revisions of the following codes, specifications, etc., as noted below which may be revised to adjust classification and addition made as necessary to assume good practice.

1. Safety - Federal Register (OSHA)
2. Other - State & local requirements

B. The following is required by ERDA-FE:

No subcontract shall be on a cost-plus-a-percentage-basis.

"This contract or purchase order pertains to the performance of ERDA-FE contract no. 14-32-0001-1521 between the United States and Foster Wheeler Energy Corporation and the subcontractor agrees that the Contracting Officer, ERDA-Fossil Energy or his authorized representative may inspect the plant and audit the books and records of the subcontractor with respect to work done or supplies, material and equipment furnished under this contract or purchase order."

Such requirements shall not apply to competitively advertised procurements, or standard "off the shelf" purchases of equipment or the subcontract or purchase order which is \$10,000 or less.

III. BASIS OF DESIGN

A. Process Gas Conditions

1. Gas Flow:

|            | <u>Normal</u> | <u>Maximum</u> |
|------------|---------------|----------------|
| lb/hr      | 3171          | 8060           |
| lb mols/hr | 173.9         | 439.1          |
| avg. M.W.  | 18.23         | 18.35          |

The gas is essentially steam with up to 2.5 vol % of contained gases consisting mainly of CO<sub>2</sub>, H<sub>2</sub>S & NH<sub>3</sub>.

2. Inlet Pressure: 20 PSIG (atmospheric press. = 14.0 PSIA)
3. Inlet Temperature: 260°F
4. Allowable Pressure Drop: 0.5 PSI max. including nozzle losses

B. Solids Removal

1. Quantity of solids to be removed is estimated to be 40-60 lbs/hr based on a mist entrainment of 2% by weight of the total vapor to be treated.
2. The separated solids and scrubbing water are to be discharged continuously and will be returned to the bottom of the stripper tower via Purchaser's piping.
3. Degree of solids removal: Vendor to specify.

C. Scrubbing Water

1. Quantity available: to 3 GPM (Vendor to state his requirements)
2. Water Temperature: 256°F
3. Pressure: Water is available at Vendor's required pressure



IV. MECHANICAL SPECIFICATIONS

- A. Design Pressure: 56 PSIG
- B. Design Temperature: 390°F
- C. Separator to be side inlet and mounted directly on the outlet nozzle (Conn. #2) of slurry stripper, T-204. Lugs shall be provided for support from T-204 as required.
- D. Material of Construction - Vendor to specify.

V. SITE CONDITIONS

- 1. Altitude (above sea level) - 1315 ft
- 2. Atmospheric Pressure - 14.0 psia
- 3. Design Temp. Summer 93°F
- Winter -25°F
- 4. Location - Outdoors
- 5. Type of Operation - Continuous

VI. STANDARDS AND JOB SPECIFICATIONS

- A. The following documents shall be considered as an integral part of this requisition:

- 1. 1590-10A1 Vessel Specification
- 2. 1590-46A1 Structural Steel
- 3. 1590-50A2 Gaskets and Surface
- 4. 1590-83A1 Painting
- 5. 1590-92A1 Preparation for shipment
- 6. 1590-1100B General Notes

# MATERIAL REQUISITION

FOSTER WHEELER CORPORATION

PAGE 1 OF 4

FORM 135-20

|                                                              |                 |                           |         |
|--------------------------------------------------------------|-----------------|---------------------------|---------|
| FOR <u>ERDA-FE</u>                                           | F.W.REF.15-1591 | REQUISITION NUMBER        | DATE    |
| SITE <u>SIOUX FALLS, SOUTH DAKOTA</u>                        |                 | 1591-1342E                | 3-22-76 |
| MATERIAL <u>VACUUM FLASHER ENTRAINMENT SEPARATOR (S-205)</u> |                 | SUPERSEDED BY CHANGE NO.: |         |
| ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION                 | C1              | C4                        |         |
| FOSSIL ENERGY - LOCATION - NSP LAWRENCE STATION              | C2              | C5                        |         |
| SIOUX FALLS, S.D.                                            | C3              | C6                        |         |

## INDEX

- I SCOPE
- II GENERAL
- III BASIS OF DESIGN
- IV MECHANICAL SPECIFICATIONS
- V SITE CONDITIONS
- VI STANDARDS AND JOB SPECIFICATIONS

|     |         |           |
|-----|---------|-----------|
| BY: | P.O.NO. | SUPPLIER: |
|-----|---------|-----------|

I. SCOPE

This specification covers the requirements for a scrubbing-type separator to remove char particles and carbon dust which may be entrained in the effluent vapor from a vacuum stripping tower. The scrubber shall consist of one or more stages of separating vanes with provision for contacting the gas with water via spray nozzles or other means.

II. GENERAL

A. The design of all equipment of vendors supply will comply with all regulations applicable to the proposed location i.e. Sioux Falls, S.D. All materials to be of United States origin. Equipment shall be furnished in accordance with the standards noted in Part VI of this specification as well as the applicable provisions of the latest revisions of the following codes, specifications, etc., as noted below which may be revised to adjust classification and made as necessary to assume good practice.

1. Safety - Federal Register (OSHA)
2. Other - State & Local Requirements

B. The following is required by ERDA-FE:

No subcontract shall be on a cost-plus-a-percentage-basis.

"This contract or purchase order pertains to the performance of ERDA-FE contract no. 14-32-0001-1521 between the United States and Foster Wheeler Energy Corporation and the subcontractor agrees that the Contracting Officer, ERDA-Fossil Energy or his authorized representative may inspect the plant and audit the books and records of the subcontractor with respect to work done or supplies, material and equipment furnished under this contract or purchase order."

Such requirements shall not apply to competitively advertised procurements, or standard "off the shelf" purchases of equipment or the contract or purchase order which is \$10,000 or less.

III. BASIS OF DESIGN

A. Process Gas Conditions

1. Gas Flow:

|            | <u>Normal</u> | <u>Maximum</u> |
|------------|---------------|----------------|
| lb/hr      | 5744          | 10,110         |
| lb mols/hr | 318           | 551            |
| avg. M.W.  | 18.06         | 18.35          |

The gas is essentially steam with up to 2.5 vol % of contained gases consisting mainly of CO<sub>2</sub>, H<sub>2</sub>S & NH<sub>3</sub>.

2. Inlet Pressure: 4 PSIA (atmospheric press. = 14.0 PSIA)
3. Inlet Temperature: 153°F
4. Allowable Pressure Drop: 0.25 PSI max. including nozzle losses

B. Solids Removal

1. Quantity of solids to be removed is estimated to be 40-60 lbs/hr based on a mist entrainment of 2% by weight of the total vapor to be treated.
2. The separated solids and scrubbing water are to be discharged continuously and will be returned to the bottom of the stripper tower via Purchaser's piping.
3. Degree of solids removal: Vendor to specify.

C. Scrubbing Water

1. Quantity available: to 3 GPM (Vendor to state his requirements)
2. Water Temperature: 153°F
3. Pressure: Water is available at Vendor's required pressure

IV. MECHANICAL SPECIFICATIONS

- A. Design Pressure: 16 PSIG & F.V.
- B. Design Temperature: 330°F
- C. Separator to be side inlet and mounted directly on the outlet nozzle (Conn. #1) of slurry stripper, T-205. Lugs shall be provided for support from T-205 as required.
- D. Material of Construction - Vendor to specify.

V. SITE CONDITIONS

- 1. Altitude (above sea level) - 1315 ft
- 2. Atmospheric Pressure - 14.0 psia
- 3. Design Temp. Summer - 93°F
- Winter - -25°F
- 4. Location - Outdoors
- 5. Type of Operation - Continuous

VI. STANDARDS AND JOB SPECIFICATIONS

- A. The following documents shall be considered as an integral part of this requisition:

- 1. 1590-10A1 Vessel Specification
- 2. 1590-46A1 Structural Steel
- 3. 1590-50A2 Gaskets and Surface
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- 5. 1590-92A1 Preparation for shipment
- 6. 1590-1100B General Notes

**FOSTER WHEELER ENERGY CORPORATION  
INSTRUMENT PROCESS DATA**

JOB NO. 15-1591  
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DATE 3/16/76 4/21/76  
PREPARED BY TP TP

ENG. FLOW SHEET NO. OP-751-576 (FS#24) SLURRY PROCESSING

79

| (1)<br><br>ITEM NUMBER<br>OR<br>SERVICE<br><br>FLOW INSTRUMENTS | (2)<br><br>NOM.<br>LINE<br>SIZE | (3)<br><br>FLUID TYPE<br>&<br>STATE | (4)<br><br>NORMAL<br>ID/H | FLOW % |      | SP. GR. AT. |       | (9)<br><br>MOL. WT. | (10)<br><br>VISC. CPS.<br>@ TEMP. | (11)<br><br>LIQ. VAPOR<br>PR. SS. PSIA | (12)<br><br>LIQ. CRITICAL<br>PRESS. lb/in <sup>2</sup> a | (13)<br><br>VAPOR<br>COMP. FACTOR | (14)<br><br>VAPOR<br>Cp/Cv | (15)<br><br>NORM. OP.<br>TEMP. °F | PRESSURES<br>AT NORM.<br>FLOW    |                                         | PRESSURES<br>AT MAX.<br>FLOW     |                                         | PRESSURES<br>AT MIN.<br>FLOW     |                                         | (18)<br><br>DOWNSTREAM<br>FLASHING | (19)<br><br>TIGHT<br>SHUTOFF | (20)<br><br>AIR<br>FAILURE | (21)<br><br>REMARKS AND/OR<br>ALARM AND<br>SHUTDOWN SETTINGS | (22)<br><br>REVISION |   |
|-----------------------------------------------------------------|---------------------------------|-------------------------------------|---------------------------|--------|------|-------------|-------|---------------------|-----------------------------------|----------------------------------------|----------------------------------------------------------|-----------------------------------|----------------------------|-----------------------------------|----------------------------------|-----------------------------------------|----------------------------------|-----------------------------------------|----------------------------------|-----------------------------------------|------------------------------------|------------------------------|----------------------------|--------------------------------------------------------------|----------------------|---|
|                                                                 |                                 |                                     |                           | (5)    | (6)  | (7)         | (8)   |                     |                                   |                                        |                                                          |                                   |                            |                                   | (16a)                            | (17a)                                   | (16b)                            | (17b)                                   | (16c)                            | (17c)                                   |                                    |                              |                            |                                                              |                      |   |
|                                                                 |                                 |                                     |                           | MAX.   | MIN. | 60°F        | COND. |                     |                                   |                                        |                                                          |                                   |                            |                                   | UPSTREAM<br>lb/in <sup>2</sup> a | DOWN-<br>STREAM<br>lb/in <sup>2</sup> a | UPSTREAM<br>lb/in <sup>2</sup> a | DOWN-<br>STREAM<br>lb/in <sup>2</sup> a | UPSTREAM<br>lb/in <sup>2</sup> a | DOWN-<br>STREAM<br>lb/in <sup>2</sup> a |                                    |                              |                            |                                                              |                      |   |
| SLURRY TO T-204                                                 |                                 |                                     | NORMAL:                   |        |      |             |       |                     |                                   |                                        |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                              |                      | 1 |
| FT-2201                                                         | 4"                              | CHAR SLURRY                         | 17000 H <sub>2</sub> O    |        |      | 1.0         | .977  | .74                 | .27                               | .6                                     |                                                          |                                   |                            | 260                               | 35                               | -                                       | -                                | -                                       | -                                | -                                       | ~10%                               | -                            | -                          | AVOID INTERNAL OBSTRUCTIONS                                  | 1                    |   |
|                                                                 |                                 |                                     | 1000                      |        |      |             |       |                     |                                   |                                        |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                              | 1                    |   |
|                                                                 |                                 |                                     | SOLIDS                    |        |      |             |       |                     |                                   |                                        |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                              |                      |   |
| FR-2201                                                         |                                 |                                     | MAXIMUM:                  |        |      |             |       |                     |                                   |                                        |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                              |                      |   |
|                                                                 |                                 |                                     | 80900 H <sub>2</sub> O    |        | 30   |             |       |                     |                                   |                                        |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                              |                      |   |
|                                                                 |                                 |                                     | 13500                     |        |      |             |       |                     |                                   |                                        |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                              |                      |   |
|                                                                 |                                 |                                     | SOLIDS                    |        |      |             |       |                     |                                   |                                        |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                              |                      |   |
| STEAM TO T-204                                                  |                                 |                                     |                           |        |      |             |       |                     |                                   |                                        |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                              |                      |   |
| FT-2202                                                         | 6"                              | LP STEAM                            | 8000                      | 120    | 30   |             |       | 18.02               | .016                              |                                        |                                                          |                                   |                            | 307                               | 74                               | 72                                      | 72                               | 70                                      | 79                               | 77                                      |                                    |                              |                            |                                                              |                      |   |
| FIC-2202                                                        |                                 |                                     |                           |        |      |             |       |                     |                                   |                                        |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                              |                      |   |
| FV-2202                                                         | 6"                              | LP STEAM                            | 8000                      | 120    | 30   |             |       | 18.02               | .016                              |                                        |                                                          |                                   |                            | 307                               | 72                               | 34                                      | 70                               | 34                                      | 77                               | 34                                      | -                                  | NO                           | C                          |                                                              |                      |   |
|                                                                 |                                 |                                     |                           |        |      |             |       |                     |                                   |                                        |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                              |                      |   |
| STEAM TO T-205                                                  |                                 |                                     |                           |        |      |             |       |                     |                                   |                                        |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                              |                      |   |
| FT-2203                                                         | 4"                              | LP STEAM                            | 5000                      | 120    | 20   |             |       | 18.02               | .016                              |                                        |                                                          |                                   |                            | 307                               | 74                               | 72                                      | 72                               | 70                                      | 79                               | 77                                      |                                    |                              |                            |                                                              |                      |   |
| FIC-2203                                                        |                                 |                                     |                           |        |      |             |       |                     |                                   |                                        |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                              |                      |   |
| FV-2203                                                         | 4"/6"                           | LP STEAM                            | 5000                      | 120    | 20   |             |       | 18.02               | .016                              |                                        |                                                          |                                   |                            | 307                               | 72                               | 4                                       | 70                               | 4                                       | 77                               | 4                                       | -                                  | NO                           | C                          |                                                              |                      |   |
|                                                                 |                                 |                                     |                           |        |      |             |       |                     |                                   |                                        |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                              |                      |   |
|                                                                 |                                 |                                     |                           |        |      |             |       |                     |                                   |                                        |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                              |                      |   |
|                                                                 |                                 |                                     |                           |        |      |             |       |                     |                                   |                                        |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                              |                      |   |
| FT-2204 (WATER TO S-204)                                        | 1"                              | PROCESS<br>WATER                    | 1500                      | 120    | 30   | 1.0         | .94   |                     | .18                               | 33                                     | 3206                                                     |                                   |                            | 256                               | 518                              | 516                                     | -                                | -                                       | -                                | -                                       | -                                  | -                            | -                          |                                                              |                      | 1 |
| FI-2204                                                         |                                 |                                     |                           |        |      |             |       |                     |                                   |                                        |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                              |                      | 1 |
| FT-2207 (WATER TO S-205)                                        | 1"                              | PROCESS<br>WATER                    | 1500                      | 120    | 30   | 1.0         | .98   |                     | .45                               | 4                                      | 3206                                                     |                                   |                            | 153                               | 494                              | 492                                     | -                                | -                                       | -                                | -                                       | -                                  | -                            | -                          |                                                              |                      | 1 |
| FI-2207                                                         |                                 |                                     |                           |        |      |             |       |                     |                                   |                                        |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                              |                      | 1 |
|                                                                 |                                 |                                     |                           |        |      |             |       |                     |                                   |                                        |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                              |                      |   |
| FT-2206 (STEAM TO SETS)                                         | 2"                              | MP STEAM                            | 1300                      | 120    | 30   |             |       | 18.02               | .016                              |                                        |                                                          |                                   |                            | 410                               | 164                              | 162                                     | -                                | -                                       | -                                | -                                       | -                                  | -                            | -                          |                                                              |                      | 1 |
| FI-2206                                                         |                                 |                                     |                           |        |      |             |       |                     |                                   |                                        |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                              |                      | 1 |
| FCV-2208 (P-211 A)                                              | 4"                              | PROCESS<br>WATER                    | *                         | -      | -    | 1.0         | .98   |                     | .45                               | 4.0                                    | 3206                                                     |                                   |                            | 153                               | 494                              | 15                                      | -                                | -                                       | -                                | -                                       | -                                  | -                            | -                          | *FLOW FOLLOWING PUMP SELECTION<br>USE YARWAY ARC OR EQUAL    |                      |   |
| FCV-2209 (P-211 B)                                              | 4"                              | PROCESS<br>WATER                    | *                         | -      | -    | 1.0         | .98   |                     | .45                               | 4.0                                    | 3206                                                     |                                   |                            | 153                               | 494                              | 15                                      | -                                | -                                       | -                                | -                                       | -                                  | -                            | -                          |                                                              |                      |   |
|                                                                 |                                 |                                     |                           |        |      |             |       |                     |                                   |                                        |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                              |                      |   |
|                                                                 |                                 |                                     |                           |        |      |             |       |                     |                                   |                                        |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                              |                      |   |
|                                                                 |                                 |                                     |                           |        |      |             |       |                     |                                   |                                        |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                              |                      |   |
|                                                                 |                                 |                                     |                           |        |      |             |       |                     |                                   |                                        |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                              |                      |   |

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ENG. FLOW SHEET NO. OP-751-576 (FS#24) SLURRY PROCESSING

FORM NO (110)-25B

JOB NO. 15-1591

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PREPARED BY TP TP

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**FOSTER WHEELER ENERGY CORPORATION  
INSTRUMENT PROCESS DATA**

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PREPARED BY TP TP

ENG. FLOW SHEET NO. OP-751-576 (FS#24) SLURRY PROCESSING

| (1)<br><br>ITEM NUMBER<br>OR<br>SERVICE | (2)<br><br>NOM.<br>LINE<br>SIZE | (3)<br><br>FLUID TYPE<br>&<br>STATE                            | (4)<br><br>NORMAL<br>lb/h | FLOW % |      | SP. GR. AT. |       | (9)<br><br>MOLE WT. | (10)<br><br>VISC. CPS.<br>TEMP. | (11)<br><br>LIQ. VAPOR<br>PRESS. PSIA | (12)<br><br>LIQ. CRITICAL<br>PRESS. lb/in <sup>2</sup> a | (13)<br><br>VAPOR<br>COMP. FACTOR | (14)<br><br>VAPOR<br>CP/Cv | (15)<br><br>NORM. OP.<br>TEMP. °F | PRESSURES<br>AT NORM.<br>FLOW    |                                         | PRESSURES<br>AT MAX.<br>FLOW     |                                         | PRESSURES<br>AT MIN.<br>FLOW     |                                         | (18)<br><br>DOWNSTREAM<br>FLASHING | (19)<br><br>TIGHT<br>SHUTOFF | (20)<br><br>AIR<br>FAILURE | (21)<br><br>REMARKS AND/OR<br>ALARM AND<br>SHUTDOWN SETTINGS                                                                     | (22)<br><br>REVISION |
|-----------------------------------------|---------------------------------|----------------------------------------------------------------|---------------------------|--------|------|-------------|-------|---------------------|---------------------------------|---------------------------------------|----------------------------------------------------------|-----------------------------------|----------------------------|-----------------------------------|----------------------------------|-----------------------------------------|----------------------------------|-----------------------------------------|----------------------------------|-----------------------------------------|------------------------------------|------------------------------|----------------------------|----------------------------------------------------------------------------------------------------------------------------------|----------------------|
|                                         |                                 |                                                                |                           | (5)    | (6)  | (7)         | (8)   |                     |                                 |                                       |                                                          |                                   |                            |                                   | (16a)                            | (17a)                                   | (16b)                            | (17b)                                   | (16c)                            | (17c)                                   |                                    |                              |                            |                                                                                                                                  |                      |
|                                         |                                 |                                                                |                           | MAX.   | MIN. | 60°F        | COND. |                     |                                 |                                       |                                                          |                                   |                            |                                   | UPSTREAM<br>lb/in <sup>2</sup> a | DOWN-<br>STREAM<br>lb/in <sup>2</sup> a | UPSTREAM<br>lb/in <sup>2</sup> a | DOWN-<br>STREAM<br>lb/in <sup>2</sup> a | UPSTREAM<br>lb/in <sup>2</sup> a | DOWN-<br>STREAM<br>lb/in <sup>2</sup> a |                                    |                              |                            |                                                                                                                                  |                      |
| PRESSURE INSTRUMENTS                    |                                 |                                                                |                           |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                                                                                                  |                      |
| PI-2209 (T-204)                         | -                               | WATER SOLIDS                                                   | -                         |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            | 260                               | 35                               | -                                       | -                                | -                                       | -                                | -                                       | -                                  | -                            | -                          |                                                                                                                                  |                      |
|                                         |                                 | DISSOLVED                                                      |                           |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                                                                                                  |                      |
|                                         |                                 | GAS                                                            |                           |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                                                                                                  |                      |
| PI-2201 (P-208 A/B)                     | 4"                              | WATER SOLIDS                                                   | -                         |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            | 260                               | 66                               | -                                       | -                                | -                                       | -                                | -                                       | -                                  | -                            | -                          |                                                                                                                                  |                      |
|                                         |                                 | DISSOLVED                                                      |                           |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                                                                                                  |                      |
|                                         |                                 | GAS                                                            |                           |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                                                                                                  |                      |
| PI-2202                                 | 4"                              | WATER SOLIDS                                                   | -                         |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            | 260                               | 66                               | -                                       | -                                | -                                       | -                                | -                                       | -                                  | -                            | -                          |                                                                                                                                  |                      |
|                                         |                                 | DISSOLVED                                                      |                           |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                                                                                                  |                      |
|                                         |                                 | GAS                                                            |                           |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                                                                                                  |                      |
| PT-2210 (OUT T-205)                     | 16"                             | STEAM &<br>NH <sub>3</sub> , H <sub>2</sub> O, CO <sub>2</sub> | -                         |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            | 153                               | 4*                               |                                         |                                  |                                         | 29*                              |                                         |                                    |                              |                            | *NOTE VACUUM: OVERPRESSURE<br>PROTECTION REQ'S<br>USE COMPOUND GAGE TO READ<br>0-14 PSIG VACUUM<br>& 0-10 PSIG POSITIVE PRESSURE |                      |
|                                         |                                 |                                                                |                           |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                                                                                                  |                      |
| PI-2210                                 |                                 |                                                                |                           |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                                                                                                  |                      |
| PI-2212 (STEAM TO JETS)                 | 2"                              | MP STEAM                                                       | -                         |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            | 410                               | 164                              | -                                       | -                                | -                                       | -                                | -                                       | -                                  | -                            | -                          |                                                                                                                                  |                      |
|                                         |                                 |                                                                |                           |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                                                                                                  |                      |
| PI-2207 (P-209 A/B)                     | 2"                              | SOUR WATER                                                     | -                         |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            | 145                               | 81                               | -                                       | -                                | -                                       | -                                | -                                       | -                                  | -                            | -                          |                                                                                                                                  |                      |
| PI-2208                                 | 2"                              | SOUR WATER                                                     | -                         |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            | 145                               | 81                               | -                                       | -                                | -                                       | -                                | -                                       | -                                  | -                            | -                          |                                                                                                                                  |                      |
|                                         |                                 |                                                                |                           |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                                                                                                  |                      |
| PI-2213 (STEAM EX J-202)                | 3"                              | SOUR STEAM                                                     | -                         |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            | 300                               | 34                               | -                                       | -                                | -                                       | -                                | -                                       | -                                  | -                            | -                          |                                                                                                                                  |                      |
|                                         |                                 |                                                                |                           |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                                                                                                  |                      |
| PI-2203 (P-210 A/B)                     | 4"                              | WATER SOLIDS                                                   | -                         |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            | 153                               | 42                               | -                                       | -                                | -                                       | -                                | -                                       | -                                  | -                            | -                          |                                                                                                                                  |                      |
|                                         |                                 | DISSOLVED                                                      |                           |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                                                                                                  |                      |
|                                         |                                 | GAS                                                            |                           |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                                                                                                  |                      |
| PI-2204                                 | 4"                              | WATER SOLIDS                                                   | -                         |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            | 153                               | 42                               | -                                       | -                                | -                                       | -                                | -                                       | -                                  | -                            | -                          |                                                                                                                                  |                      |
|                                         |                                 |                                                                |                           |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                                                                                                  |                      |
| PI-2205 (P-211 A/B)                     | 4"                              | PROCESS                                                        | -                         |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            | 153                               | 494                              | -                                       | -                                | -                                       | (594)                            | -                                       | -                                  | -                            | -                          |                                                                                                                                  |                      |
|                                         |                                 | WATER                                                          |                           |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                                                                                                  |                      |
| PI-2206                                 | 4"                              | PROCESS                                                        | -                         |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            | 153                               | 494                              | -                                       | -                                | -                                       | (594)                            | -                                       | -                                  | -                            | -                          |                                                                                                                                  |                      |
|                                         |                                 | WATER                                                          |                           |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                                                                                                  |                      |
| PI-2211 (D-213)                         | -                               | SOUR STEAM                                                     | -                         |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            | *                                 | *                                |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            | *PENDING VENDOR INFORMATION                                                                                                      | 1                    |
|                                         |                                 |                                                                |                           |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                                                                                                  |                      |
| PI-2214 (BC-201)                        | -                               | SOUR STEAM                                                     | -                         |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            | *                                 | *                                |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            | *PENDING VENDOR INFORMATION                                                                                                      | 1                    |
|                                         |                                 |                                                                |                           |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                                                                                                  |                      |
|                                         |                                 |                                                                |                           |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                                                                                                  |                      |
|                                         |                                 |                                                                |                           |        |      |             |       |                     |                                 |                                       |                                                          |                                   |                            |                                   |                                  |                                         |                                  |                                         |                                  |                                         |                                    |                              |                            |                                                                                                                                  |                      |

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ENG. FLOW SHEET NO. 23 (OP-751-575) SOUR WATER STRIPPING

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ENG. FLOW SHEET NO. 23 (OP-751-575) SOUR WATER STRIPPING

| (1)<br>ITEM NUMBER<br>OR<br>SERVICE | (2)<br>NOM.<br>LINE<br>SIZE | (3)<br>FLUID TYPE<br>&<br>STATE | (4)<br>NORMAL<br>lb/h | FLOW %      |             | SP. GR. AT. |              | (9)<br>MOL. WT. | (10)<br>VISC. CPS.<br>° TEMP. | (11)<br>LIQ. VAPOR<br>PRESS. PSIA | (12)<br>LIQ. CRITICAL<br>PRESS. lb/in <sup>2</sup> | (13)<br>VAPOR<br>COMP. FACTOR | (14)<br>VAPOR<br>Cp/Cv | (15)<br>NORM. OP.<br>TEMP. °F | PRESSURES<br>AT NORM.<br>FLOW           |                                                | PRESSURES<br>AT MAX.<br>FLOW            |                                                | PRESSURES<br>AT MIN.<br>FLOW            |                                                | (18)<br>DOWNSTREAM<br>FLASHING | (19)<br>TIGHT<br>SHUTOFF | (20)<br>AIR<br>FAILURE | (21)<br>REMARKS AND/OR<br>ALARM AND<br>SHUTDOWN SETTINGS         | (22)<br>REVISION |
|-------------------------------------|-----------------------------|---------------------------------|-----------------------|-------------|-------------|-------------|--------------|-----------------|-------------------------------|-----------------------------------|----------------------------------------------------|-------------------------------|------------------------|-------------------------------|-----------------------------------------|------------------------------------------------|-----------------------------------------|------------------------------------------------|-----------------------------------------|------------------------------------------------|--------------------------------|--------------------------|------------------------|------------------------------------------------------------------|------------------|
|                                     |                             |                                 |                       | (5)<br>MAX. | (6)<br>MIN. | (7)<br>60°F | (8)<br>COND. |                 |                               |                                   |                                                    |                               |                        |                               | (16a)<br>UPSTREAM<br>lb/in <sup>2</sup> | (17a)<br>DOWN-<br>STREAM<br>lb/in <sup>2</sup> | (16b)<br>UPSTREAM<br>lb/in <sup>2</sup> | (17b)<br>DOWN-<br>STREAM<br>lb/in <sup>2</sup> | (16c)<br>UPSTREAM<br>lb/in <sup>2</sup> | (17c)<br>DOWN-<br>STREAM<br>lb/in <sup>2</sup> |                                |                          |                        |                                                                  |                  |
| LV-2106 (P-204 DISCH)               | 1 1/2"                      | WATER & DIS-<br>SOLVED GAS      | 6570                  | 135         | 50          | 1.1         | 1.0          |                 | .15                           | 28                                | 2559                                               |                               |                        | 202                           | 69                                      | 55                                             | 68                                      | 56                                             | 79                                      | 31                                             | -                              | -                        | 0                      | *CRITICAL PRESSURE INCLUDES CON-<br>TRIBUTION OF DISSOLVED GASES | 1                |
| LT-2111 (D-212)                     | -                           | WATER & DIS-<br>SOLVED GAS      | -                     | -           | -           | 1.0         | .91          |                 | .16                           | 28                                |                                                    |                               |                        | 200                           | 28                                      | -                                              | -                                       | -                                              | 64                                      | -                                              | -                              | -                        | -                      |                                                                  |                  |
| LIC-2111                            | -                           |                                 | -                     | -           | -           | -           | -            |                 |                               |                                   |                                                    |                               |                        |                               |                                         |                                                |                                         |                                                |                                         |                                                |                                |                          |                        | RESET FIC-                                                       |                  |
| LSH-2111                            | -                           |                                 | -                     | -           | -           | -           | -            |                 |                               |                                   |                                                    |                               |                        |                               |                                         |                                                |                                         |                                                |                                         |                                                |                                |                          |                        | 5'-0" ABOVE T.L.                                                 |                  |
| LAH-2111                            | -                           |                                 | -                     | -           | -           | -           | -            |                 |                               |                                   |                                                    |                               |                        |                               |                                         |                                                |                                         |                                                |                                         |                                                |                                |                          |                        | 0'-6" ABOVE T.L.                                                 |                  |
| LSL-2111                            | -                           |                                 | -                     | -           | -           | -           | -            |                 |                               |                                   |                                                    |                               |                        |                               |                                         |                                                |                                         |                                                |                                         |                                                |                                |                          |                        |                                                                  |                  |
| LAL-2111                            | -                           |                                 | -                     | -           | -           | -           | -            |                 |                               |                                   |                                                    |                               |                        |                               |                                         |                                                |                                         |                                                |                                         |                                                |                                |                          |                        |                                                                  |                  |
| LV-2111 (P-213 DISCH)               | 2"                          | WATER & DIS-<br>SOLVED GAS      | 14500                 | 135         | 50          | .95         | .91          |                 | .16                           | 28                                | 2559                                               |                               |                        | 200                           | 77                                      | 63                                             | 76                                      | 64                                             | 90                                      | 28                                             | -                              | -                        | 0                      | *CRITICAL PRESSURE INCLUDES CON-<br>TRIBUTION OF DISSOLVED GASES | 1                |
| LG-2103 (T-202)                     | -                           | WATER & DIS-<br>SOLVED GAS      | -                     | -           | -           | 1.0         | .93          |                 |                               |                                   |                                                    |                               |                        | 248                           | 35                                      | -                                              | -                                       | -                                              | 67                                      | -                                              | -                              | -                        | -                      |                                                                  |                  |
| LG-2105 (D-202)                     | -                           | WATER & DIS-<br>SOLVED GAS      | -                     | -           | -           | 1.1         | 1.0          |                 |                               |                                   |                                                    |                               |                        | 202                           | 28                                      | -                                              | -                                       | -                                              | 64                                      | -                                              | -                              | -                        | -                      |                                                                  |                  |
| LG-2109 (T-203)                     | -                           | WATER & DIS-<br>SOLVED GAS      | -                     | -           | -           | 1.0         | .94          |                 |                               |                                   |                                                    |                               |                        | 256                           | 35                                      | -                                              | -                                       | -                                              | 67                                      | -                                              | -                              | -                        | -                      |                                                                  |                  |
| LG-2112 (D-212)                     | -                           | WATER & DIS-<br>SOLVED GAS      | -                     | -           | -           | 1.0         | .91          |                 |                               |                                   |                                                    |                               |                        | 200                           | 28                                      | -                                              | -                                       | -                                              | 64                                      | -                                              | -                              | -                        | -                      |                                                                  |                  |
| LG-2102 (E-211)                     | -                           | STEAM                           | -                     | -           | -           | 1.0         | .92          |                 |                               |                                   |                                                    |                               |                        | 307                           | 74                                      | -                                              | -                                       | -                                              | 104                                     | -                                              | -                              | -                        | -                      |                                                                  |                  |
| LG-2108 (E-212)                     | -                           | CONDENSATE                      | -                     | -           | -           | 1.0         | .92          |                 |                               |                                   |                                                    |                               |                        | 307                           | 74                                      | -                                              | -                                       | -                                              | 104                                     | -                                              | -                              | -                        | -                      |                                                                  |                  |
|                                     |                             | CONDENSATE                      |                       |             |             |             |              |                 |                               |                                   |                                                    |                               |                        |                               |                                         |                                                |                                         |                                                |                                         |                                                |                                |                          |                        |                                                                  |                  |
| TT-2108 (EX E-210)                  | 6"                          | WATER &<br>VAPORS               | -                     |             |             |             |              |                 |                               |                                   |                                                    |                               |                        | 202                           | -                                       | -                                              | -                                       | -                                              | -                                       | -                                              | -                              | -                        | -                      |                                                                  |                  |
| TIC-2108                            |                             |                                 |                       |             |             |             |              |                 |                               |                                   |                                                    |                               |                        |                               |                                         |                                                |                                         |                                                |                                         |                                                |                                |                          |                        |                                                                  |                  |
| TSL-2108                            |                             |                                 |                       |             |             |             |              |                 |                               |                                   |                                                    |                               |                        |                               |                                         |                                                |                                         |                                                |                                         |                                                |                                |                          |                        | SET @ 175°F                                                      |                  |
| TAL-2108                            |                             |                                 |                       |             |             |             |              |                 |                               |                                   |                                                    |                               |                        |                               |                                         |                                                |                                         |                                                |                                         |                                                |                                |                          |                        |                                                                  |                  |
| TV-2108 (CW EX E-210)               | 6"                          | COOLING<br>WATER                | 248000                | 135         | 50          | 1.0         | 1.0          |                 | .65                           | 1.1                               | 3206                                               |                               |                        | 110                           | 48                                      | 38                                             | 42                                      | 41                                             | 50                                      | 38                                             | -                              | NO                       | 0                      |                                                                  |                  |
| TR-2108                             |                             |                                 |                       |             |             |             |              |                 |                               |                                   |                                                    |                               |                        |                               |                                         |                                                |                                         |                                                |                                         |                                                |                                |                          |                        |                                                                  |                  |
| TT-2115 (EX E-217)                  | 6"                          | WATER &<br>VAPORS               | -                     | -           | -           |             |              |                 |                               |                                   |                                                    |                               |                        | 200                           | -                                       | -                                              | -                                       | -                                              | -                                       | -                                              | -                              | -                        | -                      |                                                                  |                  |
| TIC-2115                            |                             |                                 |                       |             |             |             |              |                 |                               |                                   |                                                    |                               |                        |                               |                                         |                                                |                                         |                                                |                                         |                                                |                                |                          |                        |                                                                  |                  |
| TSL-2115                            |                             |                                 |                       |             |             |             |              |                 |                               |                                   |                                                    |                               |                        |                               |                                         |                                                |                                         |                                                |                                         |                                                |                                |                          |                        | SET @ 175°F                                                      |                  |
| TAL-2115                            |                             |                                 |                       |             |             |             |              |                 |                               |                                   |                                                    |                               |                        |                               |                                         |                                                |                                         |                                                |                                         |                                                |                                |                          |                        |                                                                  |                  |

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ENG. FLOW SHEET NO. 23 (OP-751-575) SOUR WATER STRIPPING

| (1)<br>ITEM NUMBER<br>OR<br>SERVICE | (2)<br>NOM.<br>LINE<br>SIZE | (3)<br>FLUID TYPE<br>&<br>STATE                                         | (4)<br>NORMAL<br>lb/h | FLOW %      |             | SP. GR. AT. |              | (9)<br>MOL. WT. | (10)<br>VISC. CPS.<br>@ TEMP. | (11)<br>LIQ. VAPOR<br>PRESS. PSIA | (12)<br>LIQ. CRITICAL<br>PRESS. lb/in <sup>2</sup> a | (13)<br>VAPOR<br>COMP. FACTOR | (14)<br>VAPOR<br>CP/CV | (15)<br>NORM. OP.<br>TEMP. °F | PRESSURES<br>AT NORM.<br>FLOW             |                                                  | PRESSURES<br>AT MAX.<br>FLOW              |                                                  | PRESSURES<br>AT MIN.<br>FLOW              |                                                  | (18)<br>DOWNSTREAM<br>FLASHING | (19)<br>TIGHT<br>SHUTOFF | (20)<br>AIR<br>FAILURE | (21)<br>REMARKS AND/OR<br>ALARM AND<br>SHUTDOWN SETTINGS | (22)<br>REVISION |
|-------------------------------------|-----------------------------|-------------------------------------------------------------------------|-----------------------|-------------|-------------|-------------|--------------|-----------------|-------------------------------|-----------------------------------|------------------------------------------------------|-------------------------------|------------------------|-------------------------------|-------------------------------------------|--------------------------------------------------|-------------------------------------------|--------------------------------------------------|-------------------------------------------|--------------------------------------------------|--------------------------------|--------------------------|------------------------|----------------------------------------------------------|------------------|
|                                     |                             |                                                                         |                       | (5)<br>MAX. | (6)<br>MIN. | (7)<br>60°F | (8)<br>COND. |                 |                               |                                   |                                                      |                               |                        |                               | (16a)<br>UPSTREAM<br>lb/in <sup>2</sup> a | (17a)<br>DOWN-<br>STREAM<br>lb/in <sup>2</sup> a | (16b)<br>UPSTREAM<br>lb/in <sup>2</sup> a | (17b)<br>DOWN-<br>STREAM<br>lb/in <sup>2</sup> a | (16c)<br>UPSTREAM<br>lb/in <sup>2</sup> a | (17c)<br>DOWN-<br>STREAM<br>lb/in <sup>2</sup> a |                                |                          |                        |                                                          |                  |
| PI-2112 (VAPOR EX T-202)            | 8"                          | NH <sub>3</sub> , H <sub>2</sub> S, CO <sub>2</sub><br>H <sub>2</sub> O |                       |             |             |             |              |                 |                               |                                   |                                                      |                               |                        | 231                           | 31                                        | -                                                | -                                         | -                                                | 64                                        | -                                                | -                              | -                        | -                      |                                                          | 1                |
| PIC-2112                            |                             |                                                                         |                       |             |             |             |              |                 |                               |                                   |                                                      |                               |                        |                               |                                           |                                                  |                                           |                                                  |                                           |                                                  |                                |                          |                        |                                                          |                  |
| PV-2112 (VAPOR EX D-202)            | 4"                          | NH <sub>3</sub> , H <sub>2</sub> S, CO <sub>2</sub><br>H <sub>2</sub> O | 1653                  | 135         | 50          |             |              | 32.4            | .015                          |                                   |                                                      | 1.0                           | 1.31                   | 202                           | 28                                        | 26                                               | 27                                        | 26                                               | 64                                        | 26                                               | -                              | NO                       | C                      |                                                          |                  |
| PT-2116 (VAPOR EX T-203)            | 10"                         | NH <sub>3</sub> , H <sub>2</sub> S, CO <sub>2</sub><br>H <sub>2</sub> O |                       |             |             |             |              |                 |                               |                                   |                                                      |                               |                        | 234                           | 31                                        | -                                                | -                                         | -                                                | 64                                        | -                                                | -                              | -                        | -                      |                                                          | 1                |
| PIC-2116                            |                             |                                                                         |                       |             |             |             |              |                 |                               |                                   |                                                      |                               |                        |                               |                                           |                                                  |                                           |                                                  |                                           |                                                  |                                |                          |                        |                                                          |                  |
| PV-2116 (VAPOR EX D-212)            | 4"                          | NH <sub>3</sub> , H <sub>2</sub> S, CO <sub>2</sub><br>H <sub>2</sub> O | 825                   | 135         | 50          |             |              | 19.3            | .013                          |                                   |                                                      | 1.0                           | 1.31                   | 200                           | 28                                        | 26                                               | 27                                        | 26                                               | 64                                        | 26                                               | -                              | NO                       | C                      |                                                          |                  |
| PI-2101 (P-204 A)                   | 1½"                         | WATER &<br>DISSOLVED<br>GAS                                             | -                     | -           | -           |             |              |                 |                               |                                   |                                                      |                               |                        | 202                           | 69                                        | -                                                | -                                         | -                                                | 80                                        | -                                                | -                              | -                        | -                      |                                                          |                  |
| PI-2102 (P-204 B)                   | 1½"                         | WATER &<br>DISSOLVED<br>GAS                                             | -                     | -           | -           |             |              |                 |                               |                                   |                                                      |                               |                        | 202                           | 69                                        | -                                                | -                                         | -                                                | 80                                        | -                                                | -                              | -                        | -                      |                                                          |                  |
| PI-2103 (P-205 A)                   | 4"                          | WATER &<br>DISSOLVED<br>GAS                                             | -                     | -           | -           |             |              |                 |                               |                                   |                                                      |                               |                        | 248                           | 74                                        | -                                                | -                                         | -                                                | 110                                       | -                                                | -                              | -                        | -                      |                                                          |                  |
| PI-2104 (P-205 B)                   | 4"                          | WATER &<br>DISSOLVED<br>GAS                                             | -                     | -           | -           |             |              |                 |                               |                                   |                                                      |                               |                        | 248                           | 74                                        | -                                                | -                                         | -                                                | 110                                       | -                                                | -                              | -                        | -                      |                                                          |                  |
| PI-2105 (P-203 A)                   | 4"                          | WATER                                                                   | -                     | -           | -           |             |              |                 |                               |                                   |                                                      |                               |                        | 256                           | 518                                       | -                                                | -                                         | -                                                | 614                                       | -                                                | -                              | -                        | -                      |                                                          |                  |
| PI-2106 (P-203 B)                   | 4"                          | WATER                                                                   | -                     | -           | -           |             |              |                 |                               |                                   |                                                      |                               |                        | 256                           | 518                                       | -                                                | -                                         | -                                                | 614                                       | -                                                | -                              | -                        | -                      |                                                          |                  |
| PI-2107 (P-213 A)                   | 2"                          | WATER &<br>DISSOLVED<br>GAS                                             | -                     | -           | -           |             |              |                 |                               |                                   |                                                      |                               |                        | 200                           | 77                                        | -                                                | -                                         | -                                                | 90                                        | -                                                | -                              | -                        | -                      |                                                          |                  |
| PI-2108 (P-213 B)                   | 2"                          | WATER &<br>DISSOLVED<br>GAS                                             | -                     | -           | -           |             |              |                 |                               |                                   |                                                      |                               |                        | 200                           | 77                                        | -                                                | -                                         | -                                                | 90                                        | -                                                | -                              | -                        | -                      |                                                          |                  |
| PI-2113 (T-202)                     | -                           | WATER &<br>DISSOLVED<br>GAS                                             | -                     | -           | -           |             |              |                 |                               |                                   |                                                      |                               |                        | 248                           | 33                                        | -                                                | -                                         | -                                                | 64                                        | -                                                | -                              | -                        | -                      |                                                          |                  |
| PI-2117 (T-203)                     | -                           | WATER &<br>DISSOLVED<br>GAS                                             | -                     | -           | -           |             |              |                 |                               |                                   |                                                      |                               |                        | 256                           | 33                                        | -                                                | -                                         | -                                                | 64                                        | -                                                | -                              | -                        | -                      |                                                          |                  |

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ENG. FLOW SHEET NO. 22 (OP-751-574) GAS SCRUBBING & WATER WASH

FORM NO (110)-258

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ENG. FLOW SHEET NO. 22 (OP-751-574) GAS SCRUBBING & WATER WASH

| (1)<br>ITEM NUMBER<br>OR<br>SERVICE | (2)<br>NOM.<br>LINE<br>SIZE | (3)<br>FLUID TYPE<br>&<br>STATE | (4)<br>NORMAL<br>lb/h | FLOW %      |             | SP. GR. AT. |              | (9)<br>MOL. WT. | (10)<br>VISC. CPS.<br>- TEMP. | (11)<br>LIQ. VAPOR<br>PRESS. PSIA | (12)<br>LIQ. CRITICAL<br>PRESS. lb/in <sup>2</sup> a | (13)<br>VAPOR<br>COMP. FACTOR | (14)<br>VAPOR<br>Cp/Cv | (15)<br>NORM. OP.<br>TEMP. °F | PRESSURES<br>AT NORM.<br>FLOW             |                                                  | PRESSURES<br>AT MAX.<br>FLOW              |                                                  | PRESSURES<br>AT MIN.<br>FLOW              |                                                  | (18)<br>DOWNSTREAM<br>FLASHING | (19)<br>TIGHT<br>SHUTOFF | (20)<br>AIR<br>FAILURE                                                     | (21)<br>REMARKS AND/OR<br>ALARM AND<br>SHUTDOWN SETTINGS                                                                      | (22)<br>REVISION |
|-------------------------------------|-----------------------------|---------------------------------|-----------------------|-------------|-------------|-------------|--------------|-----------------|-------------------------------|-----------------------------------|------------------------------------------------------|-------------------------------|------------------------|-------------------------------|-------------------------------------------|--------------------------------------------------|-------------------------------------------|--------------------------------------------------|-------------------------------------------|--------------------------------------------------|--------------------------------|--------------------------|----------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|------------------|
|                                     |                             |                                 |                       | (5)<br>MAX. | (6)<br>MIN. | (7)<br>60°F | (8)<br>COND. |                 |                               |                                   |                                                      |                               |                        |                               | (16a)<br>UPSTREAM<br>lb/in <sup>2</sup> a | (17a)<br>DOWN-<br>STREAM<br>lb/in <sup>2</sup> a | (16b)<br>UPSTREAM<br>lb/in <sup>2</sup> a | (17b)<br>DOWN-<br>STREAM<br>lb/in <sup>2</sup> a | (16c)<br>UPSTREAM<br>lb/in <sup>2</sup> a | (17c)<br>DOWN-<br>STREAM<br>lb/in <sup>2</sup> a |                                |                          |                                                                            |                                                                                                                               |                  |
| LSLL-2001 (S-202)                   | -                           | WATER &<br>SOLIDS               | -                     | -           | -           | 1.0         | .94          |                 |                               |                                   |                                                      |                               |                        | 265                           | 390                                       | -                                                | -                                         | -                                                | 484                                       | -                                                | -                              | -                        | STOPS P-206 A/B PROVIDE ADEQUATE<br>ISOLATION & PURGE                      |                                                                                                                               |                  |
| LALL-2001                           |                             |                                 |                       |             |             |             |              |                 |                               |                                   |                                                      |                               |                        |                               |                                           |                                                  |                                           |                                                  |                                           |                                                  |                                |                          |                                                                            |                                                                                                                               |                  |
| LG-2002 (S-202)                     | -                           | WATER &<br>SOLIDS               | -                     | -           | -           | 1.0         | .94          |                 |                               |                                   |                                                      |                               |                        | 265                           | 390                                       | -                                                | -                                         | -                                                | 484                                       | -                                                | -                              | -                        | FLUID CONTAINS SOLIDS. PROVIDE<br>PURGE<br>"SEE-THROUGH" GAGE IS PREFERRED |                                                                                                                               |                  |
| LT-2007 (T-201 LOWER)               | -                           | WATER                           | -                     | -           | -           | 1.0         | .97          |                 |                               |                                   |                                                      |                               |                        | 180                           | 387                                       | -                                                | -                                         | -                                                | 424                                       | -                                                | -                              | -                        | SOLIDS MAY BE PRESENT, PROVIDE<br>PURGE                                    |                                                                                                                               |                  |
| LC-2007                             |                             |                                 |                       |             |             |             |              |                 |                               |                                   |                                                      |                               |                        |                               |                                           |                                                  |                                           |                                                  |                                           |                                                  |                                |                          |                                                                            |                                                                                                                               |                  |
| LV-2007 (TO S-202)                  | 2"                          | WATER                           | 14300                 | 120         | 30          | 1.0         | .97          |                 | 0.35                          | 7.53                              | 206                                                  |                               |                        | 180                           | 470                                       | 435                                              | 468                                       | 435                                              | 486                                       | 432                                              | -                              | -                        | 0                                                                          | CONTAINS SMALL AMOUNTS DISSOLVED<br>NR <sub>3</sub> ,CO <sub>2</sub> H <sub>2</sub> S AND SOLID FINES<br>SET 5'-0" ABOVE T.L. |                  |
| LSH-2007                            |                             |                                 |                       |             |             |             |              |                 |                               |                                   |                                                      |                               |                        |                               |                                           |                                                  |                                           |                                                  |                                           |                                                  |                                |                          |                                                                            |                                                                                                                               |                  |
| LAH-2007                            |                             |                                 |                       |             |             |             |              |                 |                               |                                   |                                                      |                               |                        |                               |                                           |                                                  |                                           |                                                  |                                           |                                                  |                                |                          |                                                                            |                                                                                                                               |                  |
| LSL-2007                            |                             |                                 |                       |             |             |             |              |                 |                               |                                   |                                                      |                               |                        |                               |                                           |                                                  |                                           |                                                  |                                           |                                                  |                                |                          |                                                                            |                                                                                                                               |                  |
| LAL-2007                            |                             |                                 |                       |             |             |             |              |                 |                               |                                   |                                                      |                               |                        |                               |                                           |                                                  |                                           |                                                  |                                           |                                                  |                                |                          |                                                                            |                                                                                                                               |                  |
| LI-2007                             |                             |                                 |                       |             |             |             |              |                 |                               |                                   |                                                      |                               |                        |                               |                                           |                                                  |                                           |                                                  |                                           |                                                  |                                |                          |                                                                            |                                                                                                                               |                  |
| LG-2006 (T-201 LOWER)               | -                           | WATER                           | -                     | -           | -           | 1.0         | .97          |                 |                               |                                   |                                                      |                               |                        | 180                           | 387                                       | -                                                | -                                         | -                                                | 424                                       | -                                                | -                              | -                        | SMALL AMOUNT OF SOLIDS MAY BE<br>PRESENT PROVIDE PURGE                     |                                                                                                                               |                  |
| LT-2005 (T-201 UPPER)               | -                           | WATER &<br>DISSOLVED<br>GASES   | -                     | -           | -           | 1.0         | .98          |                 | 0.54                          | -                                 | -                                                    |                               |                        | 145                           | 387                                       | -                                                | -                                         | -                                                | 424                                       | -                                                | -                              | -                        |                                                                            |                                                                                                                               |                  |
| LIC-2005                            |                             |                                 |                       |             |             |             |              |                 |                               |                                   |                                                      |                               |                        |                               |                                           |                                                  |                                           |                                                  |                                           |                                                  |                                |                          |                                                                            |                                                                                                                               |                  |
| LV-2005 (T-201 TO T-202)            | 3"                          | WATER &<br>DISSOLVED<br>GASES   | 33100                 | 120         | 30          | 1.0         | .98          |                 | 0.54                          | 23.8                              | 3206                                                 |                               |                        | 145                           | 411*                                      | 64*                                              | 410*                                      | 66*                                              | 424                                       | 34                                               | -                              | YES                      | C                                                                          | *BASED ON VALVE LOCATION @ GRADE                                                                                              |                  |
| LSH-2005                            |                             |                                 |                       |             |             |             |              |                 |                               |                                   |                                                      |                               |                        |                               |                                           |                                                  |                                           |                                                  |                                           |                                                  |                                |                          |                                                                            |                                                                                                                               |                  |
| LAH-2005                            |                             |                                 |                       |             |             |             |              |                 |                               |                                   |                                                      |                               |                        |                               |                                           |                                                  |                                           |                                                  |                                           |                                                  |                                |                          |                                                                            |                                                                                                                               |                  |
| LSI-2005                            |                             |                                 |                       |             |             |             |              |                 |                               |                                   |                                                      |                               |                        |                               |                                           |                                                  |                                           |                                                  |                                           |                                                  |                                |                          |                                                                            |                                                                                                                               |                  |
| LAL-2005                            |                             |                                 |                       |             |             |             |              |                 |                               |                                   |                                                      |                               |                        |                               |                                           |                                                  |                                           |                                                  |                                           |                                                  |                                |                          |                                                                            |                                                                                                                               |                  |
| LI-2005                             |                             |                                 |                       |             |             |             |              |                 |                               |                                   |                                                      |                               |                        |                               |                                           |                                                  |                                           |                                                  |                                           |                                                  |                                |                          |                                                                            |                                                                                                                               |                  |
| LG-2004 (T-201 UPPER)               | -                           | WATER &<br>DISSOLVED<br>GASES   | -                     | -           | -           | -           | -            |                 |                               |                                   |                                                      |                               |                        | 145                           | 387                                       | -                                                | -                                         | -                                                | 424                                       | -                                                | -                              | -                        | -                                                                          |                                                                                                                               |                  |

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FOSTER WHEELER ENERGY CORPORATION  
INSTRUMENT PROCESS DATA

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