THE NATIONAL SHIPBUILDING RESEARCH PROGRAM

REAPS 5th Annual Technical Symposium Proceedings

Paper No. 8: The Hitachi HICAS System
The National Shipbuilding Research Program REAPS 5th Annual Technical Symposium Proceedings Paper No. 8: The Hitachi HICAS System
Proceedings of the REAPS Technical Symposium
June 27-28, 1978
St. Louis, Missouri
Disclaimer

These reports were prepared as an account of government-sponsored work. Neither the United States, nor the United States Navy, nor any person acting on behalf of the United States Navy (A) makes any warranty or representation, expressed or implied, with respect to the accuracy, completeness or usefulness of the information contained in this report/manual, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or (B) assumes any liabilities with respect to the use of or for damages resulting from the use of any information, apparatus, method, or process disclosed in the report. As used in the above, “Persons acting on behalf of the United States Navy” includes any employee, contractor, or subcontractor to the contractor of the United States Navy to the extent that such employee, contractor, or subcontractor to the contractor prepares, handles, or distributes, or provides access to any information pursuant to his employment or contract or subcontract to the contractor with the United States Navy. ANY POSSIBLE IMPLIED WARRANTIES OF MERCHANTABILITY AND/OR FITNESS FOR PURPOSE ARE SPECIFICALLY DISCLAIMED.
As Chief of the Applied Engineering section at Hitachi, Mr. Ueda is responsible for several applied engineering systems including a piping design system and an electrical cable system. His past experience involved planning and development of piping design computerization.

Mr. Ueda attended Osaka Prefecture University, Industrial Engineering Department.
HICAS-P

HISTORY

<table>
<thead>
<tr>
<th>'67</th>
<th>'68</th>
<th>'69</th>
<th>'70</th>
<th>'71</th>
<th>'72</th>
<th>'73</th>
<th>'74</th>
<th>'75</th>
<th>'76</th>
<th>'77</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASIC ANALYSIS OF PIPING SYSTEM</td>
<td>HICAS DATA BASE MANAGEMENT</td>
<td>HICAS-P PHASE I</td>
<td>HICAS-P PHASE II</td>
<td>HICAS-P PHASE III</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(DEVELOPMENT OF THE TRIAL SYSTEM)</td>
<td>(PIPE PIECE DRAWING)</td>
<td>(GENERATION OF PIPE PIECE &amp; ETC)</td>
<td>(AUTOMATIC PIPE ARRANGEMENT)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DEVELOPMENT

OPERATION (ACTUAL USE)
# HICAS-P & DESIGN WORK

## Design Process

<table>
<thead>
<tr>
<th>MAIN WORK</th>
<th>PLANNING &amp; CALCULATION</th>
<th>ARRANGEMENT</th>
<th>DIVIDING PIPELINES INTO PRODUCTION UNITS (PIPE PIECES)</th>
<th>PREPARATION OF PRODUCTION INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>DESIGN PROCESS</td>
<td>SHIP SPECIFICATION</td>
<td>GENERAL PIPING ARRANGEMENT</td>
<td>DETAILED PIPING ARRANGEMENT</td>
<td>PIPE PIECE DRAWING &amp; OTHERS</td>
</tr>
<tr>
<td></td>
<td>PIPING DIAGRAM</td>
<td>MACHINERY ARRANGEMENT</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## HICAS-P

| | OPTIMUM ROUTE CALCULATION & AUTOMATIC PIPE ARRANGEMENT | AUTOMATIC JOINT POSITIONING | PRODUCTION INFORMATION PREPARATION FUNCTIONS |
| | | | |
| | AUTOMATIC DRAWING FUNCTIONS | | |

## Flowchart

- PIPE SHOP
- INSTALLATION WORK
- PRODUCTION CONTROL SYSTEMS

**Diagram Notes:**
- Solid lines indicate the main flow of work.
- Dashed lines indicate additional steps or dependencies.
- Boxes represent different stages or tasks in the design process.

**Legend:**
- PIPE PIECES
HICAS-P  AUTOMATIC DESIGN FUNCTIONS

PIPE PASSAGES  TERMINALS  OTHERS

OPTIMUM ROUTE CALCULATION

AUTOMATIC PIPE ARRANGEMENT

AUTOMATIC JOINT POSITIONING

CROSS SECTION OF PASSAGE
HICAS-P

SYSTEM COMPOSITION

PIPING DESIGN

PF
FRONT END SYSTEM

INTERACTIVE
INPUT SYSTEM
- SMALL COMPUTER
- DIGITIZER
- CRT
- FUNCTION KEYBOARD

PC
CENTRAL SYSTEM

- AUTOMATIC DESIGN FUNCTIONS
- AUTOMATIC DRAFTING FUNCTIONS
- MANUFACTURING INFORMATION
  SUPPLYING FUNCTIONS
- OTHER FUNCTIONS

DATA BASE

HULL DESIGN SYSTEM

DATA BASE

MANUFACTURING

PIPE WORKS
- NC PIPE FABRICATION SYSTEM
- PRODUCTION CONTROL SYSTEM

INSTALLATION
- PRODUCTION CONTROL SYSTEM
HICAS-P

PIPING DESIGN PROCEDURE using HICAS-P
(STEP 1)

(INPUT/OUTPUT)

HULL STRUCTURE DRAWINGS

PIPING DIAGRAM

MACHINERY ARRANGEMENT

-main & auxiliary exhaust gas pipe arrangement

- passage & ladder arrangement

AIR DUCT ARRANGEMENT

HULL STRUCTURE DATA

MATERIAL LIST DATA

SPECIAL ORDER FITTING DATA

STANDARD UNITS

COMPOSITE UNITS

COMPOSITE DRAWINGS

UNITs OF AUXILIARY MACHINES

UNITs OF VALVES & COCKS
DETERMINATION OF PIPE PASSAGES
(VERICAL PASSAGES)
Determination of Pipe Passages
(Horizontal Passages)
SECTIONAL DRAWINGS OF PIPE PASSAGES
PIPING DESIGN PROCEDURE using HICAS-P
(STEP 3)

1. EDITION OF PIPELINE DATA FOR EACH DRAWING
2. AUTOMATIC JOINT POSITIONING
3. PREPARATION OF PRODUCTION INFORMATION
4. DRAWINGS OF PIPELINES (PIPING ARRANGEMENT)
5. CHECKING
6. FINAL PIPING ARRANGEMENTS
7. PIPE PIECE DRAWINGS
8. BILL OF MATERIALS
9. NC INFORMATION
10. INSTALLATION
11. PIPE SHOP
HICAS-P

MAIN FUNCTIONS

- AUTOMATIC DESIGN FUNCTIONS
- AUTOMATIC DRAWING FUNCTIONS
- CHECKING FUNCTIONS
- FUNCTIONS TO SUPPLY VARIOUS LISTINGS
- FUNCTIONS TO SUPPLY PRODUCTION INFORMATION
- FUNCTIONS TO CONNECT WITH OTHER SYSTEMS
- INTERACTIVE INPUT STATION (PF SYSTEM)
HICAS-P

DEFINITION OF PIPE PASSAGE

(BASIC SHAPE)

UNAVAILABLE SPACE
DEFINITION OF PIPING SYSTEM (TERMINALS)

1. ANCHOR POINT—ANCHOR POINT

2. GROUPING

3. RING MAIN

4. ANCHOR POINT—SEQUENCE
HICAS-P

OPTIMUM ROUTE CALCULATION

[Diagram showing different routes and points labeled A, B, C, and D]
AUTOMATIC PIPE ARRANGEMENT

A → B → D
C → E

PASSAGE
HICAS-P

AUTOMATIC JOINT POSITIONING

BEFORE PROCESSING

100A --- 80A

PIPE SUPPORTER

65A

MAXIMUM LENGTH

ZONE WHERE JOINT CAN'T BE PLACED

HULL BLOCK SEAM

AFTER PROCESSING

FW-1 --- FW-2 --- FW-3 --- FW-4

REDUCER

PIPE PIECE

FW-11

FW-12 --- FW-13

FW-5

FW-6 --- FW-7 --- FW-8

ADJUSTING PIPE

CHECK ITEMS
- PLATING BATH
- COATING & LINING
- BENDING CONDITIONS
- OTHERS
AUTOMATIC DRAWING FUNCTION

- SPEC. OF THE DRAWING CAN BE FREELY INDICATED

  (VIEW DIRECTION, DRAWING AREA, OBJECT TO BE DRAWN, ETC)

- THE FOLLOWING CAN BE AUTOMATICALLY DRAWN

  1. HIDDEN LINE ELIMINATION
  2. RELATIVE POSITION OF PIPELINES FROM HULL STRUCTURE
  3. PIPE PIECE NO., HEIGHT OF PIPELINES, DIA. OF PIPES, NAME OF HULL STRUCTURE
  4. OTHERS
HICAS-P

PIPING ARRANGEMENT (ON DECK)
HICAS-P PIPING ARRANGEMENT (IN DOUBLE BOTTOM)
HICAS-P  PIPING ARRANGEMENT (ENLARGEMENT, ELEVATION)
HICAS-P
INTERFERENCE CHECKING FUNCTION

PIPE

PIPE

HULL STRUCTURE

PIPE

MACHINERY
## HICAS-P INTERFERENCE CHECK LIST

<table>
<thead>
<tr>
<th><strong>S. NO.</strong></th>
<th><strong>PAGE</strong></th>
<th><strong>INTERFERENCE CHECK LIST</strong></th>
<th><strong>DESIGNER</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PIPE TO PIPE (P. NO.= 3, P. NO.= 163, L. NAME= L1 2, S.E.O. = 71 TC (P. NO.= 166, P. NO.= 167, L. NAME= L1 2, S.E.O. = 81)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P. NO.</td>
<td>3</td>
<td>P. S1L505 P</td>
<td>127</td>
</tr>
<tr>
<td>U=1:1OBM</td>
<td>U</td>
<td>U=1:1OBM</td>
<td>U</td>
</tr>
<tr>
<td>**********</td>
<td>INTERFERENCE DEPTH: 45.</td>
<td>**********</td>
<td></td>
</tr>
</tbody>
</table>

| **PIPE TO PIPE (P. NO.= 9, P. NO.= 233, L. NAME= L1 2, S.E.O. = 131 TC (P. NO.= 170, L. NAME= L1 2, S.E.O. = 9, JOINT NAME= FL)** |
| P. NO. | 9 | P. S1L505 P | 90 | P. NO. | 213 | P. S1L505 S | 367 | P. NO. | 170 | P. S1L505 S | 368 |
| U=1:1OBM | U | U=1:1OBM | U | 317 | U=1:1OBM | U | 507 | U=1:1OBM | U | 507 |
| ********** | INTERFERENCE DEPTH: 90. | ********** |

| **PIPE TO PIPE (P. NO.= 171, P. NO.= 172, L. NAME= L1 2, S.E.O. = 91 TC (P. NO.= 184, P. NO.= 195, L. NAME= L1 2, S.E.O. = 10)** |
| P. NO. | 171 | P. S1L507 P | 190 | P. NO. | 172 | P. S1L505 S | 194 | P. NO. | 194 | P. S1L507 S | 20 |
| U=1:1OBM | U | U=1:1OBM | U | 330 | U=1:1OBM | U | 330 | U=1:1OBM | U | 324 |
| ********** | INTERFERENCE DEPTH: 41. | ********** |

<p>| <strong>PIPE TO PIPE (P. NO.= 171, P. NO.= 172, L. NAME= L1 2, S.E.O. = 91 T (P. NO.= 195, P. NO.= 204, L. NAME= L1 2, S.E.O. = 21)</strong> |
| P. NO. | 171 | P. S1L507 P | 190 | P. NO. | 172 | P. S1L505 S | 194 | P. NO. | 194 | P. S1L507 S | 20 |
| U=1:1OBM | U | U=1:1OBM | U | 330 | U=1:1OBM | U | 330 | U=1:1OBM | U | 324 |
| ********** | INTERFERENCE DEPTH: 22. | ********** |</p>
<table>
<thead>
<tr>
<th>VALVE</th>
<th>RATING</th>
<th>MATERIAL</th>
<th>STANDARD</th>
<th>OPERATION</th>
<th>VALVE NO.</th>
<th>LOCATION</th>
<th>APPLICATION</th>
<th>WEIGHT (KG)</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSV</td>
<td>10.00</td>
<td>SC</td>
<td>F7319</td>
<td>M</td>
<td>21 DSV-2x9</td>
<td>FWD. SPACE</td>
<td>DK STEAM</td>
<td>44.80</td>
<td></td>
</tr>
<tr>
<td>GSV</td>
<td>10.50</td>
<td>SC</td>
<td>F7319</td>
<td>M</td>
<td>21 DSV-6x9</td>
<td>UPPER DECK</td>
<td>DK STEAM</td>
<td>17.90</td>
<td></td>
</tr>
<tr>
<td>GSV</td>
<td>10.60</td>
<td>SC</td>
<td>F7319</td>
<td>M</td>
<td>11 DSV-51</td>
<td>UPPER DECK</td>
<td>DK STEAM</td>
<td>29.80</td>
<td></td>
</tr>
<tr>
<td>GSV</td>
<td>10.80</td>
<td>SC</td>
<td>F7319</td>
<td>M</td>
<td>11 DSV-4x7</td>
<td>UPPER DECK</td>
<td>DK STEAM</td>
<td>64.80</td>
<td></td>
</tr>
<tr>
<td>GSV</td>
<td>10.100</td>
<td>SC</td>
<td>F7319</td>
<td>M</td>
<td>91 DSV-47.5</td>
<td>UPPER DECK</td>
<td>DK STEAM</td>
<td>87.80</td>
<td></td>
</tr>
<tr>
<td>GSV</td>
<td>10.125</td>
<td>SC</td>
<td>F7319</td>
<td>M</td>
<td>11 DSV-50</td>
<td>UPPER DECK</td>
<td>DK STEAM</td>
<td>69.80</td>
<td></td>
</tr>
<tr>
<td>GSV</td>
<td>10.200</td>
<td>SC</td>
<td>F7319</td>
<td>M</td>
<td>11 DSV-37</td>
<td>UPPER DECK</td>
<td>DK STEAM</td>
<td>156.00</td>
<td></td>
</tr>
<tr>
<td>GSV</td>
<td>10.250</td>
<td>SC</td>
<td>F7319</td>
<td>M</td>
<td>11 DSV-46</td>
<td>UPPER DECK</td>
<td>DK STEAM</td>
<td>257.00</td>
<td></td>
</tr>
<tr>
<td>GSV</td>
<td>10.650</td>
<td>SC</td>
<td>F7319</td>
<td>M</td>
<td>21 DSV-34x35</td>
<td>AUX. P. RM</td>
<td>DK STEAM</td>
<td>26.10</td>
<td></td>
</tr>
<tr>
<td>GSV</td>
<td>10.125</td>
<td>SC</td>
<td>F7319</td>
<td>M</td>
<td>11 DSV-36</td>
<td>AUX. P. RM</td>
<td>DK STEAM</td>
<td>69.80</td>
<td></td>
</tr>
<tr>
<td>GSV</td>
<td>10.100</td>
<td>SC</td>
<td>F7319</td>
<td>M</td>
<td>21 DSV-100.103</td>
<td>AUX. P. RM</td>
<td>DK STEAM</td>
<td>44.80</td>
<td></td>
</tr>
<tr>
<td>GSV</td>
<td>10.150</td>
<td>SC</td>
<td>F7319</td>
<td>M</td>
<td>21 DSV-24.27</td>
<td>AUX. P. RM</td>
<td>DK EXHAUST</td>
<td>96.50</td>
<td></td>
</tr>
<tr>
<td>GSV</td>
<td>10.250</td>
<td>SC</td>
<td>F7319</td>
<td>M</td>
<td>31 DSV-125.127</td>
<td>AUX. P. RM</td>
<td>DK STEAM</td>
<td>257.00</td>
<td></td>
</tr>
<tr>
<td>GSV</td>
<td>10.150</td>
<td>SC</td>
<td>F7319</td>
<td>M</td>
<td>31 DSV-117</td>
<td>AUX. P. RM</td>
<td>DK STEAM</td>
<td>62.50</td>
<td></td>
</tr>
<tr>
<td>GSV</td>
<td>10.250</td>
<td>SC</td>
<td>F7319</td>
<td>M</td>
<td>21 DSV-62.63</td>
<td>AUX. P. RM</td>
<td>DK STEAM</td>
<td>16.50</td>
<td></td>
</tr>
<tr>
<td>GSV</td>
<td>10.50</td>
<td>SC</td>
<td>F7472</td>
<td>M</td>
<td>21 WBG-105</td>
<td>AUX. P. RM</td>
<td>WATER BALLAST</td>
<td>310.00</td>
<td></td>
</tr>
<tr>
<td>PAGE</td>
<td>PIECE NO.</td>
<td>DIAMETER</td>
<td>ELBOW LENGTH</td>
<td>TREAT</td>
<td>PAINTING</td>
<td>TEST</td>
<td>BRAND</td>
<td>ADJUST</td>
<td>HUNT</td>
</tr>
<tr>
<td>------</td>
<td>-----------</td>
<td>----------</td>
<td>---------------</td>
<td>-------</td>
<td>----------</td>
<td>------</td>
<td>-------</td>
<td>--------</td>
<td>------</td>
</tr>
<tr>
<td>1</td>
<td>FW-1-11</td>
<td>20</td>
<td>0</td>
<td>1.5</td>
<td>0</td>
<td>A-150</td>
<td>0</td>
<td>0</td>
<td>ADJUST</td>
</tr>
<tr>
<td>2</td>
<td>FW-1-12</td>
<td>20</td>
<td>0</td>
<td>2.0</td>
<td>G</td>
<td>R-2</td>
<td>N</td>
<td>A-150</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>FW-1-13</td>
<td>15</td>
<td>0</td>
<td>0.8</td>
<td>G</td>
<td>R-2</td>
<td>N</td>
<td>A-150</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>FW-1-14</td>
<td>40</td>
<td>0</td>
<td>2.2</td>
<td>G</td>
<td>R-2</td>
<td>N</td>
<td>A-150</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>FW-23-01</td>
<td>20</td>
<td>2</td>
<td>0.9</td>
<td>G</td>
<td>R-2</td>
<td>N</td>
<td>A-150</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>FW-23-02</td>
<td>20</td>
<td>1</td>
<td>0.6</td>
<td>G</td>
<td>R-2</td>
<td>N</td>
<td>A-150</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>FW-23-03</td>
<td>15</td>
<td>0</td>
<td>5.0</td>
<td>G</td>
<td>R-2</td>
<td>N</td>
<td>A-150</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>FW-23-15</td>
<td>50</td>
<td>0</td>
<td>1.5</td>
<td>G</td>
<td>R-2</td>
<td>N</td>
<td>A-150</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>FW-23-16</td>
<td>40</td>
<td>0</td>
<td>0.9</td>
<td>G</td>
<td>R-2</td>
<td>N</td>
<td>A-150</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>FW-23-17</td>
<td>40</td>
<td>0</td>
<td>1.6</td>
<td>G</td>
<td>R-2</td>
<td>N</td>
<td>A-150</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>FW-123-11</td>
<td>40</td>
<td>0</td>
<td>2.3</td>
<td>G</td>
<td>R-2</td>
<td>N</td>
<td>A-150</td>
<td>0</td>
</tr>
<tr>
<td>12</td>
<td>FW-123-12</td>
<td>125</td>
<td>2</td>
<td>1.2</td>
<td>G</td>
<td>R-2</td>
<td>N</td>
<td>A-150</td>
<td>0</td>
</tr>
</tbody>
</table>
## BILL OF MATERIALS

### HICAS-P TABLE OF MATERIALS

<table>
<thead>
<tr>
<th>HIS CODE</th>
<th>DIMENSION</th>
<th>MATERIAL</th>
<th>PR</th>
<th>CD</th>
<th>FW</th>
<th>CO</th>
<th>TOTAL LENGTH/WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>41351-3</td>
<td>15 x 1.5</td>
<td>ISGP-E</td>
<td>901</td>
<td>3</td>
<td>01</td>
<td>01</td>
<td>11</td>
</tr>
<tr>
<td>41352-3</td>
<td>20 x 2.0</td>
<td>ISGP-E</td>
<td>901</td>
<td>3</td>
<td>01</td>
<td>01</td>
<td>11</td>
</tr>
<tr>
<td>41351-50</td>
<td>40 x 5.0</td>
<td>ISGP-E</td>
<td>901</td>
<td>3</td>
<td>01</td>
<td>01</td>
<td>11</td>
</tr>
<tr>
<td>41352-60</td>
<td>50 x 5.0</td>
<td>ISGP-E</td>
<td>901</td>
<td>3</td>
<td>01</td>
<td>01</td>
<td>11</td>
</tr>
<tr>
<td>41353-50</td>
<td>40 x 3.0</td>
<td>ISGP-2S #40</td>
<td>111</td>
<td>01</td>
<td>13</td>
<td>01</td>
<td>01 13</td>
</tr>
<tr>
<td>41352-39</td>
<td>30 x 3.9</td>
<td>ISGP-2S #40</td>
<td>111</td>
<td>01</td>
<td>11</td>
<td>01</td>
<td>01 11</td>
</tr>
<tr>
<td>41352-31</td>
<td>35 x 3.2</td>
<td>ISGP-2S #40</td>
<td>111</td>
<td>01</td>
<td>11</td>
<td>01</td>
<td>01 11</td>
</tr>
<tr>
<td>41352-315</td>
<td>125 x 6.6</td>
<td>ISGP-2S #40</td>
<td>111</td>
<td>2</td>
<td>01</td>
<td>01</td>
<td>01 2</td>
</tr>
</tbody>
</table>

**TOTAL**

- Length: 27
- Weight: 164

---

**C. TOTAL LENGTH**

- Total: 241
- Weight: 221

---

**DATE:** 10/21/77

**PAGE:** 2
HICAS-P

ADMINISTRATIVE INFORMATION SYSTEM

- CONSTRUCTION SCHEDULE
- OTHERS

INFORMATION ON PIPES

COPPS

INFORMATION FOR
- PRODUCTION PLAN
- PRODUCTION CONTROL
- MATERIAL MANAGEMENT
- OTHERS

PIPE PIECE DRAWINGS

PIPE ARRANGEMENTS

PIECE SHOP

PALLETTING

OUTFITTING YARD

STOCK YARD

DELIVERY

• NON-PIPE FITTINGS
• OTHERS

INFORMATION ON PIPES

JOS

INFORMATION FOR
- JOB ORDERING
- DELIVERY PLAN
- MATERIAL MANAGEMENT
• OTHERS

LISTINGS

239
## PIPE CUTTING PLAN

<table>
<thead>
<tr>
<th>Pipe No.</th>
<th>Type</th>
<th>Length</th>
<th>Diameter</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>JEA-200</td>
<td>300</td>
<td>3.0</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>JEA-300</td>
<td>30</td>
<td>3.6</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>JEA-400</td>
<td>30</td>
<td>4.0</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>JEA-500</td>
<td>30</td>
<td>5.0</td>
<td>3.5</td>
<td></td>
</tr>
</tbody>
</table>

**Total:**

---

Notes:
- All pipes are steel, galvanized.
- Lengths are in meters.
- Diameters are in millimeters.
HICAS-P TYPICAL FLOW OF NC PIPE FABRICATION SYSTEM

NC PIPE FABRICATION INFORMATION

PIPE PIECE DRAWINGS

INDEXES OF PIPE PIECE DRAWINGS

QUANTITATIVE LISTS OF PARTS

PIPE RACK

NC PIPE CUTTER

FLANGE FEEDER

FLANGE STAMPING MACHINE

NC FLANGE FITTER

AUTO-FLANGE-WELDER

NC-FINISHING-MACHINE

AUTO-PIPE-LOADER

NC PIPE BENDER

AUTO-PIPE-UNLOADER

PIPE DISPATCH

BRANCH PIPE FABRICATION
1 PIPE RACK
2 NC PIPE CUTTING MACHINE
3 FLANGE RACK WITH AN IMPRESSING MACHINE
4 NC FLANGE FITTING MACHINE
5 SKID FOR BYPASS
6 AUTOMATIC FLANGE WELDING MACHINE
7 NC PIPE FINISHING MACHINE
8 DOLLY FOR BYPASS
9 CONTROLLER
10 PIPE UNLOADING DOLLY
11 NC PIPE BENDER
12 SORTING STAGE
HICAS-P

EFFECT

- REDUCTION OF PIPING DESIGN TERM
- PREVENTION OF ERRORS IN DESIGN & MANUFACTURE
- NOT WANTED SKILLED PIPING DESIGNER
- INFORMATION SUPPLY FOR PIPING CONTROL SYSTEM
- OTHERS
Additional copies of this report can be obtained from the National Shipbuilding Research and Documentation Center:

http://www.nsnet.com/docctr/

Documentation Center
The University of Michigan
Transportation Research Institute
Marine Systems Division
2901 Baxter Road
Ann Arbor, MI 48109-2150

Phone: 734-763-2465
Fax: 734-763-4862
E-mail: Doc.Center@umich.edu