DUKE POWER COMPANY
DESIGN ENGINEERING DEPARTMENT
WORKPLACE DOCUMENT CONTROL
USAGE AUTHORIZATION

SPECIFICATION NO.: CNS-1206.00-02-100
2/20/75
REVISION 23 (5/28/81)

QA CONDITION I

DIVISION: Mechanical Nuclear

SECTION: Analysis

GROUP: Catawba Stress Analysis

TITLE: Catawba 1-2, Procedure for selection of type of piping branch connection.
Duke Classes B, C, E, F, G; CNSA-DOC77-003

FORMAT DESCRIPTION (i.e., bound or loose leaf, choice of Workplace Procedure, Manual, Handbook, or other):

Workplace Procedure

NUMBER OF SHEETS: 12

DESIGN ENGINEERING DEPARTMENT

PREPARED BY: Charles E Robinson DATE: 7-17-80

INSPECTED BY: Richard J Carlson DATE: 7-17-80

APPROVED: V L Ebell DATE: 7-25-80

QUALITY ASSURANCE DEPARTMENT

REVIEWED AND DESIGNATED QA CONDITION 1 BY: W. H. Bradley

DATE: 8/4/80

REV.	INSPECTED	DATE	APPROVED DE	APPROVED QA	DATE	PAGES REVISED
1	M.D. Pell	8/7/81	[illegible] 8/14/81	C.A. Bell	8-17-81	3, 4, 6, 7, 12 Add 7A

RECORD OF REVISIONS

Rev. No.	Issue Date	Ppd. by	Ckd. by.	App. by	Pages Revised and Description
0	7-16-80	CER	RJC	JLE	Original Issue
1	8/19/81	KWS	MDP	RWB	3, 4, 6, 7, 12, Add 7A (Rev. as noted)

PROCEDURE FOR THE SELECTION OF TYPE OF PIPING BRANCH CONNECTION DUKE CLASSES B, C, E, F & G

TABLE OF CONTENTS

1.0 Purpose of Procedure

2.0 Scope of Procedure

3.0 Description of Procedure

4.0 List of Tables

Table 1	Branch Type Selection
Table 2	Branch Type Description
Table 3.1	1/2" & 3/4" Branch Pipe Size
Table 3.2	1" Branch Pipe Size
Table 3.3	1 1/2" Branch Pipe Size
Table 3.4	2" Branch Pipe Size

5.0 List of References

1.0 PURPOSE OF PROCEDURE

- The purpose of this procedure is to provide a document to enable the piping designer to select the preferred type of piping branch connection. The tables are based on pressure reinforcement considerations only and do not reflect any consideration of mechanical piping loads from other sources. If the piping designer specifies a branch connection that does not meet this workplace procedure, it will be his responsibility to document by calculation the acceptability of that branch connection.

2.0 SCOPE OF PROCEDURE

This procedure covers branch connections for all Duke Class B, C, E, F and G piping. The branch piping must intersect perpendicular to the run piping. The procedure is applicable for ASME B & PVC Section III, 1974, through Winter 1976 Addenda; ANSI B31.1, 1973, through Winter 1976 Addenda, ANSI B16.11, 1973; ASME B & PVC Section III, 1977, through Winter 1977 Addenda, ANSI B31.1, 1977 through Winter 1977 Addenda and ANSI B16.11, 1977.

The results reflected in the tables are derived in Duke Power Company Stress Analysis Group Calculation DNK-3-28-77 (File No. MCC 1206.02-54-0005).

3.0 DESCRIPTION OF PROCEDURE

The attached tables give the types of branch connections based on pressure reinforcement considerations.

Table 1 lists the preferred branch types in terms of Duke Class, branch size and run size. This table also refers to Table 3 which gives further definition of 2 inch and smaller connections into 2½ inch and larger run pipe.

Table 2 gives the description of the allowed branch connection types.

In almost every case, an alternate branch connection is allowed. The designer has the option of using the first alternate specified and may even use the alternate for the first alternate, and so on. However, the designer is cautioned that the greater the variation from the preferred connection, the greater the chance that the connection may be overstressed, due to thermal loads. Overstressed connections (as determined by piping stress analysis) would require revision to the piping system. The cost of such a change would, of course, be dependent on the state of construction at the time the overstress condition was discovered. The designer must indicate on the construction drawing the option that the Construction Department is to construct. Variations to this option must then be requested through the Variation Notice procedure.

Note that area reinforcement must be verified on all "pipe to pipe" connections (commonly referred to as fabricated tees), and on almost all connections of branch pipes < 2½" to run pipes > 24".

Any questions regarding these tables should be directed to R. W. Bonsall, Catawba Stress Analysis. 1

4.0 EXCEPTIONS

A. Large Temperature Changes at Fabricated Tee Connections 1

Experience has shown that reinforced fabricated tee connections are highly stressed in the area of the pad-to-pipe weld joints when subjected to sudden and large changes in temperature. Cracking of these welds has occurred after being subjected to an undetermined number of cold-to-hot cycles resulting from steam being dumped into cold lines. It is, therefore, recommended that reinforced fabricated tee connections not be located downstream within 20 diameters of pressure isolation valves where such valves are capable of periodically suddenly releasing high temperature steam (approximately 500°F) into a normally cold line.

B. Past Procedures and Calculations 1

Branch connections on the Catawba Nuclear Station sized prior to March 28, 1977 were designed according to the 1974 edition of the ASME B & PVC, Section III, Subparagraphs NC-3643.2(b), ND-3643.2(b), or ANSI B31.1-1973, Subparagraph 104.3.1, C.2 (Reference calculation: CNC-1206.00-02-1001). Branch connections sized on or after March 28, 1977 but before July 16, 1980, were designed to Stress Analysis Group Calculation DNK-3-28-77 (File MCC-1206-02-54-0005). All branch connections sized on or after July 16, 1980, shall be designed to this workplace procedure (CNSA-DOC77-003).

TABLE 1

BRANCH TYPE SELECTION

CLASS	BRANCH SIZE	RUN	BRANCH TYPE
B,C,E,F&G	$\leq$ 2"	$\leq$ 2"	SWT
	$\leq$ 2"	$2\frac{1}{2}$ - 36"	See Table #3
	$\geq 2\frac{1}{2}$"	$\geq 2\frac{1}{2}$"	BWT

TABLE 2

BRANCH TYPE DESCRIPTION

SWT	Forged steel socket welding tee per ANSI B16.11. No alternate permitted except by the Stress Analyst.
BWT	Factory made wrought butt-welding tee per ANSI B16.9. BWT-R may be used as an alternate. See Note 3.
BWT-R	Factory made wrought butt-welding tee per ANSI B16.9 and a single butt-welding reducer per ANSI B16.9. BWSW may be used as an alternate. See Note 3.
BWSW	Forged butt-welding Sweepolet (Source Fitting). See Note 4. BWW may be used as alternate. See Note 8 for limitations.
HC	Forged socket welding half coupling per ANSI B16.11 shaped to header O.D. and beveled for full penetration weld. SPWB may be used as an alternate provided wall thickness of run pipe is $\geq$.5 inches and run pipe nominal size is $\geq$ 8 inches. See Note 2 and Note 10. |1 3HC - 3000# half coupling 6HC - 6000# half coupling
SPWB	Forged special welding boss as detailed on MDG-ES-2 and MDG-ES-3. BWSO may be used as an alternate. See Note 7.
BWSO	Forged butt-welding Sockolet (or Thredolet as applicable) (Source Fittings). See Note 5.
BWW	Forged butt-welding Weldolet (Source Fitting). See Note 6. FT may be used as an alternate. See Note 8 for limitations.
FT	Fabricated Tee (pipe-to-pipe corner joint). See Note 1 and Note 9. |1

NOTES

(1) Branch to header size ratio and reinforcement calculations per (a) Fig. NC-3673.2(b)-1 and NC-3643 for Class B, (b) Fig. ND-3673.2(b)-1 and ND-3643 for Class C, and (c) Figure D-1 and Paragraph 104.3 for Classes E, F, and G must be performed for all sizes.

(2) See Detail "R" on Drawing MC-1676-1.1, CN-1676-1.1, and P81-1676-1.1.

(3) The branch to header size ratio will be limited to the availability of fittings as listed in manufacturers' catalogs.

(4) Sweepolets will be used where the fitting sizes are not available and/or in situations where two header welds may be overcome by such design. For limitations of branch-to-run size ratio, see manufacturers' catalog. See Detail "AA" on Drawing MC-1676-1.2, CN-1676-1.1, and P81-1676-1.1.

(5) See Detail "Y" on Drawing MC-1676-1.2, CN-1676-1.1 and P81-1676-1.1.

(6) See Detail "Z" on Drawing MC-1676-1.2, CN-1676-1.1 and P81-1676-1.1.

(7) See Detail "X" on Drawing MC-1676-1.2, CN-1676-1.1 and P81-1676-1.1.

(8) For Class B, the use of BWW and FT is limited to branch sizes $\leq$ 4".

(9) Fabricated tees requiring reinforcement, either for Stress Analysis Group's reduction of Stress Intensification Factors and/or Power Piping's qualification of nozzle welds for pressure stress, shall be sized using the following criteria: 1

t_e = thickness of reinforcing pad

t = nominal wall thickness of run pipe

$t_e = 1.5\ t$

The width (w) of the pad should be the greater of:

a. The width of the pad sized for pressure reinforcement by the Power Piping Section.
b. One half the nominal outside diameter of the branch pipe but not to be less than 1" or greater than 6".

This criteria should be used on nozzle welds that require reinforcing pads, effective January 21, 1981.
(Ref. letter: CN-SA-81-0035)

(10) Thermowells used on Catawba were designed to fit 3000 lb. half-couplings. By using the branch selection chart to size the thermowell connection, a 3000 lb. half-coupling may be acceptable for run piping with a thin wall, but a 6000 lb. half-coupling would be required for run piping with a wall thickness over a certain schedule. Since the branch selection chart is designed for typical branch connections, with branch connections being defined as branch pipe intersecting with run piping, it is preferred that the thermowell connections be sized using 3000 lb. half-couplings with a separate calculation to qualify the connection. The thermowell connections may be sized according to the branch selection chart, but this should be used as an alternate method. If a 6000 lb. half-coupling is used, the internal diameter of the coupling must be bored to the same diameter of a 3000 lb. half-coupling to allow for thermocouple installation. The only difference between the two half-couplings would be the outside diameter. (Ref. letter: CN-SA-81-0211) 1

TABLE 3.1

1/2" AND 3/4" BRANCH PIPE SIZE

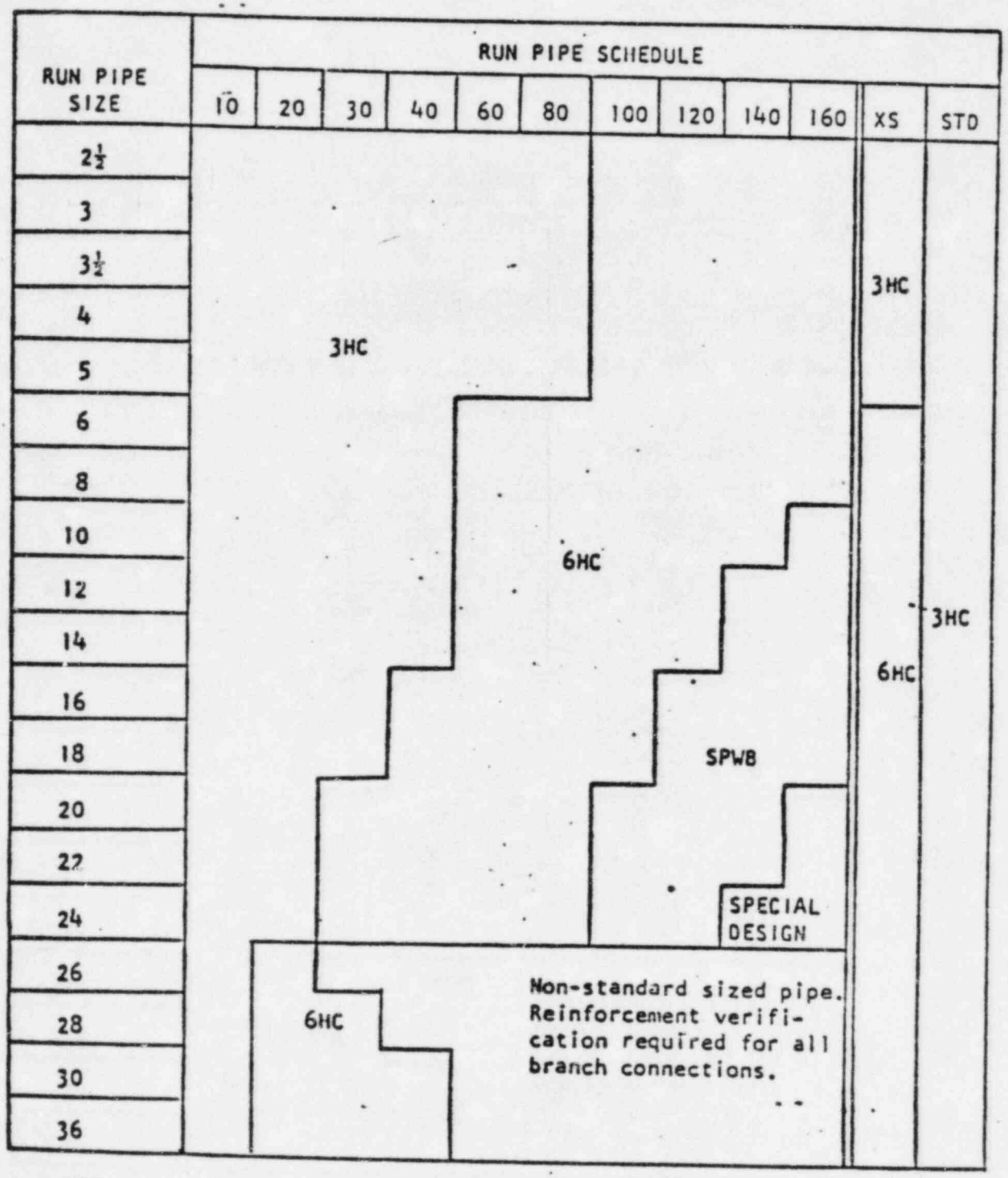
RUN PIPE SIZE	RUN PIPE SCHEDULE											
	10	20	30	40	60	80	100	120	140	160	XS	STD
2½	3HC										3HC	3HC
3												
3½												
4												
5												
6											6HC	
8												
10							6HC					
12												
14										SP'B		
16												
18												
20										SPECIAL DESIGN		
22												
24												
26			6IIC									
28												
30												
36												

Non-standard sized pipe. Reinforcement verification required for all branch connections.

NOTE: SEE TABLE 2 FOR BRANCH TYPE DESCRIPTION

TABLE 3.2

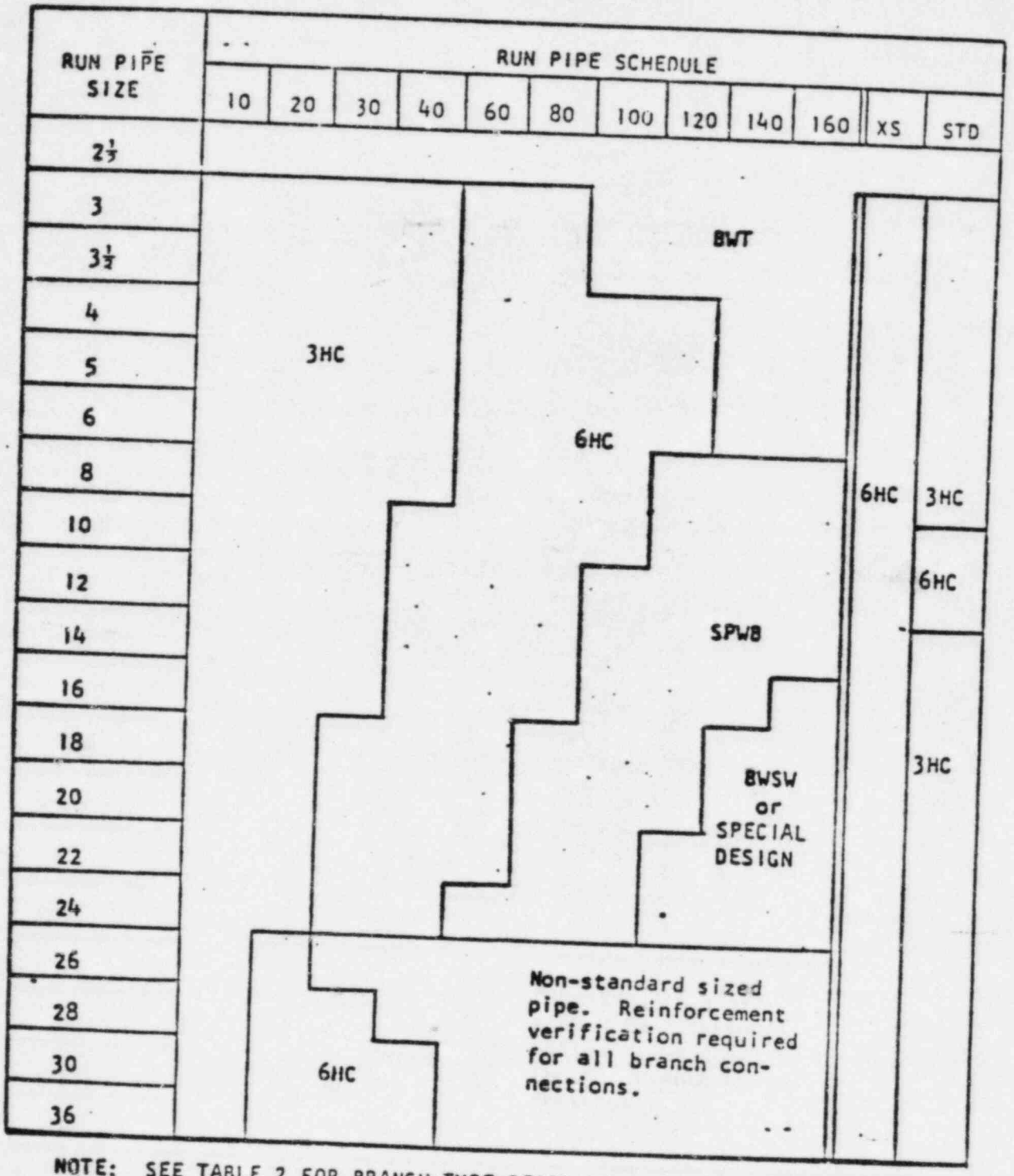
1" BRANCH PIPE SIZE



NOTE: SEE TABLE 2 FOR BRANCH TYPE DESCRIPTION

TABLE 3.3

$1\frac{1}{2}$" BRANCH PIPE SIZE



NOTE: SEE TABLE 2 FOR BRANCH TYPE DESCRIPTION

TABLE 3.4

2" BRANCH PIPE SIZE

RUN PIPE SIZE	RUN PIPE SCHEDULE											
	10	20	30	40	60	80	100	120	140	160	XS	STD
2½	BWT											
3												
3½	3HC										3HC	
4												
5												
6												
8												
10												
12												
14					6HC			SPWB			6HC	
16												
18												
20												6HC
22									BWSW or SPECIAL DESIGN			
24												
26		6HC										
28												
30												
36	Non-standard sized pipe. Reinforcement verification required for all branch connections.											

5.0 LIST OF REFERENCES

1. ASME B & PVC, Section III, 1974, Through Winter 1976 Addenda.

2. ANSI B31.1, 1973, Through Winter 1976 Addenda.

3. ANSI B16.11, 1973

4. Duke Power Co. Stress Analysis Group Calculation DNK-3-28-77.

5. ASME B & PVC, Section III, 1977, through Winter 1977 addenda.

6. ANSI B31.1, 1977, through Winter 1977 Addenda.

7. ANSI B16.11, 1977.

8. Letter to R. L. Williams from W. R. Selden, dated January 21, 1981 (CN-SA-81-0035).

9. Letter to R. L. Williams from W. R. Selden, dated March 4, 1981 (CN-SA-81-0211).

10. Half coupling branch connection calculation CNC-1206.00-02-1001.

1