TENNESSEE VALLEY AUTHORITY

DESIGN SPECIFICATION

BNP-DS-1940-4809-RO

BELLEFONTE NUCLEAR PLANT

FLEXIBLE METAL INSTRUMENTATION HOSES

FOR INSTRUMENTATION AND CONTROL SYSTEM

I certify that this design specification is correct and complete and is in compliance with Paragraph NCA-3252 of the ASME Boiler and Pressure Vessel Code, Section III, Nuclear Power Plant Components. This design specification consists of the following:

1. Item 1

2. Attachment C, Quality Assurance Requirements for ASME Section III Components (Excluding Pumps, Valves, and Automatic Backwash Filters), Component Supports, and Piping Subassemblies

3. Attachment M, Marking and Certification Requirements for Pipe, Fittings, Flanges, and Bolting for Use in ASME Section III Nuclear Class 2 or 3 Systems

4. Attachment Q, Pipe, Fittings, Tubing, and Miscellaneous Components Austenitic Stainless Steel Heat Treatment Welding Materials, Packaging, and Marking

Prepared Date

Correlated Date

Submitted Date

Approved Date

(1)
INFORMATION REQUIRED BY NCA-3252 AND ITS LOCATION IN THIS SPECIFICATION

1. Function of the component including any dimensions upon which the functional performance depends.

2. The design requirements, i.e., the mechanical and operational loadings.

3. The environmental conditions, including radiation.

4. The code classification of the component.

5. The definition of the component.

6. Material requirements.

7. Certification of the design specification.

8. Operability requirements.
Flexible instrumentation hose - The flexible hose shall be a straight section of hose with end connections. Flexible hose shall be NPT stamped and meet the requirements of ASME B&PV Code Case N-192.

The flexible hose is to have annular convolutions and be covered with braid. The pressure containing boundary consists of single-ply, welded or seamless tubing of inconel 625, ASME SB-443 (Material to meet the requirements of SB-444 as modified by ASME Code Case N-188. Pressure test may be performed at top assembly, reference ND-6114.), or SB-444.

The braided wire covering the convoluted metal bellows shall be stainless and heat resisting steel wire in accordance with ASTM A 580-75 of material types listed in Tables I-7.0 and I-8.0 of ASME SA-479. All wire strands shall be welded to the welding collars and visually examined.

The end connections shall be square cut 3/8" od tube with a wall thickness of 0.065", material of ASME SA-213, TP304. The end connections shall be of sufficient length to adapt to a standard compression fitting.

Metal Bellows Corporation nuclear instrumentation hose assembly, or equal.

The boundaries of the hose assemblies are the ends of the end connections.

The complete flexible hose assembly requires NPT stamp.
Design Requirements

Function

The hose assemblies will transport essential air from the systems essential air headers to the instrument air sources at various locations and elevations in the auxiliary building and the secondary containment of the reactor building.

Internal Conditions

Design pressure = 150 lb/in\(^2\)g
Operating pressure = 100 lb/in\(^2\)g
Design temperature = 150\(^\circ\) F
Operating temperature = 100\(^\circ\) F
Pneumatic test pressure = 187-1/2 lb/in\(^2\)g
Pneumatic test temperature = Ambient

Auxiliary Building

Environment Conditions

Nominal: Temperature = 50\(^\circ\) F to 120\(^\circ\) F
Pressure = 14.3 to 16.0
Humidity = 30\% to 80\%
Radiation = Up to 1 x 10\(^8\) rads 40 years accumulated design

Upset: Temperature = 50\(^\circ\) F to 120\(^\circ\) F
Pressure = 14.3 to 16.0
Humidity = 10\% to 98\%
Radiation = Up to 1 x 10\(^8\) rads 40 years accumulated design

Accident: Temperature = 400\(^\circ\) F
Pressure = 30 lb/in\(^2\)g
Humidity = 100\%
Radiation = Up to 1 x 10\(^8\) rads 40 years accumulated design
Cyclic Life Requirements

General

The hose assemblies shall be designed for a total lifetime of 40 years while undergoing the conditions specified below. Each hose assembly shall be identical. Cyclic life design shall be based on analytical and test results. A certified design report shall be submitted for permanent retention by TVA. Satisfaction of the requirements of applicable ASME Code criteria shall be documented.

Model Description

The hose assemblies will be installed per Contractor's recommendations as delineated in an instruction manual to be submitted for permanent retention by TVA. Displacements are applied to one end connection along three orthogonal axes simultaneously. The assembly is filled with fluid and pressurized to the operating pressure. Flexible instrumentation hoses and material shall be manufactured in accordance with Section III of the ASME Boiler and Pressure Vessel Code, Division 1, latest edition and addenda in effect on contract date.

Installation

A nominal offset misalignment of +1/2" in the X, Y, and Z directions shall be assumed in the design calculations as a result of installation. Installation temperature is assumed to be 70°F.

Displacement Due to Thermal Expansion

The hose assemblies shall be capable of the following thermal expansion movements for 5000 cycles:

\[
\begin{align*}
X \text{ axis} &= 0 \\
Y \text{ axis} &= 0 \\
Z \text{ axis} &= 0 \\
\text{Vectorial sum} &= 5.0"
\end{align*}
\]

Mechanically Induced Vibration

Sine wave input corresponding to 0.5 g acceleration in each direction at frequencies of 10, 15, 30, and 60 Hz. Evaluate for input at most critical frequency for 40 years of continuous service.
<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>ARTICLES OR SERVICES (GIVE DESCRIPTION OR CATALOG NO.)</th>
<th>QUANTITY</th>
<th>UNIT</th>
<th>UNIT PRICE</th>
<th>AMOUNT</th>
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<tbody>
<tr>
<td>1</td>
<td>Pressure Fluctuations</td>
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<td>2</td>
<td>Internal pressure from zero to operating pressure for 5000 cycles.</td>
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<td>Seismic Criteria</td>
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<td>Seismic test criteria shall be as delineated in Metal Bellows Corporation's qualification test procedure QTP73989, paragraph 4.6.</td>
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<td>5</td>
<td>Protection from Damage</td>
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<td>6</td>
<td>Contractor shall furnish data with respect to the susceptibility of the flexible instrumentation hose assemblies to damage by inadvertent mishandling (e.g., crushing and kinking) and also provide any special handling instruction/protection methods he feels are required to prevent such damage.</td>
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<td>7</td>
<td>Flexible instrumentation hoses and material shall be manufactured in accordance with Section III of the ASME Boiler and Pressure Vessel Code, Division 1, latest edition and addenda in effect on contract date.</td>
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<td>8</td>
<td>For additional requirements see attachments C, M, and Q and contract document requirements list.</td>
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<tr>
<td>9</td>
<td>ASME Section III, Class 2</td>
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<td>Brand name &amp; figure No.</td>
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<td>Drawing submittal after award, days</td>
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Schedule of Prices

Has the supplier's, manufacturer's or bidder's Quality System Certificate or Quality Assurance Program been approved on a previous TVA contract? Yes  No  

If not, please refer to attachment C and ensure that your bid complies with the submittal requirements therein.

If yes, identify in the following space the previous TVA contract number on which approval was obtained:

Noncompliance with the above may result in your bid being ruled nonresponsive.

Shipping Data. Bidder must state:

Number of calendar days after award for delivery, days  

Point of origin of shipment  

Method of shipment from origin and name of first carrier  

Method of delivery at destination  

Shipping weight  

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TVA 5051 (DP-9-72)