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ESKOM

KOEBERG NUCLEAR POWER STATION

DESIGN ENGINEERING

Specification Title


***INSTRUMENTATION ISOLATION MANIFOLD  
AND BELLOWS SEALED VALVES  
FOR USE IN ASME III NC APPLICATIONS***

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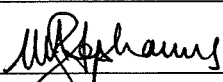


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2017-08-31

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**KOEBERG NUCLEAR POWER STATION**  
**NUCLEAR ENGINEERING**

	<b>APPROVED: P Maphumulo</b>	<b>DATE:2011-07-29</b>
<b>REVISIONS</b>	<b>PREPARED BY</b>	<b>REVIEWED BY</b>
0	MP Gaito/ A Lawrence / PN Clark	NW Boonzaier/ J Venter

**RECORD OF REVISIONS**

Rev	Date	Description of Revision	Prep.	Rev.	Appr.
0	2011-06-30	Original	MPG/ AL / PNC	NWB/ JV	PM
1	2017-05-31	To address manufacturers comments	PNC	XB / SS	AMS
1a	2017-08-14	To address manufacturers comments regarding ASME Code article NC-4800	PNC	XB / SS	AMS

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## 1.0 SCOPE

### 1.1 General

- 1.1.1 This specification, with referenced documents, contains the information applicable to small bore instrument isolation socket weld manifold valves, with or without bellows.
- 1.1.2 These valves shall meet the requirements of the ASME Boiler and Pressure Vessel Code Section III, Division 1, Subsection NC for Class 2 Components (ASME SECT III 2010 EDITION NO ADDENDA).
- 1.1.3 The instrument isolation valves are used at various locations on the plant, to isolate "pressure instruments" from the main process lines for maintenance interventions.
- 1.1.4 The valves covered by this specification are for installation in Eskom's Koeberg Nuclear Power Station Units 1 and 2 of the Republic of South Africa.
- 1.1.5 If any conflicts arise between this specification and the referenced documents, the Supplier shall not proceed, but shall request clarification, in writing, from the approved Eskom Buyer.

### 1.2 Scope of Supply

- 1.2.1 This specification defines the requirements for the quality assurance, procurement, fabrication, welding, testing, inspection, cleaning, storage, supply of documentation design, manufacture, test, package, storage and shipment of 3/8" instrument isolation socket weld manifold valves, with or without bellows.
- 1.2.2 The valves shall meet all the requirements of the mandatory references listed in paragraph 2.1 of this document.
- 1.2.3 The supplier shall supply reconciliation reports to the requirements of ASME Boiler and Pressure Vessel Code, Section XI paragraph IWA 4221 for any non compliance with the ASME Boiler and Pressure Vessel Code, Section III, Division 1 Subsection NC for Class 2 Components or the standards referenced therein.

## 2.0 REFERENCES

### 2.1 Mandatory

**Note:** The editions of the following shall be approved by Eskom and USNRC prior to commencing manufacturing.

- 2.1.1 ASME Boiler and Pressure Vessel Code, Section II, Materials, Part A, Ferrous Material Specifications and Part B, Nonferrous Material Specifications
- 2.1.2 ASME Boiler and Pressure Vessel Code, Section III, Division 1, Subsection NC, Class 2 Components
- 2.1.3 ASME Boiler and Pressure Vessel Code, Section III, Subsection NCA, General Requirements for Division 1 and Division 2

- 2.1.4 ASME Boiler and Pressure Vessel Code, Section XI, Rules for In-service Inspection of Nuclear power Plant Components
- 2.1.5 ASME NQA-1 Quality Assurance Requirements for Nuclear Facility Applications
- 2.1.6 ANSI/ASME B16.34 Valves Flanged, Threaded and Welding Ends
- 2.1.7 ANSI/ASME B16.11 Forged Steel Fittings, Socket-Welding and Threaded
- 2.1.8 IAEA 50-C/SG-Q Quality Assurance for Safety in Nuclear Power Plants and other Nuclear Installations
- 2.1.9 ISO 9001 Quality Management
- 2.1.10 MSS SP-61 Pressure Testing of Steel Valves

## **2.2 Useful**

- 2.2.1 Code Case N-62-2 Internal and External Valve Items, Section III, Division 1, Class 1, 2 and 3

## **3.0 DESIGN REQUIREMENTS**

### **3.1 General Requirements**

#### **3.1.1 Service Conditions**

##### **3.1.1.1 Normal Environmental Conditions**

Temperature (max)	: 50°C
Pressure	: 100 kPa ± 20 kPa
Humidity	: 20 – 80% RH
Radiation (gamma)	: 2 Gy/h (200 rad/hour)

##### **3.1.1.2 Accident Environmental Conditions**

Temperature (max)	: 150°C
Pressure	: 500 kPa
Humidity	: 100% RH
Radiation (per year)	: 1.5 E6 Gy (1.5 E8 Rad)

##### **3.1.1.3 Operating Conditions**

Medium	: Borated water
Temperature	: 314.1°C
Pressure	: 15.5 MPa
Radiation (gamma)	: 0.5 Gy/h (50 rad/hour)

##### **3.1.1.4 Accident Conditions**

This equipment is required to operate during and/or after a seismic event combined with nuclear accident conditions.

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### 3.2 Functional and Operating Requirements

#### 3.2.1 Valve Design Requirements

- Temperature (max) : 343°C
- Pressure (max) : 17,6 MPa
- Relative Humidity : 100% RH
- Connections : 3/8"socket weld tubing
- Manifolds : single and 3 way
- Body and bonnet material : 316L stainless steel
- Minimum passage size : 5 mm diameter
- Design life : 40 years

3.2.2 Valve assemblies shall have a natural frequency of greater than 33 Hz.

3.2.3 Weld end connections shall comply with the requirements given in NC-4240

3.2.4 The valves shall have socket weld ends in accordance with ANSI/ASME B16.11 Forged Steel Fittings, Socket-Welding and Threaded.

3.2.5 All valves shall be supplied with integral backseats

3.2.6 Any valve stem surface in contact with packing shall be supplied with a surface finish of maximum 0.4µm or better.

3.2.7 The valves shall be permanently marked to indicate flow direction.

3.2.8 The supplier shall stipulate specifically which codes and standards were used for relevant design and manufacturing aspects.

### 3.3 Bellows Design

3.3.1 With the metal bellows used to seal the valve stem, article NC-3515 applies and the primary stem seal shall be a gland packing. Any other design shall be submitted to Eskom for review and approval including the tests and manufacturing inspections carried out on the bellows.

3.3.2 The fatigue life of the bellows shall be  $\geq 2000$  cycles where a cycle is defined as operation of the valve from the fully closed position to fully open position and back to the initial position, with the pressure varying from atmospheric in the closed position to the design pressure in the lifted position.

3.3.3 The supplier shall provide fatigue test results demonstrating achievement of the above life by a sample of similar bellows. This test shall be followed by leak tests as described in paragraph 4.3.

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### **3.4 Seismic Effects**

- 3.4.1 In addition to mechanical loads applied to the component by the attached piping at the valve boundaries, seismic accelerations may result in the generation of internal forces and moments. These forces and moments shall be accounted for in the design of the valves.
- 3.4.2 All valve assemblies shall be designed to withstand simultaneously applied seismic loadings of 3,2g in both horizontal and vertical directions for 1/2 Safe Shutdown Earthquake (SSE) and 4,0g in both horizontal and vertical directions for SSE. The equipment shall be capable of performing proper actuation and all intended functions during and after being subjected to these loadings.
- 3.4.3 The Supplier shall submit documentation that the equipment meets the seismic design requirements. Documentation to verify the ability of the equipment to meet the seismic conditions may be in the form of a mathematical analysis, actual test of the equipment under simulated conditions, or a combination of the two. Equipment subjected to actual testing shall not be shipped.

### **3.5 Material Requirements**

- 3.5.1 Valve materials shall conform to the requirements given in the Eskom approved manufacturer's detailed drawing which shall be approved by Eskom prior to commencing manufacture of the valves.
- 3.5.2 Materials used shall comply with specification DSG-317-094.
- 3.5.3 Austenitic stainless steel shall be tested and certified to be resistant to intergranular corrosion.
- 3.5.4 Heat treatment procedures shall be submitted to Eskom for approval.
- 3.5.5 Nitriding of wetted parts shall be prohibited.

## **4.0 MANUFACTURING REQUIREMENTS**

### **4.1 General Requirements**

- 4.1.1 Eskom shall review the design drawings including welding details, dimensions, materials and tolerances prior to the supply of valves and/or subcomponents.
- 4.1.2 Where metal bellows expansion joints are used to seal the valve stems, the metal bellows expansion joints shall comply with ASME Code article NC-3515.

### **4.2 Welding Requirements**

- 4.2.1 Welders and welding procedures shall be qualified in accordance with the requirements of ASME III and IX or an Eskom approved equivalent standard.
- 4.2.2 Assembly, repair welding, and heat treatment procedures shall comply with the requirements of ASME III Subsection NC as applicable to the material and product.
- 4.2.3 Welds shall be uniform, free of defects and shall run continuously without undercuts to the assembled parts.
- 4.2.4 All temporary markings shall be completely removed before heating, welding, heat treating, assembly or shipment.

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4.2.5 Heat treatment operations for pressure retaining materials shall be in accordance with ASME Section III and the material specification.

### **4.3 Verification and Testing**

4.3.1 Each valve shall be subjected to the required examinations and testing in accordance with ASME III and XI as well as including the following tests.

4.3.2 Non destructive examination of all the valve parts including the bellows, welds and hard facing shall be performed in accordance with ASME III.

4.3.3 Non destructive examinations shall be performed by persons qualified in accordance with ASME III.

4.3.4 Non destructive examination results shall be documented in reports which denote the component, examination procedure used and the acceptance criteria, as well as the quantitative results.

4.3.5 Pressure retaining parts shall be inspected in accordance with ASME III Subsection NC.

4.3.6 All valves assemblies shall meet the minimum wall thickness verification requirements of ASME III Subsection NC.

4.3.7 Hydrostatic and seat leakage tests shall be in accordance with ASME III Paragraph NC 6220, MSS SP-61 and ASME B16.34. No visible leakage shall be permitted.

4.3.8 Hydrostatic testing shall be conducted with demineralised water at a temperature that provides sufficient margin relative to the Nil Ductility Transition Temperature (NDTT).

4.3.9 All test and examination results shall be documented and included in the QA document package.

### **4.4 Active Valve Requirements**

4.4.1 In addition to compliance with the design requirements, assurance of operability of active equipment under all design loading combinations shall be provided.

4.4.2 A report demonstrating the operability of active components under all design loading combinations and environmental conditions shall be submitted. The report shall include a description of the measures used. Structural interaction of the entire assembly shall be considered. If super-position of test results for other than the combined conditions is used, the applicability of such procedure must be demonstrated.

### **4.5 Cleaning and Painting**

4.5.1 The valves shall be thoroughly cleaned after fabrication to remove all oil, grease, rust, scale, chips etc. to conform to ASME NQA-1 cleanliness class C.

4.5.2 Stainless steel valves shall not be permanently coated or plated.

### **4.6 Marking and Identification**

4.6.1 Each instrument isolation manifold valve shall be stamped in accordance with ASME Boiler and Pressure Vessel Code, Section III, Subsection NCA, Article NCA-8000.



4.6.2 The name plate on each instrument isolation manifold valve shall include the following information:

- Manufacturer's Trade Name;
- Part Number;
- Serial Number;
- Design Pressure;
- Design Temperature;
- Body Material.

## **5.0 ENGINEERING QUALITY REQUIREMENTS**

### **5.1 Classification Technical Control**

#### **5.1.1 Equipment / Goods Classification**

- Safety Class : 2
- Seismic Class : 1A
- Quality Level : Q1
- Environmental Class : NEV (non-environmental)

### **5.2 Specific Process Control**

5.2.1 The supplier's detailed quality control plan (QCP) shall be submitted to Eskom Engineering, Quality Assurance and Quality Control for approval prior to the commencement of any work.

### **5.3 Specific Technical Control**

5.3.1 A detailed quality plan describing the contractor's quality program and the work during the design, manufacture, test, package, storage and shipment must be developed by the supplier.

5.3.2 This detailed quality plan must be submitted to Eskom for the adding of the Eskom specific quality control hold, witness and verification points and review for acceptance, prior to the commencement of any work.

5.3.3 The Eskom hold, witness and verification points shall be signed by the relevant Eskom appointed representative prior to continuation of work.

### **5.4 Quality Assurance Data List**

The supplier shall provide a quality assurance data package on completion of the work that shall include, but not be limited to, the following:

- 5.4.1 Certificate of conformance to the purchase order and the specification requirements
- 5.4.2 Copy of the Eskom order
- 5.4.3 Manufacturer's specification

5.4.4 QCP (Quality Control Plan)

5.4.5 Design calculations

5.4.6 Detailed valve drawing, including the following:

- Bill of materials which lists all parts of the assembly as well as the Material Specification and Grade for each item;
- Applicable SA specification for all parts covered by ASME;
- Valve design and operating temperatures with corresponding pressures;
- Applicable ASME code year and addenda year;
- Maximum weight and the position of centre of gravity;
- Cv value if available;
- Torque values;
- Overall dimensions including end configuration, seat diameter and packing information.

5.4.7 Material certificates for:

- Body
- Bellow seal
- Stem
- Defects and Repairs (if applicable)
- Weld filler metal

5.4.8 Material certification including the batch number, the expiry date and certificate of conformance.

5.4.9 Certification for elastomeric items, in accordance with specification DSG-314-007, including certificates for material compound, hardness and batch number, cure date and shelf life certificate.

5.4.10 Heat treatment records.

5.4.11 Weld qualifications.

5.4.12 Weld maps.

5.4.13 All the verification and testing as well as the non-destructive examination reports.

5.4.14 Hydrostatic and leak test reports for the body and seat.

5.4.15 Seismic test certificate certifying meeting of the design requirements.

5.4.16 Dimensional tests report including wall thickness records.

5.4.17 Final inspection report.

5.4.18 Final supplier quality assurance release.

5.4.19 Certification that the valve material was not exposed to and does not contain mercury or other hazardous materials.

5.4.20 Non-conformance reports.

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5.4.21 Eskom waivers.

5.4.22 Guarantee certificate.

## **5.5 Quality Assurance Programme**

5.5.1 The supplier shall have a Quality Assurance program in place complying to ISO 9001 and ASME-NQA 1 or IAEA 50-C/SG-Q.

5.5.2 The supplier shall meet Eskom's quality requirements as specified in DSG-318-087, Quality Requirements for the Procurement of Assets, Goods and Services.

5.5.3 The supplier's quality assurance program shall include written procedures to control all aspects of the work.

5.5.4 Eskom reserves the right of access to supplier or sub-supplier facilities and records for the purpose of inspection or audit.

5.5.5 When requested by Eskom, the supplier shall make available to Eskom for their approval, documentation describing the experience of the personnel to perform the requirements of this specification.

## **6.0 TRAINING**

6.1 No training is required for Engineering, Maintenance, and Operating as the proposed replacement is the same as the original.

## **7.0 DOCUMENTATION**

7.1 The documents submitted shall be compiled and formatted such that it may be easily reviewed by the 3rd party and/or Eskom.

7.2 All designs, calculations and drawings shall be signed and approved by a professionally registered qualified engineer in accordance with ASME III Subsection NCA.

7.3 All drawings, data and technical documents supplied to Eskom by the Contractor shall be in the English language with SI system of measurements. These requirements also apply to manufacturing drawings.

7.4 Hard copies of documents submitted for review and approval shall be in the form of electronic pdf format, and shall be clear, legible, full-size copies of reproducible quality. Hard copies of the final submittal of the QADP shall be in the form of two (2) sets of clear, legible, full-size copies of reproducible quality suitable for microfilming.

7.5 Electronic media shall be in a format fully compatible with the following software (latest version in use by Eskom at the time of delivery):

7.5.1 Final computer-aided drafting (CAD) drawings (i.e. vendor equipment drawings) in order of preference:

7.5.2 Microstation (any version).dgn

7.5.3 AutoCAD (version 2002 and below).dwg

7.5.4 Drawing Exchange Format (any version).dxf

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- 7.5.5 Processing : Microsoft Word
- 7.5.6 Database : Microsoft Access
- 7.5.7 Spreadsheets : Microsoft EXCEL
- 7.5.8 Photogrammetry 3D drawings : Electronic files compatible with Microstation
- 7.5.9 Digital photographs : JPEG format
- 7.5.10 Documents to be supplied:
  - Installation, Operating and Maintenance Instructions.
  - Recommended spare parts lists with part numbers.

## **8.0 PACKAGING AND SHIPMENT**

- 8.1 The supplier shall ensure that all products are packaged and stored in accordance with ASME NQA 1 – 2008 subpart 2.2 or an Eskom approved equivalent.
- 8.2 In addition to paragraph 8.1, each package shall be identified with the following:
  - Eskom Purchase Order Number
  - Equipment Part Number
  - This Specification Number

## **9.0 APPENDICES**

None