Eskom	DIVISION	REFERENCE	REVISION
	GENERATION	**GGS 1427**	**0**

DOCUMENT TYPE **STANDARD**	DATE **March 2007**

TITLE: **INSTRUMENT PIPING FOR FOSSIL AND HYDRO POWER STATIONS**	PAGE **1** OF **16**

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REVISION	DESCRIPTION OF REVISIONS	APPROVAL	DATE
0	Original issue	MD(GD)	Feb. 2007

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1 Scope

1.1 Purpose

This document sets out the minimum standards and requirements for the materials and installation of pipe work used to provide sensing connections to instruments used for monitoring and control of power station processes.

1.2 Applicability

This Standard applies to all sub-critical fossil and hydro power stations. It applies to instrument piping from the Root Valve to the monitoring and control instruments for new or replacement installations. Where modifications are made to existing instrument piping either this Standard will be applied or the code to which the original Impulse Piping installation was made.

It excludes:

- Control air piping,
- Sampling piping for chemistry,
- Piping connecting specialised level measuring equipment to vessels (e.g. standpipes, manifolds etc.),
- Capillary tubes of commercial instruments,
- Instruments
- Manifolds

Piping from the Process Tap to the Root Valve is discussed, but for design and construction purposes is to be treated as part of the process line or vessel and is the responsibility of the process supplier.

2 References

2.1 Normative References

The following documents contain provisions that, through reference in the text, constitute requirements of this document. At the time of publication, the editions indicated were valid. These documents are subject to revision and users are responsible to ensure that the most recent editions of the documents listed below are referenced.

DIN 19210, *Differential pressure piping for flow measurement devices*.

BS EN 10204. 2004, *Metallic products – Types of inspection documents.*

BS EN ISO 15614, *Qualification of weld procedures for metallic materials.*

ISO 5817, *Fusion welding joints- Quality levels for imperfections.*

GGS 1407: Rev.0, *Control of erection, repair and maintenance welding activities .*

GGS 0462: Rev.1, *Quality requirements for engineering and construction works in Generation.*

GGS 1275: Rev.0, Plant *classification standard.*

GGS 1279: Rev.0, *Modification control standard.*

2.2 Informative References

References to the following documents will enhance the understanding of the reader on the subject covered in this document. The requirements of these documents are, however, not an extension of this document.

NWS 1451, *High pressure pipework for fossil fired power stations.*

GGG 1205: Rev.2, *Guideline for steam and water sampling.*

ANSI/ISA - 77.*70-1994(2005), Fossil fuel power plant piping installation.*

BS EN 13480. 2002, *Metallic industrial piping, Parts 1 to 7.*

3 Definitions and Abbreviations

3.1 Definitions

3.1.1 Anchor: A reliable permanent support that fastens the Impulse Line in place and prevents movement in all directions.

3.1.2 Blowdown Line: The pipe or tubing located below the Instrument connection for draining the process fluids to a safe location.

3.1.3 Blowdown Valve: The valve in the Impulse Line used to discharge undesirable fluids.

3.1.4 Breakable Fitting: a fitting that is easily removed without damaging the tubing, pipe or Instrument to allow the connection to be broken and remade successfully without replacement of components.

3.1.5 Capillary: A small diameter tube used for final connection to the Instrument, and is treated as part of the Instrument.

3.1.6 Classification: The allocation of Classification Level 1, 2 or 3 to a process system or component according to GGS 1275 – Plant classification standard.

3.1.7 Condensate Pot: Reservoirs that are used in the measurement of steam or other vapours for condensing to the liquid state at ambient temperature.

3.1.8 Control Piping: Is piping not connected to the process, that is used to interconnect pneumatically or hydraulically operated control apparatus, as well as signal transmission systems used to interconnect instruments.

3.1.9 Hazardous Fluids: Are process fluids whose presence or escape constitute a Hazard or could cause an Incident in terms of the OHS Act, or possible damage to plant and equipment or injury to people. Examples are: lubrication oils, hydraulic fluids, Hydrogen, fuels, corrosive and poisonous and similar substances.

3.1.10 High Duty: Where the operating pressure of the process fluid is at or exceeds 4 Mpa, **or** the operating temperature of the process fluid is 250º C or above.

3.1.11 Impulse Line: The line, tubing or pipe that connects the Root Valve to the primary measuring element of the instrument loop and includes all valves, fittings, tubing and piping used to connect the primary instrument to other instruments, apparatus, or measuring equipment.

3.1.12 Installation Detail: Installation documentation in the form of standards, specifications, procedures, drawings, line diagrams, quality control plans and erection manuals. Details of Primary

Connections, Impulse Line layout, Instrument location, access platforms, ladders and supports shall be included.

3.1.13 Instrument Isolation Valve: The valve or valve manifold in the Impulse Line that is nearest to the instrument.

3.1.14 Instrument: A mechanical, electrical, pneumatic or hydraulic device used to measure a process variable.

3.1.15 Low Duty: Where the operating pressure of the process fluid is less than 4 Mpa **and** the operating temperature of the process fluid is less than 250º C. This category includes Impulse Lines connected to vacuum installations.

3.1.16 Manifold: An assembly of two or more valves, often in one package, used to facilitate calibration and maintenance.

3.1.17 Modification: A permanent or temporary change to an Impulse Line installation including the replacement of tubing, valves and fittings. See GGS 1279 – Modification control standard.

3.1.18 Normal Access: Means that the mechanism or plant item can be reached from a walkway, platform or fixed ladder.

3.1.19 Primary Connection: The Primary Connection comprises the Process Tap, the piping between the Process Tap and the Root Valve, and the Root Valve.

3.1.20 Process Tap: The connection into the process line or vessel.

3.1.21 Root Valve: The first valve located on the instrument piping after it taps off the process line or vessel. The Root Valve may also be known as: First isolating valve, Shutoff valve, or Primary cut-off valve

3.1.22 Slide: A device that supports the dead weight of the Impulse Line but allows axial movement.

3.1.23 Appointed Inspection Authority: An Inspection Authority appointed by Eskom to oversee the design, procurement or installation of Impulse Lines.

Note: All defined terms used in the text have Capital letters.

3.2 Abbreviations

3.2.1 BSP: British Standard Pipe

3.2.2 FTR: Free Text Retrieval

3.2.3 OD: Outside Diameter

3.2.4 OHS: Occupational Health and Safety

4 Requirements

4.1 Management and Administration

4.1.1 Design approval

The Installation Detail for the proposed piping installation shall be approved by a Registered Profession Engineer before submission to the appropriate Eskom authority and the Appointed Inspection Authority for approval. No installation work may start before approval is obtained.

4.1.2 Classification

All Impulse Lines shall be treated as Level 1 plant as defined in GGS 1275 – Plant classification standard.

4.1.3 Duty categories of Impulse Lines

Two duty categories are stipulated:

- **High Duty** – where the operating pressure of the process fluid is at or exceeds 4 Mpa, **or** the operating temperature of the process fluid is 250º C or above.

- **Low Duty** – where the operating pressure of the process fluid is less than 4 Mpa **and** the operating temperature of the process fluid is less than 250º C.

4.1.4 Temperature concession

The design temperature for Impulse Lines may be reduced to a value 100° C less than the maximum operating temperature of the process fluid.

4.1.5 Quality control plans

Quality control plans shall be developed that clearly stipulate the work to be performed in a logical order and the hold, witness and surveillance points required for inspection and verification. The plans shall be submitted as part of the Installation Detail and comply with GGS 0462- Quality requirements for engineering and construction work in Generation.

4.1.6 Plant identification and coding

The appropriate Plant Identification Code shall be applied in the Installation Detail and shall refer to the related plant measurement device, valve, or equipment.

4.1.7 Documentation

Documentation to be compiled and retained shall be the Instrument Detail, as-built Data Book and any other documentation needed to comply with statutory and safety stipulations.

4.2 Mechanical Design

4.2.1 Primary Connection

The Primary Connection shall comply with the design code for the process line or vessel. The Root Valve shall be located as close as possible to the Process Tap connection.

The minimum size of the tap shall be 19.05 mm (3/4" BSP). If the process line is smaller than 19.05 mm the tap connection shall be the same size as the process line.

The connections should be located so that Normal Access to the Process Tap and the Root Valve is possible. If the Primary Connection is not accessible from Normal Access, fixed ladders or platforms shall be provided.

4.2.2 Process Tap

The required location of Process Taps shall be shown on a Pipe and Instrument Diagram. The exact location shall be shown in the Instrument Detail.

The Process Tap shall be positioned to ensure the functionality of the instrument system.

The Process Tap on piping shall be located as near as possible to a pipe support to limit the effect of vibration.

A separate Process Tap shall be provided for each measurement, indication or protective device. Should this not be practical, the reason shall be clearly stated in the Instrument Detail supplemented by a formal application for a concession.

4.2.3 Tube specification

Low Duty
Tube material shall be austenitic X6CrNiMoTi 17122 as in DIN 7458-material number 1.4571.
The size shall be 12mm x 1.6mm wall thickness. (Material code 5 in DIN 19210.)

High Duty
Tube material shall be austenitic X6CrNiMoTi 17122 as in DIN 7458-material number 1.4571.
The size shall be 14mm x 2.6mm wall thickness. (Material code 6 in DIN 19210.)

The use of an alternative equivalent tube material may be allowed, providing formal approval for the use of the proposed material is obtained from the Generation Technology Manager prior to the installation of such material.

4.2.4 Tube joins and connections

There shall be as few joins or connections as possible in each Impulse Line between the Root Valve and the Instrument, or between the Root Valve and the Manifold.

Connections on Impulse Lines between tubes and tubes and between tubes and fittings shall be welded or made with compression fittings as specified below:

Impulse Lines connected to these services shall have welded connections:

- High Duty Impulse Lines,
- Low Duty Impulse Lines connected to Hazardous Fluids,
- Low Duty Impulse Lines connected to vacuum installations.
- Low Duty Impulse Lines located where access for maintenance and inspection is restricted or difficult, regardless of pressure, temperature and process fluid.

High Duty impulse lines shall be butt-welded. For Low Duty welded Impulse Lines, the tubing and welding process used shall be the same as that for High Duty Impulse Lines. See Annex A.

Low Duty non-welded Impulse Lines are connected with compression fittings.

Connections to Instruments and Manifolds shall be made with Breakable Fittings. The use of fittings shall not reduce the flow area of an Impulse Line. Bends rather than fittings should be used to change direction of Impulse Lines, and fittings shall be positioned at least three tube diameters away from a bend.

4.2.5 Weld transition pieces

For High Duty Impulse Lines and Low Duty welded Impulse Lines, where it is necessary to connect dissimilar tube materials or sizes, transition pieces of compatible nickel based material and dimensions shall be provided, with the concomitant Weld Procedure Specifications. The materials, design, and Weld Procedure Specifications for the transition pieces shall be approved by the Appointed Inspection Authority before installation.

4.2.6 Material compatibility

The material of the fittings, labels, fittings, compression fittings, Anchors, Slides, clamps, tools, and any materials that will be in temporary or permanent contact with the Impulse Lines shall be of material compatible with the Impulse Line material and its use shall have no chemical, metallurgical, or other deleterious effect on the Impulse Lines or the Impulse Line installation or the measurements produced.

4.2.7 Compression fittings

Compression fittings manufactured and installed to a recognised international Standard may be used, except where welded or other connections are specified. The Standard for compression fittings is DIN 3850 and the material X6CrNiMoTi 17122 steel (material number 1.4571).

These fittings shall be installed in accordance with the manufacturer's instructions, which shall form part of the Quality Control Plan.

4.2.7 Isolating valves

Impulse Lines for High Duty and for Hazardous fluids shall have a minimum of two isolating valves, which can be the Root Valve and the Instrument Isolating Valve.

Impulse Lines with remote mounted Instruments shall have at least two valves between the Process Tap and the Instrument, which can be the Root valve and the Instrument Isolating Valve.

For Low Duty services only one valve is required if the Root Valve is within easy reach of the Instrument and the Instrument is clearly visible from the Root Valve. Additional valves shall be provided as needed.

All directional valves shall be installed with the flow arrow pointing in the direction of flow.

4.2.9 Instrument isolating valves

The Instrument Isolation Valve or valve manifold shall be available to personnel during normal plant operation for isolating the instrument from the process. The Instrument Isolation Valve shall be located to be within easy reach of the Instrument and so that the Instrument is clearly visible from the Instrument Isolation Valve.

Instrument Isolation Valves shall be so supported that they remain in place when disconnected from Instruments or Impulse Lines.

4.2.10 Root valve

This valve shall be located as close as possible to the Process Tap. The Root Valve shall be of such quality to ensure tight isolation against the most demanding process conditions.

4.2.11 Environmental and ambient conditions

Where environmental and ambient conditions along the location of the Impulse Lines may affect the accuracy of measurements adequate provisions shall be made to eliminate the effects of these conditions. Examples of these provisions are trace heating and thermal insulation.

4.3 Installation

4.3.1 Tube configuration and routing

Impulse Lines shall be kept as short as possible, with as few joins as possible, and as few direction changes as possible, but with appropriate compensation for differential movement or expansion.

Impulse Lines shall run together wherever possible. Lines running in parallel groups shall not cross each other and the sequence of Impulse Lines shall be maintained through each successive set of clamps, bends, connections, penetrations or barriers.

Impulse Lines shall not be installed in walkways or near stairways or where they will obstruct maintenance or operational activities. Minimum clearances shall be:

- 2.2 m over walkways,
- 3 m in open areas.

4.3.2 Tube cutting

Tubing shall be cut with a fine-tooth saw using a cutting guide, or the correct sized tube cutter. The cutting wheel shall be sharp and in good condition to prevent damage to the tubing.

The tube ends shall be lightly de-burred internally and externally without causing damage to, or scratching the tubing. After cutting and de-burring all foreign matter on the inside and outside of the tube shall be cleared.

For automatic welding only a tube cutter should be used.

4.3.3 Tube bending

Bends rather than fittings should be used to change directions of Impulse Lines.

- The minimum bend radius for 12 x 1.6mm tube is 30mm.
- The minimum bend radius for 14 x 2.5mm tube is 35mm.

Tubing shall be bent at ambient temperature using a suitable bending device. For bending austenitic tubing the formers, slide rails, and other parts of the device that come in direct contact with the tubing shall be made from austenitic material.

All tube bends shall be free from deformation, kinks, flat spots, or scoring. Fittings shall be positioned at least three tube diameters away from a bend.

Free hand bending is not permitted.

4.3.4 Connections to instruments and manifolds

Breakable Fittings shall be used for connections to Instruments and Manifolds, and if threaded, parallel threads shall be used.

The entry of Impulse Lines to Instrument Isolation Valves and Manifolds shall be from the front or the bottom for safety reasons.

4.3.5 Welding

Welding and NDE of Primary connections shall comply with NWS 1451.

Welding of Impulse Lines is to comply with GGG 1407.

Weld Procedure Specifications shall be approved by the Appointed Inspection Authority, and welds shall be subjected to the required level of inspection. The Weld Procedure Specifications shall be qualified to BS EN ISO 15614 and the quality levels for imperfections set out in ISO 5817 shall be applied.

4.3.6 Passivation

The post-weld passivation process shall be included as part of the Weld Procedure Specifications.

4.3.7 Tubing slope and instrument positioning

Minimum slope on all Impulse Lines shall be 8% (80 mm per 1 metre length of line). Where this minimum slope cannot be achieved due to structural or physical constraints the proposed solution shall be set out in the Instrument Detail and supplemented by a formal application for a concession.

The route of Impulse Lines shall ensure that the function of these lines is not affected by the entrapment of inappropriate gas or liquid. High point vents or low point drains, or both, shall be provided to ensure that all the entrapped gas or liquid can be purged from the Impulse Line. Condensate pots shall be fitted where necessary to ensure accurate measurements.

For steam, water and liquid process fluids the Instruments shall be located below the Root Valve. The downward slope of the Impulse Line from the Process Tap to the Instrument shall be 80mm or more per metre run. This arrangement is to limit the penetration of gas bubbles into the system and to limit the temperature at the Instrument.

For air, gas and vacuum processes the Instruments shall be located above the Process Tap. The upward slope from the Process Tap to the Instrument shall be 80mm or more per metre run. This arrangement will allow condensed liquid to drain back into the process rather than into the instrument, which could cause errors in measurement. Where this cannot be achieved due to structural or physical constraints, the instruments can be located below the process tap, provided a drain tank having a minimum capacity of 0.5 l with a Blowdown Valve is installed at the lowest possible point to collect condensate. The design and location of the condensate pots or weirs shall be included in the Installation Detail.

4.3.8 Condensate pots

Condensate pots or weirs are used in the measurement of steam and other vapours for condensing the vapour to a liquid state to minimise errors due to gas trapped in the Impulse Lines. Condensate pots installed in a horizontal position shall be installed level and be protected from excessive vibration. Those installed in vertical positions are used for collecting liquids drained from an Impulse Line. The design, test procedure and location of the condensate pots shall be included in the Installation Detail.

4.3.9 Routing through barriers and penetrations

Impulse lines routed through penetrations, walls or other barriers where visual contact is lost or impaired shall be labelled with permanent tags that clearly show the identity of the Impulse Line. The tags shall be attached securely on either side of the barrier. Material for the tags shall be compatible with the material of the Impulse Line. Labels removed for any reason shall be replaced without delay.

Openings shall be large enough to ensure that there is no possibility of damage to the Impulse Lines. Anchors, Slides or other means shall be applied to ensure the integrity of the Impulse Lines through the barrier or penetration.

4.3.10 Instrument installation and location

Instruments shall be installed with easy access to all connections, and so that servicing, calibration, or replacement can be made with a minimum of disassembly.

Local instruments, other than direct mounted indicators such as pressure gauges, should be mounted at an accessible location on floor-mounted instrument stands or racks. They shall not be mounted on process piping or vessels, handrails, walkways, or main building support structures.

The mounting height to the centre-line of the Instruments shall be 1.4 metres from the floor or permanent access platform.

Instruments shall be located where Normal Access is available but should not obstruct walkways or operating areas. High point vent and low point drains shall be within reach from Normal Access.

If Instruments or Impulse Lines are located where damage could occur, protective barriers or shields shall be provided.

Connecting lines between the Instrument Isolating Valves or Manifolds and the Instruments or Instrument rack shall be neatly arranged with sufficient flexibility to avoid undue strain on the Instruments.

4.3.11 Manifolds

Manifolds shall be so supported that they remain in place when disconnected from Instruments or Impulse Lines.

Material for manifolds shall be selected taking cognisance of the Impulse Line material, the requirements of the Instrument suppliers and the process conditions.

4.3.12 Capillary tubes

If these are supplied sealed to the Instrument by the manufacturer, they shall not be opened or cut. Manufacturer's installation instructions shall be meticulously followed. Racks, supports and shields shall be provided to protect Capillary Tubes, which should be clamped to racks or supports at frequent intervals.

4.3.13 Supports, slides, anchors and clamps

Supports shall be designed so that the Impulse Lines are not stressed beyond a safe limit.
Supports and racks shall be of adequate strength and spacing to bear the total weight of piping including the process fluid, insulation, and any barriers or protection. The design shall take account of environmental and operational factors to which the installation will be exposed.
Supports and racks for Impulse Lines and Instruments shall be constructed and mounted in a way that limits to an absolute minimum vibration transferred to the Impulse Lines and Instruments. The supports and racks shall not be attached to process lines, vessels or equipment, handrails, walkways, or main building support structures. The spacing between supports shall not exceed 1.5 metres.

Anchors shall be placed in each straight run of tubing that requires a support. Connections to Root Valves, Instrument Isolating Valves, Manifolds and clamps are regarded as Anchors. Connections to Instruments are not classified as Anchors.

Impulse Lines shall be supported with Slides where axial movement along the line axis may occur due to temperature, vibration, or ambient conditions. Such Slides shall allow adjacent Impulse Lines to move independently of each other.

Tube clips and clamps shall be rigid enough to secure, but not to damage the Impulse Lines. Support and clamp design and materials shall be chosen to avoid damage to the Impulse Lines by vibration or galvanic action.
Special insulation may be required for Impulse Lines connected to certain services e.g. Stator coolant system.

For multiple Impulse Lines, simple saddles consisting of a corrugated clamp bolted to a flat bar shall not be used and will not be approved.

4.3.14 Syphons and loops

Pressure Instruments for steam or hot fluids service shall have a loop (pigtail) or other suitable isolator between the Instrument and the source of pressure when mounted on process piping. This isolator protects the Instrument from excessive temperature. Syphons shall not be used on differential pressure instruments.

4.3.15 Pre-commissioning cleaning

All lines shall be cleaned after installation and before testing or being placed in service.
Cleanliness of all Impulse Lines shall be consistent with the requirements of the main process.

Cleanliness may be achieved by pneumatic blowdown with compressed air or inert gas, or by flushing with a liquid compatible with the process fluid and of sufficient purity to minimise corrosion of the materials of the Impulse Lines and fittings.

4.3.16 Coating of piping

Coating of Impulse Lines is not required or permitted.

4.4 Quality Assurance

4.4.1 Receipt of materials

Prior to unloading, a visual inspection shall be made to ensure whether any damage occurred during shipping.
Each shipment shall be examined, as appropriate for:

- Compliance with purchase specifications,
- Physical damage,
- Adequate storage protection,
- Conformance to dimensional and physical property specifications,
- Proper identification and marking,
- Full and compliant documentation.

Materials found deficient during this inspection shall be clearly identified and segregated from acceptable materials. Rejected materials should be returned to the vendor or disposed of appropriately.

4.4.2 Handling

Handling of materials shall be controlled to prevent damage and contamination with extraneous deleterious matter or substances such as oil, grease, dirt and chips.

Tubing and fittings shall be carefully handled during receipt, storage, and installation to prevent scratching, gouging, and nicking that could affect sealing and cause leaks or subsequent failure. Tubing should not be dragged across hard surfaces and sharp edges of steelwork, concrete and gravel.

4.4.3 Storage

Tubing, fittings, other materials or assemblies shall be stored in a dry space and protected from contamination and physical damage. Containers or stacks shall be clearly marked with their contents, material designation, and if applicable, plant identification codes.

4.4.4 Cleanliness

The interior of all tubing, valves and fittings shall be smooth, clean, and free from foreign material.
Tube ends, valves and fittings should be sealed at all times till positioned for installation.
All Impulse Lines shall be cleaned after installation and before being placed in service.
The cleanliness, appropriate to the process application, of all Impulse Lines shall be proved prior to pressure testing or commissioning.

4.4.5 Pre-test inspection

Each installation shall be visually inspected prior to testing. This inspection shall ensure compliance with the Installation Detail. All joints shall be left uninsulated and exposed for examination during pressure testing.

The pre-test inspection shall verify that:

- Correct materials have been used,
- The specified Installation Details have been followed,
- Specified slopes have been maintained,
- Supports are adequate and vibration has been mitigated,
- Connections have been correctly and properly made,
- Welded connections have been visually inspected,
- Valves and instruments have been accurately labelled,
- High-point vents and low-point drains have been provided as required,
- Documentation demonstrating compliance with this Standard has been provided,
- All control and non-destructive testing certificates have been provided.
- Non-conformances have been identified and Concessions approved.

4.4.6 Pressure tests

Pressure tests shall be conducted to ensure the pressure integrity of the Impulse Lines.

4.4.7 Pressure test boundaries

The Impulse Lines shall be pressure tested from the Root Valve to the Instrument Isolation Valve or manifold.

4.4.8 Hydrostatic testing

Hydrostatic testing is required for all High Duty Impulse Lines and those for Hazardous fluids.

The following shall be observed when planning a hydrostatic test programme:

- A calibrated test pressure gauge shall be visible at all times to the operator controlling the applied pressure. The gauge must have a valid calibration certificate,
- For Impulse Lines of austenitic stainless steel, testing should be performed with demineralised water or the process liquid,

The applied test pressure shall be 1.25 times the maximum permissible operating pressure of the process fluid. The pressure shall be applied with water or process liquid at a temperature not less than 16deg Celsius and shall be held for 30 minutes.

4.4.9 Pneumatic testing

Pneumatic testing may be performed as appropriate for some Impulse Lines.
For leak-testing commercial leak-testing fluids shall be used. Soapsuds or household detergents are not permitted.

The test pressure applied shall be 1.1 times the maximum permissible operating pressure of the process fluid. This pressure shall be applied with non-flammable gas and shall be held for 30 minutes. The procedure for pneumatic testing shall be approved by the appointed Inspection Authority.

4.4.10 Material certification

4.4.10.1 Materials of construction

All materials used in the manufacture of tubing and components shall be certified by the manufacturer with a certificate of compliance. The manufacturer shall have a quality assurance programme for material control and verification.

The quality management system shall comply with ISO 9001: 2000 - Quality Management Systems – Requirements.

4.4.10.2 Certificates of compliance

Certificates of Compliance for the material used in a component and for the completed component shall be furnished by the manufacturer, when or before the component is delivered. These certificates of compliance shall meet the requirements of BS EN 10204. 2004, Metallic products – Inspection document type 3.2.

4.4.10.3 Tube identification

Tubing shall be marked with the OD with alloy, grade size, wall thickness Code of Manufacture, and other information required for unambiguous identification prior to installation. The marking method and materials applied shall not affect the integrity of the tube material.

5 Document Availability

This document can be accessed electronically via the Eskom Intranet and the FTR system.

Annex A

TUBE AND JOINT SELECTION LOGIC