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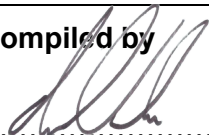
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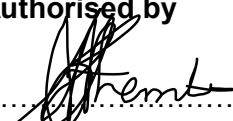
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CONTENTS

	Page
1. INTRODUCTION	3
1.1 FOREWORD	3
1.2 INTRODUCTION TO THE HIGH PRESSURE PIPEWORK SUPPORTS STANDARD	3
2. SUPPORTING CLAUSES	3
2.1 SCOPE	3
2.1.1 Purpose	4
2.1.2 Applicability	4
2.2 NORMATIVE/INFORMATIVE REFERENCES	4
2.2.1 Normative	4
2.2.2 Informative	4
2.3 DEFINITIONS	4
2.3.1 Disclosure Classification	6
2.4 ABBREVIATIONS	6
2.5 ROLES AND RESPONSIBILITIES	6
2.6 PROCESS FOR MONITORING	6
2.7 RELATED/SUPPORTING DOCUMENTS	6
3. STANDARD FOR HIGH PRESSURE PIPEWORK SUPPORTS	7
3.1 REQUIREMENTS	7
3.1.1 General	7
3.1.1.1 Attachments to pipes	7
3.1.2 Delivery requirements for new hangers	8
3.1.3 Control hangers	9
3.1.4 Snubbers	10
3.2 TESTS	10
3.3 ERECTION OF HANGERS AND SUPPORTS	10
3.3.1 Damage	10
3.3.2 Particular locations	10
3.3.3 Orientation	10
3.3.4 Cold commissioning	11
3.3.5 Initial operation inspection	11
3.3.6 Guarantee inspection	11
3.4 IN-SERVICE MAINTENANCE AND TESTING	11
3.4.1 General	11
3.4.2 Snubbers	11
3.5 SPARES AND TOOLS	12
3.6 DRAWING / DOCUMENTATION	12
4. AUTHORISATION	13
5. REVISIONS	13
6. DEVELOPMENT TEAM	13
7. ACKNOWLEDGEMENTS	13
APPENDIX A : OLDER SYSTEMS - UPGRADING	14

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1. INTRODUCTION

1.1 FOREWORD

This Standard has been compiled by Asset Management, which resides within Generation.

This Standard defines the requirements for the design, supply, maintenance and / or testing and installation of HP pipework supports. The application of these components to the pipe systems is defined in Eskom Standard 240-56239129 High Energy Pipework Standard for Eskom Power Plants Standard.

This Standard specifies the Eskom requirements which are to be incorporated in the supporting arrangements of HP pipework enquiries and subsequent contracts.

The requirements of this Standard are complementary to those laid down in the national codes and standards, and are based on knowledge and experience gained in the HP pipework fraternity. It has therefore been found necessary to eliminate certain undesirable designs and practices commonly found in the supporting arrangements of HP pipework. Similarly, designs and industry practices which have proven themselves by long and satisfactory service are now made mandatory.

1.2 INTRODUCTION TO THE HIGH PRESSURE PIPEWORK SUPPORTS STANDARD

This Standard is to be read in conjunction with Eskom Standard 240-56239129, High Energy Pipework Standard for Eskom Power Plants.

It has been adequately demonstrated that in order to achieve the anticipated useful life of the high pressure pipework, it is essential to limit the stresses imposed on the pipework by providing a supporting system designed for static and dynamic conditions. The design, erection and performance of the support system must be of a high standard and the support system must be subjected to inspection and maintenance interventions on a regular basis. Appropriate facilities must be provided to undertake the aforementioned tasks.

Experience has shown that it is essential for the pipework to expand in the manner determined by the designer. The pipework is to be balanced on its support system so that each support takes the intended share of the total mass of the pipe. This includes hanger rods, clamps, suspended drain piping or warming lines, lagging and contained fluid. The support system must be designed to maintain the pipe system at its intended design stress, whilst maintaining the correct drainage slope in the hot and cold conditions.

2. SUPPORTING CLAUSES

2.1 SCOPE

This Standard is applicable to all components of supports and restraints used on HP pipework systems. This includes but is not restricted to pipe clamps, hanger rods, turnbuckles, anchors, single axis restraints, fixed rod hangers, variable load spring hangers, constant load hangers, load measuring devices, control hangers, snubbers and trunnions. Excluded from this specification is the secondary steelwork used to attach the supports or restraints to the building structure.

Whilst the aforementioned items are commercially produced components that conform to national codes and standards, Eskom in certain instances has stipulated more stringent requirements within this Standard, based on past experiences.

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2.1.1 Purpose

2.1.2 Applicability

This document shall apply throughout Eskom Holdings Limited Divisions.

2.2 NORMATIVE/INFORMATIVE REFERENCES

Note 1: For replacements or upgrading of systems, the latest standards shall apply.

Note 2: For reference to the appropriate Standards which may be used, attention is drawn to the latest British & American Standards.

Note 3: All attachment welds shall be performed by the pipework contractor and shall preferably be done in a workshop environment with the associated heat treatment and non-destructive testing.

2.2.1 Normative

- [1] ISO 9001 - Quality Management Systems
- [2] OHS ACT: 1993, Occupational Health and Safety Act and Regulations (Act No. 85 of 1993).
- [3] BS EN 13480-3 — Metallic Industrial Piping, Section 13 - Supports.
- [4] ANSI ASME B31.1 – Power Piping
- [5] MSS SP-58 – Pipe hangers & supports; materials, design & manufacture
- [6] MSS SP-69 – Pipe hangers & supports; selection & application
- [7] BS EN 13906-1 Cylindrical helical springs made from round wire and bar. Calculation and design. Compression springs.
- [8] BS EN 13906-2 Cylindrical helical springs made from round wire and bar. Calculation and design. Extension springs.
- [9] BS EN 13906-3 Cylindrical helical springs made from round wire and bar. Calculation and design. Torsion springs.
- [10] 240-56239129 High Energy Pipework Standard for Eskom Power Plants Standard.

2.2.2 Informative

- [11] None

2.3 DEFINITIONS

Definition	Description
Approved Inspection Authority	An approved inspection authority approved by the Chief Inspector and is appointed to carry out the duties laid down in the code of construction, the OHS Act and its regulations, and be approved by SANAS.
Calibrated load	For a new constant load support, the calibrated load shall be the average load, including ancillary components over the whole range of movement, as ordered by the pipework system designer. The deviation shall be within the allowable range.

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Definition	Description
	For a variable spring hanger, the design load shall be the load exerted by the hanger when the pipe is at its theoretical position at design temperature.
Code	A collection of compatible rules, regulations and standards prepared by a standards authority, also referred to as a code of construction or a code of practice.
Cold Starts	The start-up of a unit after it has been shut down for more than 72 hours.
Constant Load Hanger	A device that exerts a supporting load which is approximately constant on a pipe or component of a piping system, within defined limits, anywhere within the range of movement of the device.
Deviation, also known as load error	The maximum amount by which the force exerted by a constant load support varies from the mean load anywhere within its travel range, expressed as a percentage.
Hanger	A mechanical device containing one or more springs which supports a pipe from above, and allows vertical movement.
High pressure pipework	Pipes and fittings in such systems for the conveyance of steam, water, gases or other fluids whose design pressure equals or exceeds 4.0 MPa and / or whose design temperature equals or exceeds 250 °C.
Hot Start	The start-up of a unit which has been stopped for less than 8 hours.
Hysteresis	The amount by which the force exerted by a constant load or variable spring support varies whether it is being pulled down or being allowed to move up, expressed as a percentage plus and minus of the mean load.
Regulations	The regulations forming part of the Occupational Health and Safety Act.
Restraint	Any device which exerts a force on a pipe or component of a piping system. A restraint may act in one or two directions at the same time.
Standard	The detailed requirements specified for the supply of materials, the design of plant or equipment and the testing of materials, plant and equipment within which compliance is mandatory.
Trunnion	Hollow cylindrical sheer lugs welded to the pipe to transfer the supporting load to the pipe clamp without imposing a notable bending moment. Generally two trunnions are installed 180° apart for each support position.
Variable Spring Hanger	A device containing a spring which exerts a force on a pipe, or component of a piping system, which varies linearly with the movement of its spring.

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Definition	Description
Shock Absorber (Snubber)	A mechanical or hydraulic device which exerts a force on a pipe or piping component of a pipework system in a direction opposite to that of the movement, and of a magnitude proportionally or otherwise related to the velocity.
Warm Start	The start-up of a unit which has been shut down for a period between 8 hours and 72 hours.
Works	The Manufacturer or Repairers workshop where the hangers are manufactured or repaired.

2.3.1 Disclosure Classification

Controlled Disclosure: Controlled Disclosure to External Parties (either enforced by law, or discretionary).

2.4 ABBREVIATIONS

Abbreviation	Description
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
BS EN	British Standard European Norm
HP	High pressure
MSS	Manufacturers Standardisation Society
NDT	Non-destructive testing
OHS Act	Occupational Health and Safety Act
SANAS	South African National Accreditation System
SANS	South African National Standards

2.5 ROLES AND RESPONSIBILITIES

The high pressure pipework System Engineer at the power station shall ensure compliance to this Standard for the current and new systems

Asset Management, Mechanical Engineering shall update the Standard as required.

Any deviation from this Standard shall follow the Engineering Change Management process.

2.6 PROCESS FOR MONITORING

Eskom's Documentation Management Department shall ensure that the document is reviewed as per the review date.

2.7 RELATED/SUPPORTING DOCUMENTS

240-56239129: High Energy Pipework Standard for Eskom Power Plants Standard.

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3. STANDARD FOR HIGH PRESSURE PIPEWORK SUPPORTS

3.1 REQUIREMENTS

3.1.1 General

The Eskom requirements for HP pipework supports state that the supports must comply with BS EN 13480-3 for the European designed stations and ASME B31.1, MSS SP-58 & MSS SP-69 for American (ASTM / ASME) designed stations, as qualified by this Standard. All appropriate documentation must be supplied in the form of a data book. The content of the data book shall be agreed with the Eskom System Engineer prior to contract placement.

All hanger design and assembly arrangements shall be reviewed by Eskom. The designer of the system maintains professional liability for the design.

3.1.1.1 Attachments to pipes

The attachment of supports to high pressure pipes shall be made by one of the following methods:

- a. For horizontal pipes, supports shall be attached to the pipes by means of pipe clamps.

The material of the pipe clamp or saddle type design clamp shall conform to the design temperature of the pipe, and shall be certified and stamped accordingly.

Design stresses in the pipe clamp or saddle type clamp shall not exceed that allowed for the clamp material, at the design temperature of the pipe.

To prevent sliding along the pipe, pipe clamps on inclined pipes may be provided with stop blocks welded to the pipe, as is done for riser clamps.

- b. For vertical pipes and inclined pipes, supports shall be attached to the pipes by means of riser clamps. These are often referred to as vertical restraints.

Support blocks attached to the pipe shall be welded along all four edges in the fabrication shop, the load-bearing faces being subsequently machined square and true to one another, with a radius that does not impose undue stresses on the pipe at their junction with the pipe wall. The welds shall be ground to a smooth contour. Weld undercut is not permissible.

Welds of the support lugs to the pipe wall shall be heat treated in the fabrication shop.

The top surface of the riser clamp shall be true and in complete contact with the support block, being machined if necessary to achieve this condition. The assembly shall be erected in the shop to ensure that each support block is in contact with the clamp.

Any bolts, studs and nuts will be designed to the clamp design parameters. During fitting, the threads will be treated with an anti-seize compound. The bolts must be torqued to the design torque. Between two and five threads shall protrude from the nut when the bolt is correctly torqued.

- c. The use of dummy branches for supporting HP pipework is not acceptable.
- d. The attachment of pipes to restraints, anchors and similar components shall be carried out by clamping the pipe, without any welding, except for locating lugs similar to those used for riser clamps.

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The requirement for bolts securing such clamps is the same as for riser clamps. Allowance shall be made for the relative expansion between the pipe and the clamp.

- e. All attachment welds to pipes, including lightly loaded stops for lagging crinoline rings, shall preferably be performed in the fabrication workshop, including post weld heat treatment and non-destructive testing (NDT).
- f. Attachments to pipes shall be capable of withstanding whichever is the most severe of the following cases, using the materials and design considerations of the applicable design code:
 - The load imposed under normal design conditions;
 - The load at that position when the pipe is fully lagged and is full of water for acid cleaning or hydraulic testing and blow through;
 - The load imposed at that position due to steam hammer caused by a 100% load rejection by the turbine, by water hammer or similar dynamic loads in the piping.
- g. No other pipes shall be supported from the high pressure pipework, except the pressure tapping lines, drains, vents and warming lines which may be supported from the pipes with which they are associated.
- h. The mass of auxiliary pipes and their contents, together with valves and their actuators, lagging, cladding, pipe clamps and supports shall be included in the flexibility analysis of the main system.
- i. Constant load hangers and variable spring hanger rods shall be fitted with adjustment turnbuckles to enable the final adjustment on site. Locknuts shall be fitted to the turnbuckle.
- j. Trunnions will be allowed when they are utilised as a sheer lug. These shall be welded with full penetration welds, post weld heat treated and tested during the pre-manufacturing phase in the workshop. Trunnions are not allowed to protrude through the cladding.

3.1.2 Delivery requirements for new hangers

In addition to any requirements of the code of construction, all hangers shall comply with the following:

- a. As specified in Eskom standard 240-56239129 High Energy Pipework Standard for Eskom Power Plants, all hangers shall be designed for a life of 200 000 operating hours or for the specified remaining plant life, with the following operating regime:
 - 300 cold starts
 - 1050 warm starts
 - 4 000 hot starts
- b. The springs of all hangers, both variable spring and constant load types, shall be manufactured in accordance with the agreed code.

The springs supplied for both variable spring and constant load hangers shall be designed to be free from a tendency to buckle within the range of compression they will experience in service.

- c. The bearings of constant load hangers shall be protected from dust and moisture ingress.

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- d. Variable spring and constant load type hangers shall be fitted with an indicator which shows the position of the hanger within its range of operation. An accuracy of 2 mm and which, when clean, is legible at a distance of six (6) metres is required. The position scale on variable spring hangers shall indicate the load exerted at any position. All hangers shall be fitted with a red circular dot not less than 20 mm in diameter adjacent to the movement scale, at the position the hanger should be in when the pipework is at its working temperature. A white dot of the same diameter shall be affixed at the cold operating position.
- e. The full movement travel of a constant load hanger shall include a margin of not less than 25% of the theoretical vertical movement of the pipe, or 30 mm, whichever is the greater, at the hot and cold position to the physical block position.
- f. The full movement travel of a variable spring hanger shall include a margin of not less than 20% of the theoretical vertical movement of the pipe, or 20 mm, whichever is the greater, at the hot and cold position to the physical block position.
- g. The load exerted by all constant load hangers shall be capable of being adjusted by not less than 20% above and below the works set load, without compromising the requirements of paragraph 3.1.2 "e" and "f". Should any adjustment be required, the employer will be notified and must agree to the adjustments. The adjustments shall be performed on a certified calibration rig, and the hanger name plate data will be corrected. The data book shall be updated with the new functional test data and calibration graphs.
- h. The total deviation of constant load hangers shall not exceed plus and minus 2.5% of the calibrated load over the total travel range. This allows a band width of 5% in the hot and cold positions.
- i. The length of hanger rods installed shall be sufficient to limit their angularity caused by horizontal movement of the pipework, to no more than 4° from the vertical in the cold position. The angularity of the hanger rod shall not be more than 1° from the vertical when the pipework is at its normal working temperature (hot position).
- j. The mean calibration load to which constant load hangers are set shall be between 0% and +1% of the design load to allow for further relaxation of the spring with time.
- k. Variable spring hangers shall not be installed in positions where the difference between cold and hot conditions exceeds 20% of the design load. The design load will be the hot load.
- l. Variable spring and constant load type hangers shall be provided with blocking arrangements. These permit the hanger to be locked at any position within its range of movement. The blocking gear shall have sufficient strength to withstand the same load as the hanger, and shall be capable of being locked out of use in a way which will prevent the blocking gear from accidentally blocking the hanger. Unless otherwise agreed with the pipework contractor, the constant load hangers shall be blocked in the cold position and the variable spring hangers in the hot position, before leaving the Works.

3.1.3 Control hangers

Should the use of control hangers or similar devices be required during the design phase, such details will be agreed upon by the Employer.

3.1.4 Snubbers

Snubbers shall be of the hydraulic type and suitably sized to accommodate for dynamic events. Mechanical types are not acceptable.

Snubbers shall be made accessible for normal maintenance and inspections, without the erection of scaffolding.

3.2 TESTS

- a. All hangers shall be tested and certified at the testing centre. Proof of such tests must be provided in the data packs.
- b. The force measured by the load cell shall be increased by the mass of any links connecting the load cell to the hanger, to give the correct force exerted on the hanger.
- c. On completion of the test, the hanger metal name plate will be applied with the following hard stamped data as a minimum:
 - Manufacturer's name and address
 - The type or identity number of hanger
 - The maker's serial number
 - The pipe system and location identification for the hanger
 - The calibrated load of the hanger
 - The design movement
 - For variable spring hangers — the spring rate and the hot load

3.3 ERECTION OF HANGERS AND SUPPORTS

3.3.1 Damage

Before the erection of hangers on the plant, all hangers and associated components shall be inspected for any signs of damage which may have occurred in transit. The inspection shall include any distortion of the spring case or any other parts that could restrict the natural movement of the hanger. The inspection should furthermore ensure that the movement indicators are intact, and the blocking device is fitted and holding the hanger in its correct position for erection in the plant.

3.3.2 Particular locations

An inspection by the third party inspection authority shall be carried out to ensure that each hanger to be erected is the correct one for the location. This shall be done by verifying the hanger details on the nameplate, including the calibrated load and design movement against the pipework design drawings. The Employer shall verify the results prior to the installation of the hangers.

3.3.3 Orientation

An examination shall be carried out to ensure that the orientation of the hanger, in relation to the pipework, is correct in the X and Y axes and within the tolerances stated by the pipework designer as each hanger is lifted into position.

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For balancing of the pipework and to avoid horizontal forces, the hanger rods must be vertical. The steelwork carrying the hanger shall be examined to ensure that it provides for the hanger to be displaced sufficiently to allow for the installation of cold pull. On completion of the cold pull, the hangers may require repositioning to ensure that the rod angularity shall not be more than 4° from the vertical in the cold position, and 1° in the hot position.

3.3.4 Cold commissioning

During cold commissioning and prior to start-up, a pipework survey comprising of hanger indicator readings and elevations shall be conducted. A full set of readings of the hanger positions, visual inspection reports, pipe elevation levels and drainage graphs shall be provided to the Employer.

3.3.5 Initial operation inspection

Within forty eight (48) hours of a unit achieving full operating temperature, a walk down of the plant shall be carried out to look for anomalies. This would include hangers that are in the blocked position.

A full pipework and hanger survey shall be carried out by the pipework contractor seven (7) days after the unit has achieved full operating temperature. The applicable scope will be as detailed in paragraph 3.3.4.

3.3.6 Guarantee inspection

Prior to the shut-down of the unit for the planned guarantee inspection, the pipework contractor shall carry out a comprehensive survey of the pipework at full operating temperature.

The survey shall include the levels of all pipes at hanger positions and mid-way between hangers, readings of pipe position indicators, readings of hanger position indicators and hanger load settings. The survey shall furthermore include a visual examination to ensure that none of the hanger rods have been incorrectly adjusted since erection, there are no pipework clashes and all the lagging and cladding is undamaged.

After the shut-down guarantee inspection survey, a repeat survey shall be carried out in the cold condition. The pipework contractor may wish to carry out adjustments to the pipe support system in order to improve the performance of the pipework. Work of this nature shall be agreed to and accepted by the Employer.

3.4 IN-SERVICE MAINTENANCE AND TESTING

3.4.1 General

During general overhauls, surveys of the HP pipework may indicate that some hangers are not performing in the correct manner, either by loss of load, increase in friction or other anomalies. It may become necessary to test the hangers to establish the reason for the anomaly. Functional testing shall be performed in a certified test rig. The functional test graph will provide the information required to correct the anomaly.

3.4.2 Snubbers

All snubbers shall be inspected for signs of damage and oil leaks during general overhauls. Snubbers that are deemed to be questionable in terms of their function as a dampening device shall be removed and refurbished.

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3.5 SPARES AND TOOLS

Should there be specialised tools needed for the load adjustments on the hanger, one set per unit will be supplied. When hangers of two different types are supplied, the contract shall include a minimum of two load adjustment tools per hanger type. These tools shall be packed in boxes and preserved for long term storage.

3.6 DRAWING / DOCUMENTATION

The manufacturer shall provide test certificates for all hangers. These certificates shall include all details identifying the unit, maker's name, type of unit, serial number, design load, ordered movement range, mean load as tested and deviation. The certificate shall include a diagram of load against movement, a computer printout of load against position within the movement range, and confirmation that the movement of the unit is not less than that specified by the pipework contractor.

After the Works test, the name plates shall be attached permanently to the bodies of constant load hangers. The white and red indicator labels shall be applied to the travel scales.

Certificates for variable spring hangers shall include the same identifying information as for constant load hangers. In addition, the positions at which the ordered cold and hot loads are achieved shall be identified. The spring rate, as tested and certified, shall be within 5% of design.

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4. AUTHORISATION

This document has been seen and accepted by:

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5. REVISIONS

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November 2012	1	E van Zyl	Final Document for Review from 45-224 approved by TDAC
November 2015	1.1	V. Cronje	Updated Draft document for review
January 2016	1.2	V. Cronje	Final Draft Document for Comments Review Process
May 2016	1.3	V. Cronje	Updated final Draft after Comments Review Process
May 2016	2	V. Cronje	Final Rev 2 Document for Authorisation and Publication
September 2020	2.1	Dr RM Clark	Document updated with minor changes.
October 2020	2.2	Dr RM Clark	Updated final Draft after Comments Review Process
October 2020	3	Dr RM Clark	Final Rev 3 Document for Authorisation and Publication

6. DEVELOPMENT TEAM

The following people were involved in the development of this revised document:

- Erick van Zyl
- Dr Robert Clark

7. ACKNOWLEDGEMENTS

- The Boiler care Group for their comments on the Standard.

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APPENDIX A: OLDER SYSTEMS - UPGRADING

The design of pipework built before 1970 may contain certain deficiencies, as much of the calculation work was carried out by hand. It is advisable for such systems to be re-modelled using a computer program in order to investigate improvements which can be made to the design, thereby extending the life of such systems by revision of their flexibility and supports.

It may be found that the pipework has been made very flexible in order to reduce reactions at terminal points, but the normal deviations in hanger performance may create unacceptably large deflections in the pipes, even to the extent of reversing the drainage slope.

Pipe systems designed to German codes from the early 1970's were often installed with no more than 0,5% drainage slope in the cold condition. Some designs even created negative drainage slopes in the hot condition.

Drainage slopes can sometimes be increased by cutting the pipes and removing a spool at the upstream end, but this solution may be limited by the obstructions caused by adjacent plant. In such cases, it may be necessary to control the movement of the pipework more closely.

With very flexible systems, it may be possible to stiffen the pipework by replacing one of the constant load hangers near the middle of a run of pipe with a variable spring support, or, in extreme cases, by a fixed rod support. Such solutions can easily be investigated once the computer model has been prepared, and the possible improvements can be assessed to give the desired extended life.

If the computer modelled flexibility analysis shows that neither rod nor variable spring hangers are feasible, consideration can be given to the use of control hangers, as these can be retrofitted to existing systems.

The design life required for upgraded systems will be stated by Eskom.

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